COGNITIVE STUDIES | ÉTUDES COGNITIVES, 23
Warsaw 2023

Article No.: 2858
DOI: 10.11649/cs.2858

Citation: Dinc, D., Aslan, A., & Ergenoglu, T. (2023). Can we interpret implicitness? *Cognitive Studies | Études cognitives*, *2023*(23), Article 2858. https://doi.org/10.11649/cs.2858

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Can We Interpret Implicitness?

Abstract

This study investigates whether cognitive styles have an effect on the interpretation of implications hidden in speech and examines the Event-Related Potential (ERP) pattern of this effect. In the first study (104 participants), a Cognitive Style Analysis (CSA) test, an interpretation task (meaning), Indirectness Scale, Cultural Communication Scale-Turkish (CCS-TUR), and information collection forms were used as data collection tools. In the second study (29 participants), an interpretation task (implicitness) and the EEG-ERP system were used. In the meaning interpretation task, the analyses revealed that individuals with an Analytic CS tendency preferred interpretations containing implications less than individuals with Holistic CS. In addition, it has been observed that individuals with an Analytic CS tendency focus their attention more when asking questions for the texts in the implicitness interpretation task according to the ERP patterns. This may be an indication that brain function is physically different in all individuals when interacting with each other.
Keywords: cognitive style; analytic cognitive style; holistic cognitive style; speech context; event-related potential

1 Introduction

1.1 Cognitive Styles

With the observation of cultural differences in terms of social cognition and emotions, psychologists have started to deal with the subject of culture. It has also been observed in experimental studies that cultural factors play an important role in cognitive processes such as memory or judgments (Kagitcibasi, 2010).

Definition of the concept of "style" have been made by many researchers in different ways. While some researchers emphasize personality traits (Allport, 1937; Riding, 2001; Riding & Rayner, 1998), some studies emphasize contextual features in terms of style use (Schmeck, 1988; Zhang & Sternberg, 2001). One of the most common distinctions we come across is that between the holistic and analytic cognitive styles. It is stated that individuals who have a tendency to the holistic cognitive style use the style in all situations, and individuals who have a tendency to the analytic cognitive style use it in all situations. The holistic cognitive style requires a holistic approach; in individuals with a tendency to this style, events or situations are perceived as a whole and evaluated and interpreted accordingly. Individuals look at events or situations as relational. The analytic cognitive style, on the other hand, requires an analytic approach, and individuals with a tendency to this style perceive each detail constituting the event or situation separately.

They evaluate and interpret the details by observing them more closely. These individuals see events more as conceptual investigations (Kagitcibasi, 2010).

Kagitcibasi (2010) examined the terms related to cognitive style in her studies into self-formation. However, she used the term relational self instead of "field-dependent" and autonomous self instead of "field-independent". She mentioned that the self-structures in individualistic societies are more autonomous, while the self-structures in collectivistic societies are more relational (Kagitcibasi, 2010). Kagitcibasi (2010) also evaluated the analytic and holistic cognitive styles in terms of individualism/collectivism concepts. Based on this evaluation, it can be said that those living in collectivistic cultures tend towards the holistic cognitive style, while those living in individualistic cultures tend towards the analytic cognitive style. According to Kagitcibasi (2010), it is stated that individuals living in an individualistic culture make internal references to their own behaviors or the behaviors of others, similar to the characteristics of individuals with a tendency towards the analytic cognitive style. It also affects their understanding of others, their explanation of behaviors, their own behaviors, and the communication that individuals establish with others (Kagitcibasi, 2010). It has been stated that individuals living in an individualistic culture attribute the observed behaviors to personal characteristics and do not think about the situation (Kagitcibasi, 2010).

Riding and Rayner (1998) try to explain the cognitive style distinction in two different dimensions: the analytic–holistic and the verbal–imagery dimensions. In the analytic–holistic dimension, individuals tend to see a part of or the whole of the information while organizing their minds. However, in the verbal–imagery dimension, individuals are inclined to think about the representation of knowledge in their minds verbally or in mental pictures (Riding & Rayner, 1998). It has been suggested that individuals prone to analytic–holistic cognitive styles have differences in many psychological processes, such as cognitive schema, information processing or emotional regulation (Kagitcibasi, 2010; Markus & Kitayama, 1991; Masuda & Nisbett, 2001). In a study comparing cognitive styles in terms of EEG recordings, it was reported that cortical activation was observed more in the left hemisphere of participants with both holistic and verbal cognitive style tendencies (Glass & Riding, 1999). In Littlemore's (2001) study investigating the relationship between cognitive styles and communication strategies, it was investigated which of the identification-comparison-based communication strategies are more common in individuals with the analytic–holistic cognitive style. It was observed that there is a correlation between the analytic–holistic cognitive style distinction and the choice of identification-comparison-based communication strategies. In the study, it was stated that individuals with the analytic cognitive style tend to use more description-based communication strategies, including focusing on the basic features of the target, while individuals with the holistic cognitive style tend to use comparison-based communication strategy more (Littlemore, 2001). As can be seen, how individuals behave is guided by which cognitive style they tend towards.

1.2 Speech Context – Indirect Speech

Indirectness in speech has been defined as having a meaning other than what the speaker says (expressed in words) and having a meaning in the expression itself in the speech. Here, what the speaker says and what he wants to say coexist (Holtgraves, 1997). Indirect speech is described as "not expressing what is meant to be told explicitly between words, not to say it clearly." (Turkish Language Institution, 2011, p. 2314). Most of the time, what is implied differs from what is said. In this case, what is said has an indirect meaning, because the meaning of what is implied in that context has different meanings. In most cases, the implicit meaning in the uttered statement can be directly understood. However, in some cases, it is necessary to make a cognitive effort to determine the indirect meaning that is meant to be conveyed. In such cases, determining the indirect meaning takes time as it requires in-depth analysis (Holtgraves, 1997).

There are two types of indirect speech: one is direct quotations (the same as speech) and the other is indirect quotations (Coulmas, 1986; Holtgraves, 1997). In a direct quotation, what the

speaker says is received and transmitted in the same way. It is independent of the speaker's or listener's point of view. In indirect speech, the speech is interpreted, adapted, and transmitted according to the speaker's situation. The perspective of the speaker or listener also affects the interpretation of the speech (Coulmas, 1986). There are many extra-linguistic and intra-linguistic situations in interpersonal communication fluency. The first of these is context. Intuitions made in the spoken text, which are as important as the context, are also important (Hirik, 2017). Implicitness is also defined as a kind of trope, and tropes in which the purpose is implicitly stated are defined as implicitness and cues (Coskun, 2008). From birth, all the meanings of each word are learned during the learning of language coding (Levinson, 2013). Therefore, during speech the speaker's intention rather than what the speaker directly says drives the listener's behavior. The listener also uses the context to understand the speaker's intent. Context provides information necessary for understanding linguistic expressions and the speaker's intention (Levinson, 2013).

In one study, how listeners interpret irony using contextual clues was tested. It was found that irony was especially affected by context. When the participants were asked to comment on the speakers they listened to, it was observed that contextual clues facilitated their comments (Adler et al., 2016). In another study, it was found that an increase in contextual clues facilitates the interpretation of irony (Regel et al., 2010). Shapiro and Murphy (1993) state that implicit meaning is primarily context-dependent. They argue that the derivation of direct meaning is also a necessity and an important part of understanding every utterance. They claim that it takes longer to process indirect expressions in sentences and that the existence of signification is evaluated depending on the context of the sentence (Shapiro & Murphy, 1993).

1.3 Event-Related Potential

Event-related potential (ERP) was first described in 1964 and was defined as EEG measurements of electrical activities in the cerebral cortex in response to sensory, emotional or cognitive events (Di Russo & Pitzalis, 2014; Kamel, 2015; Sanei & Chambers, 2021). The fluctuations created by successive electrical activities on the cerebral cortex during the time they correspond to sensory, motor, or cognitive stimuli are measured as postsynaptic potentials (PSPs). ERP is observed as the sum of these many PSPs (Hu & Zhang, 2019; Sanei & Chambers, 2021). ERP signals are recorded as positive waves represented by the letter P, such as P300, or as negative waves, represented by the letter N, such as N100 and N200 (Sanei & Chambers, 2021).

The P3 wave was first described by Sutton et al. (1965). It is related to information processing and attention and is stated to be one of the most frequently recorded ERPs in experimental research. The P300 wave is called P300 because it occurs approximately 300 ms after the presentation of the stimulus in the studies. It is a positive wave thought to reflect the updating of working memory and attention-related processes (Sutton et al., 1965).

The P2 wave is related to the cognitive matching system, and is the response that occurs regarding the identification, comparison, classification of sensory stimuli and decision-making about sensory stimuli. It is claimed that the individual can express sensory scanning behavior (Barry et al., 2000).

The N1 wave, which can be observed in the frontal and central regions, occurs in relation to the attention given to the stimulus when it first arrives. Its latency and amplitude may vary depending on the sensory and physical characteristics of the stimulus. It is associated with triggering attention to stimuli and sensory analysis of stimuli (Hillyard & Kutas, 1983). In the parietal region, it appears as the P1 wave. The N1 wave reflects sensory processes very poorly.

It has been shown that the N2 wave is the response that occurs automatically to stimuli that are not related to the task while performing a cognitive task. It is associated with passive attention (Falkenstein et al., 2002).

Studies on the electrophysiology of language comprehension are very recent. In a study that tested the validity of the use of virtual reality and EEG measurement in terms of examining language comprehension in a visually rich context, it was found that the N400 wave in particular

was observed in the tasks given to the participants about language comprehension (Tromp et al., 2018).

In a study in which the participants' ERPs for indirect meanings were evaluated, it was found that it was expected that different ERPs could occur in terms of meanings. However, in this study, the participants were in a virtual restaurant environment. In one context, the participants were assigned as waiters, while in another context, they acted as critics. The difference in ERPs was found not in terms of indirect meanings, but related to the difference between participants' roles (Tromp et al., 2018).

It was thought that a study like this would be beneficial in terms of improving the communication of people in their context. As social beings, humans need to be in contact with others. Communication can also take place by creating a common language with others. When what some people say can be interpreted in different ways, people can misunderstand each other and this can cause problems in communication.

In language, words gain importance through concepts and relationships, not with intrinsic values. Facts and knowledge structures are represented by gaining meaning with these conceptual relations (Solso et al., 2007). Harris (2016) states that what is said and what is implied in a speech is shaped by how the speaker communicates. However, this speech is shaped by contextual effects such as how the listener perceives the person in front of him or what that individual says, the gestures and facial expressions of the speaker, and the environment in which the speech is made.

Language is one of the foundations for humans as social beings: it is at the heart of social interaction and is the primary channel for people to express themselves in social life. People use language every day to influence or motivate others (Holtgraves, 1997; van Berkum, 2018). The fact that verbal development in humans is higher than in other species has led to extensive studies on language and words (Solso et al., 2007). When the literature is examined, those with hearing impairment and those without hearing impairment are compared in perception of spoken language (Boothroyd, 2002; Panzeri & Foppolo, 2016), but the importance of the environment/context on this perception in individuals without any hearing impairment has not been studied. In fact, it is also very important to show the role of individual differences in understanding the spoken language by showing the contribution of the constantly changing context to perception. In some cases, no matter how much the context changes, the perception can only change according to the characteristics of the individual. From this point of view, it is thought that this study can contribute to the examination of whether there are differences in perceiving speech of individuals who are prone to the analytic–holistic and imagery–verbal cognitive styles. Therefore, the purpose of our first study is to determine the tendencies of individuals in terms of cognitive styles and to evaluate their perception of implication in speech. The purpose of the second study is to examine the ERPs of participants whose cognitive style tendencies were determined when they perceived the implication in speech.

STUDY I

2.a. Materials and Methods In study I there were 104 participants (39 males and 65 females) who are students from various departments in Mersin University. Their ages were between 18 and 30 ($M = 21.74$, $SD = 2.64$).

The independent variables were the analytic–holistic style or the verbal–imagery style tendency that was evaluated by using the Cognitive Styles Analysis (CSA) test and gender. The dependent variables were the meaning interpretation task, the sub-dimensions of Conversational Indirectness Scale-CIS (interpretation and production) and the sub-dimensions of Cultural Communication Scale-Turkish (high and low context).

2.a.1. CSA The CSA test was developed by Riding in 1991 to distinguish between analytic or holistic and imagery or verbal cognitive styles. Peterson et al. developed a parallel version in 2003

and it was found that using the two together was more reliable. In this study, the extended version of the CSA test, which was adapted to the Turkish sample by Aslan et al. (2018), was used. There are a total of 80 questions belonging to 40 Analytic – 40 Holistic CS tests applied on computer and a total of 232 questions belonging to 116 Imagery – 116 Verbal CS tests. For each participant, the median values of the reaction times they spend for the parts are calculated. Then the median of the reaction time in the Holistic CS test is divided by the square of the reaction time in the Analytic CS test. If the value obtained is above 1, the individual has the Analytic CS; if it is less than 1, the individual has the Holistic CS. At the same time, if the median of the reaction time is above 1, the subject has the Imagery CS; if it is less than 1, the subject has the Verbal CS (Littlemore, 2001).

2.a.2. Interpretation Task (MEANING) Using the research of Holtgraves (1997), 18 scenarios were created. The scenarios were created by taking into account the contexts that individuals use most when communicating in daily life, and also by making use of the scripts from similar previous studies using texts. The created texts were first read by 10 individuals who are both doctoral students and research assistants in different faculties and departments and suggested corrections were made. The final version was created by applying it to a group of students taking the Experimental Applications in Psychology course and a group of 4^{th}-year students in the Psychology department. Depending on the situations described at the beginning of the scenario, a conversation between two people takes place in each script. The participant is asked how s/he interprets a sentence (the specified sentence) uttered during this conversation, taking into account the situations stated in the scripts. For each sentence there are two explanations, one indirect and one direct. One of the statements is directly related to what the speaker said; the other relates to what the speaker implies (not being said at the moment). In the scripts presented in the task, after the context was presented in a short way, each speech was formed in such a way that it would pass between at least two people. Here, the participant's task is to read a brief description of the situation and the script of the situation, and then to show how they interpreted the last statement from among the speakers. After the scripts, two comments about the last statement were presented. Participants chose one of these explanations about how they had understood the sentence by adhering to the situation stated in the script. In order to remove the effect that may occur on the ordering of the scripts given in the meaning interpretation task, the scripts were arranged in different ways and created in 4 different orders. In this study, the Cronbach Alpha reliability coefficient of the meaning interpretation task was found to be .62.

2.a.3. Conversational Indirectness Scale-CIS The CIS was developed by Holtgraves (1997) to determine whether individuals use indirect speech and whether they evaluate others' speech in terms of indirectness. It is a 19-item, 7-point Likert-type scale and each item is evaluated between 1- Strongly Disagree and 7- Totally Agree. The scale consists of two factors: "interpretation" and "production". In the original scale, items 1, 4, 5, 7, 8, 10, 12, 15, 16, and 19 are in the interpretation factor, and items 2, 3, 6, 9, 11, 13, 14, 17, and 18 are in the production. Items 3, 8, 12, 13, 18, and 19 are reverse items and are evaluated by scoring in reverse. The test–retest reliability of the scale is stated as $r = .90$ for the whole scale, $r = .87$ for the interpretation, and $r = .85$ for the production. High values from the scale indicate that indirectness is also high (Holtgraves, 1997). The Cronbach Alpha reliability coefficient for the Interpretation was .75; for the production was .80.

2.a.4. Cultural Communication Scale – Turkish (CCS-TUR) CCS-TUR was developed by Erdem (2006) with the High–Low Context model. The scale has two factors: high context and low context. It was created to assess the extent to which context is. It consists of 15 expressions of interest. 8 included the high context (items 1, 3, 5, 7, 9, 11, 13, and 15), and 7 included the low context (items 2, 4, 6, 8, 10, 12, and 14). Each item is evaluated on a 7-point Likert scale ranging

from 1- Strongly Disagree to 7- Totally Agree (Erdem, 2006). In the study, the Cronbach Alpha reliability coefficient for the High Context was .56 and for the Low Context it was .56.

2.a.5. Process After the approval (013–03.09.2018) of the ethics committee for the study, appropriate scenarios were created. The scenarios were created by taking into account the contexts that individuals use most when communicating in daily life, and also by making use of the scripts from similar previous studies using texts. The created texts were first read by 10 individuals who are both doctoral students and research assistants in different faculties and departments and suggested corrections were made. The final version was created by applying it to a group of students taking the Experimental Applications in Psychology course and a group of 4^{th}-year students in the Psychology department. Afterward, undergraduate, master's, and Ph.D. students in different departments of the University were reached and those who wanted to participate in the study voluntarily were given an appointment date and time. The participants who came to the research laboratory of the Department of Psychology were given general information about the study and after their consent was obtained, the Cognitive Style Analysis (CSA) test, which was uploaded to the computer screen, was applied individually. Then, the participants were asked to evaluate the situations presented in the interpretation task (Meaning) and to fill in the CCS-TUR and CIS. After the experiment was completed, general information about the next phase of the study was given and they were asked whether they could participate in this second phase.

2.a.6. Statistical Analysis The data were analyzed by factorial variance analysis (ANOVA), Pearson's Correlation analysis, and Independent Sample t-Test on the IBM SPSS 21 software package.

3.a. Results The variables indirectness (production) ($r = .21$, $p < .05$) and interpretation ($r = .22$, $p < .05$) with the number of implied interpretations in the interpretation task (meaning) were found to be positively correlated. Production and interpretation were found to be positively correlated ($r = .28$, $p < .01$). Between the High Context factor and the response time during the Holistic CS task ($r = -.22$, $p < .05$) and the response time during the Verbal CS task ($r = -.21$, $p < .05$) were found to be negatively correlated. It can be said that the tendencies of these individuals become more Holistic and more Verbal as the High Context scores increase. The variables the response time during Analytic CS task and interpretation ($r = .27$, $p < .01$) were found to be positively correlated. In CSA, the increase in response time during the Analytic CS task indicates that individuals are inclined to the Holistic CS. Therefore, it can be said that these individuals are inclined to more Holistic CS as the interpretation scores increase (Table 1).

A repeated factorial ANOVA was conducted to compare the main effects of the CSA task and interpretation task; the interaction effect between CSA and interpretation task on the count of correct answers to the question asked in the interpretation task. The main effect for interpretation task yielded an F ratio of $F(1, 89) = 3.556$, $p = .06$, *partial* $\eta^2 = .04$, indicating marginally significant difference on implication texts between Holistic CS ($M = 12.24$, $SD = 3.02$) and Analytic CS ($M = 10.86$, $SD = 2.92$) groups.

An independent sample t-test was conducted to compare the interpretation task for males and females. There was a significant difference in the scores for males ($M = 12.44$, $SD = 3.05$) and females ($M = 10.77$, $SD = 2.76$); $t(94) = -2.771$, $p < .01$. An independent sample t-test was conducted to compare production factor for males and females. There was a significant difference in the scores for males ($M = 4.06$, $SD = .97$) and females ($M = 3.52$, $SD = 1.13$); $t(100) = -2.477$; $p < .05$.

Table 1. Pearson Correlation Analysis related with interpretation task (meaning).

	1	2	3	4	5	6	7	8
1. Implied	–							
2. Production	.208*	–						
3. Interpretation	.219*	.285**	–					
4. Low context	−.111	−.133	−.070	–				
5. High context	.161	.015	.151	−.027	–			
6. CSA-A (rt)	.064	.108	.273**	−.057	−.153	–		
7. CSA-H (rt)	−.015	.024	.167	−.002	−.201*	.773***	–	
8. CSA-I (rt)	.014	.102	.101	−.026	−.097	.653***	.589***	–
9. CSA-V (rt)	.006	.122	.085	−.014	−.210*	.652***	.605***	.724***

*$p < .05$; **$p < .01$; ***$p < .001$
(rt): response time/ A: analytic/ H: Holistic/ I: Imagery/ V: Verbal

STUDY II

2.b. Materials and methods For the second phase of the study, all participants with the lowest holistic cognitive style values (a tendency towards the holistic cognitive style) and highest analytical cognitive style values (tending towards the analytical cognitive style) were reached. In study II, there were 29 participants (13 males and 16 females), students from study I. Their ages were between 18 and 29 ($M = 21$, $SD = 2.49$).

The independent variables were the analytic–holistic style tendency, which was evaluated by using the Cognitive Styles Analysis (CSA) test in Study I, the type of script, and anteroposterior (AP) and lateral (LAT) distribution. The sependent variables were the late positive potential (LPP), P3, P2, and N1 amplitude and latency values of the ERP components of the recordings taken during the participants' answers to the questions for the texts, and the amplitude averages of the LPP between 450–600 ms.

2.b.1. Interpretation Task (IMPLICATION – implicitness) Using the scenarios in Study I, scripts with 19 implications and 17 no-implications were created for Study II. At the beginning of the scenarios, there is an explanation of the context that facilitates the understanding of the situations described, and there are examples with and without implication. In each text, two people speak to each other and there are sentences that these people say to each other. In the conversation between two people, sentences containing implications and no-implications were determined, and after reading each situation and their sentences, the participants were asked to determine whether the sentence of one of these people contains implications or not. For each situation, a sentence in the script is shown in bold. Then, the participants were asked, "Is there any implication in the statement that was said? – Press E for 'Yes' and press H for 'No'". In this task, the number of times the participants pressed E in texts with implications and how many times they pressed H in texts without implications were considered. At the same time, the moment they pressed the key while making their decision is taken as the measurement of the reaction time. In order to remove the effect that may occur on the order of the texts given in the implication interpretation task, the texts were arranged in 3 different sequences in different ways.

2.b.2. EEG-ERP Recording and Analysis System EEG-ERP data were recorded continuously and digitally with the 32-channel EEG amplifier of the La Mont Medical Inc. company. Using a 0.1 Hz high pass and 70 Hz low pass filter, a 16-bit analog / digital (A / D) converter

card (National Instruments, Austin, Texas) was transferred to the computer's hard disk at 256 points / second sampling rate and analyzed. The recording and analysis of the EEG-ERP data were made with the MATLAB-based TAMEEG / ERP Recording and Analysis System (Demiralp et al., 2005). The EEG-ERP recording and analysis system consists of a computer that collects and records the data and two computers that do the job of presenting stimuli.

2.b.3. Process For study II, after the participants were asked whether they would like to participate if they were called to study II at the end of the first study and the names and phone numbers of those who wanted to participate were taken. Appointments were then made by calling the participants who met the criteria for study II. Which group the volunteers were assigned to in the study was determined according to the data obtained from the CSA test applied in the study. For study II, re-appointment was given to those participants with a tendency towards Holistic and Analytic CS and who had participated in study I and wanted to participate in the second phase. ERP records of the participants were taken on the appointment days and times given in the Brain Dynamics Research Laboratory (BEDAL) in the Physiology Department of the Faculty of Medicine of the University. Recordings were taken from 30 electrode sites using the international 10/20 system. Electrodes; fronto-polar (Fp1, Fp2), frontal (F7, F3, Fz, F4, F8), fronto-central (FC3, FCz, FC4), central (C3, Cz, C4), centro-parietal (CP3, CPz, CP4), parietal (P7, P3, Pz, P4, P8), temporal (T7, T8), fronto-temporal (FT7, FT8), temporo-parietal (TP7, TP8) and occipital (O1, Oz, O2) regions were fixed and placed with an EEG cap. ERPs were recorded as unipolar with reference to the average of the electrodes on the right and left earlobes. Ag/AgCl disc electrodes were placed in the annular spaces on the cap and Abralyte-2000 Gel was used through an injector to ensure conductivity in these spaces. After the EEG paste was placed on the disc electrodes, it was wetted with 1 M KCl in order to increase its conductivity and placed on the right and left earlobes of the participants. Before recording, the resistances of all electrodes were checked to be below 10 KOhm.

2.b.4. Statistical Analysis To evaluate the tendency towards the analytic–holistic styles, in addition to the type of script, the data were analyzed by factorial variance analysis (ANOVA) and Pearson's Correlation analysis on the IBM SPSS 21 software package.

3.b. Results The response time during the Analytic CS task and the response time during the interpretation task (implication) ($r = .39$, $p < .05$) were found to be positively correlated. The number of correct answers to the question asked in the interpretation task and the response time during the analytic task ($r = -.39$, $p < .05$) were found to be negatively correlated (Table 2).

Table 2. Pearson Correlation Analysis for response times of the tasks.

	1	2	3	4	5
1. No implication (ca)	–				
2. Implication (ca)	−.153	–			
3. No implication (rt)	.055	.115	–		
4. Implication (rt)	.195	.068	.687**	–	
5. CSA-A (rt)	−.008	−.387*	.221	.395*	–
6. CSA-H (rt)	.011	−.109	.268	.235	.729**

*$p < .05$; **$p < .001$
(rt): response time/ (ca): count of correct answers/
A: analytic (14 participant)/ H: Holistic (14 participant)/

A repeated factorial ANOVA was conducted to compare the main effects of the CSA task and interpretation task; the interaction effect between the CSA and the interpretation task on the number of correct answers to the question asked in the interpretation task. The main effect for the interpretation task yielded an F ratio of $F(1, 27) = 28.84$, $p = .000$, *partial* $\eta^2 = .52$, indicating a significant difference between implication texts ($M = 13.90$, $SD = 2.83$) and no-implication texts ($M = 15.62$, $SD = 1.50$).

3.b.1. OIP records received during questioning for texts (Figure 1)

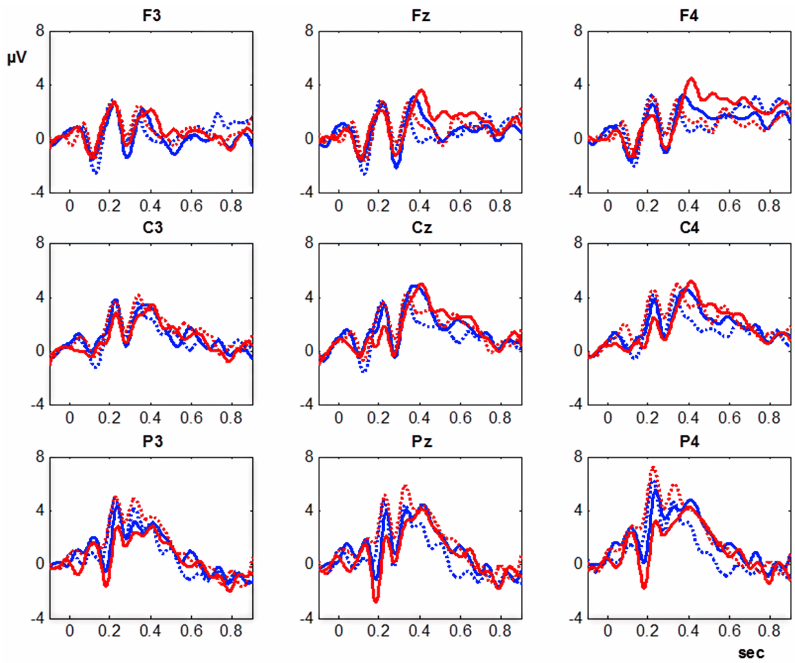


Figure 1. ERP records were received during questioning for texts. (Dotted blue: Analytic CS & No implication; dotted red: Holistic CS & No implication; solid blue: Analytic CS & Implication; solid red: Holistic CS & Implication).

3.b.1.1. LPP amplitude A repeated factorial ANOVA was conducted to compare the main effects of the CSA, interpretation task, AP, and LAT patterns; the interaction effect between the CSA, interpretation task, AP, and LAT patterns on the LPP amplitude (Figure 2). The interaction effect for AP and LAT patterns yielded an F ratio of $F(4, 104) = 17.40$, $p < .01$, *partial* $\eta^2 = .40$, indicating a significant difference on central right ($M = 2.85$) and middle ($M = 2.52$) and on frontal right ($M = 2.06$) and middle ($M = .83$). The interaction effect for the CSA, interpretation task and AP pattern was significant $F(2, 52) = 5.28$, $p < .01$, *partial* $\eta^2 = .17$, indicating a significant difference between central ($M = 3.0, SD = 1.14$) and parietal ($M = 1.94$, $SD = 1.03$) in the Analytic CS group for implication texts. There was a significant difference between central right (ACS $M = 3.37$, $SD = .80$ and HCS $M = 2.33$, $SD = .84$) and middle (ACS $M = 2.87$, $SD = .98$ and HCS $M = 2.18$, $SD = 1.0$) and also between frontal right (ACS $M = 2.84$, $SD = .90$ and HCS $M = 1.29$, $SD = .75$) and middle (ACS $M = 1.37$, $SD = .93$ and HCS $M = .30$, $SD = .90$) for the Analytic CS and Holistic CS groups.

3.b.1.2. P3 amplitude A repeated factorial ANOVA was conducted to compare the main effects of the CSA, interpretation task, AP, and LAT patterns; the interaction effect between the CSA, interpretation task, AP, and LAT patterns on the P3 amplitude (Figure 2). The main effect for AP patterns yielded an F ratio of $F(2, 52) = 18.62$, $p < .01$, *partial* $\eta^2 = .42$, indicating a significant

difference between frontal ($M = 4.73$) and parietal ($M = 7.09$) with central ($M = 6.71$). The main effect for LAT patterns yielded an F ratio of $F(2, 52) = 14.90$, $p < .01$, *partial* $\eta^2 = .36$, indicating a significant difference between the left ($M = 5.40$) and the right ($M = 6.71$) with the middle ($M = 6.42$).

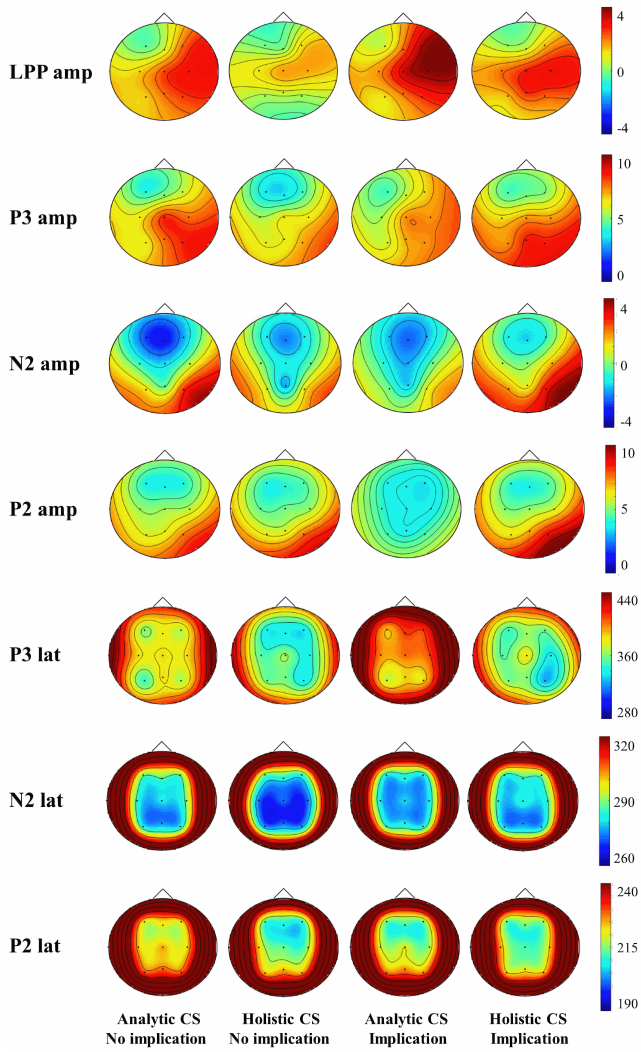


Figure 2. LPP, P3, N2, P2 amplitude and latency records received during questioning for texts.

3.b.1.3. P3 latency A repeated factorial ANOVA was conducted to compare the main effects of the CSA, interpretation task, AP, and LAT patterns; the interaction effect between the CSA, interpretation task, AP, and LAT patterns on the P3 latency (Figure 2). The main effect for CSA yielded an F ratio of $F(1, 26) = 14.83$, $p < .01$, *partial* $\eta^2 = .36$, indicating a significant difference between ACS ($M = .38$) and HCS ($M = .35$). The interaction effect for CSA and LAT pattern was significant $F(2, 52) = 4.08$, $p < .05$, *partial* $\eta^2 = .14$, indicating a significant difference between the middle ($M = .36$) and the right ($M = .34$) with the left ($M = .35$) in the Holistic CS group. There was a significant difference between the middle ($M = .39$) and the left ($M = .38$) in the Analytic CS group.

The interaction effect for the interpretation task and AP pattern was significant $F(2, 52) = 3.34$, $p < .05$, *partial* $\eta^2 = .11$, indicating a significant difference on frontal and central areas

between implication (F $M = .38$; C $M = .38$) and no-implication (F $M = .35$; C $M = .37$) texts. The interaction effect for the CSA, AP, and LAT patterns was significant $F(4, 104) = 4.11$, $p < .01$, *partial* $\eta^2 = .14$, indicating a significant difference in the Holistic CS group on the central area between the middle ($M = .37$) and right ($M = .34$). There was a significant difference in the Analytic CS group on left (C $M = .39$; F $M = .37$; P $M = .35$) and middle (C $M = .39$; F $M = .39$; P $M = .38$) among central, frontal, and parietal areas.

3.b.1.4. N2 amplitude A repeated factorial ANOVA was conducted to compare the main effects of the CSA, interpretation task, AP, and LAT patterns; the interaction effect between the CSA, interpretation task, AP, and LAT patterns, on the N2 amplitude (Figure 2). The main effect for AP patterns yielded an F ratio of $F(2, 52) = 11.05$, $p < .01$, *partial* $\eta^2 = .30$, indicating a significant difference among parietal ($M = .66$), central ($M = -.29$) and frontal ($M = -1.69$). The main effect for LAT patterns yielded an F ratio of $F(2, 52) = 18.92$, $p < .01$, *partial* $\eta^2 = .42$, indicating a significant difference between the left ($M = -.34$) and the right ($M = .30$) with the middle ($M = -1.29$). The interaction effect for AP and LAT patterns yielded an F ratio of $F(4, 104) = 7.66$, $p < .01$, *partial* $\eta^2 = .23$, indicating a significant difference between on central left ($M = -.22$) and middle ($M = -1.03$) and on the frontal right ($M = -1.30$) and middle ($M = -2.20$). The interaction effect for the CSA, interpretation task and LAT pattern was significant $F(2, 52) = 3.14$, $p < .05$, *partial* $\eta^2 = .11$, indicating a significant difference among middle ($M = -1.61$), left ($M = -.18$) and right ($M = -.16$) in the Holistic CS group for no-implication texts. There was a significant difference between HCS no-implication (for middle area $M = -1.61$) and HCS implication (for middle area $M = -.21$) groups. The interaction effect for the CSA, interpretation task and AP pattern was significant $F(2, 52) = 4.20$, $p < .05$, *partial* $\eta^2 = .14$, indicating a significant difference between frontal ($M = -2.44$) and central ($M = -.51$) areas in the Analytic CS group for no-implication texts.

3.b.1.5. N2 latency A repeated factorial ANOVA was conducted to compare the main effects of the CSA, interpretation task, AP, and LAT patterns; the interaction effect between the CSA, interpretation task, AP, and LAT patterns on the N2 latency (Figure 2). The main effect for AP patterns yielded an F ratio of $F(2, 52) = 3.90$, $p < .05$, *partial* $\eta^2 = .13$, indicating a significant difference between frontal ($M = .286$) and parietal ($M = .279$); frontal and central ($M = .281$). The main effect for LAT patterns yielded an F ratio of $F(2, 52) = 3.32$, $p < .05$, *partial* $\eta^2 = .11$, indicating a significant difference between the left ($M = .283$) and the right ($M = .283$) with the middle ($M = .280$).

3.b.1.6. N1 amplitude A repeated factorial ANOVA was conducted to compare the main effects of the CSA, interpretation task, AP, and LAT patterns; the interaction effect between the CSA, interpretation task, AP, and LAT patterns, on the N1 amplitude. The main effect for AP patterns yielded an F ratio of $F(1, 26) = 16.48$, $p < .01$, *partial* $\eta^2 = .39$, indicating a significant difference between frontal ($M = -3.22$) and central ($M = -2.21$). The main effect for LAT patterns yielded an F ratio of $F(2, 52) = 6.24$, $p < .01$, *partial* $\eta^2 = .19$, indicating a significant difference between the left ($M = -2.70$) and the right ($M = -2.41$) with the middle ($M = -3.03$). The interaction effect for interpretation task, AP and LAT patterns yielded an F ratio of $F(2, 52) = 4.28$, $p < .05$, *partial* $\eta^2 = .14$, indicating a significant difference between central left ($M = -2.25$), right ($M = -2.19$) and middle ($M = -2.90$) and on frontal left ($M = -3.65$), right ($M = -3.42$) and middle ($M = -3.99$) for no-implication texts. There was a significant difference between the frontal right ($M = 2.62$) and central right ($M = -1.40$) for implication texts.

3.b.1.7. N1 latency A repeated factorial ANOVA was conducted to compare the main effects of the CSA, interpretation task, AP, and LAT patterns; the interaction effect between the

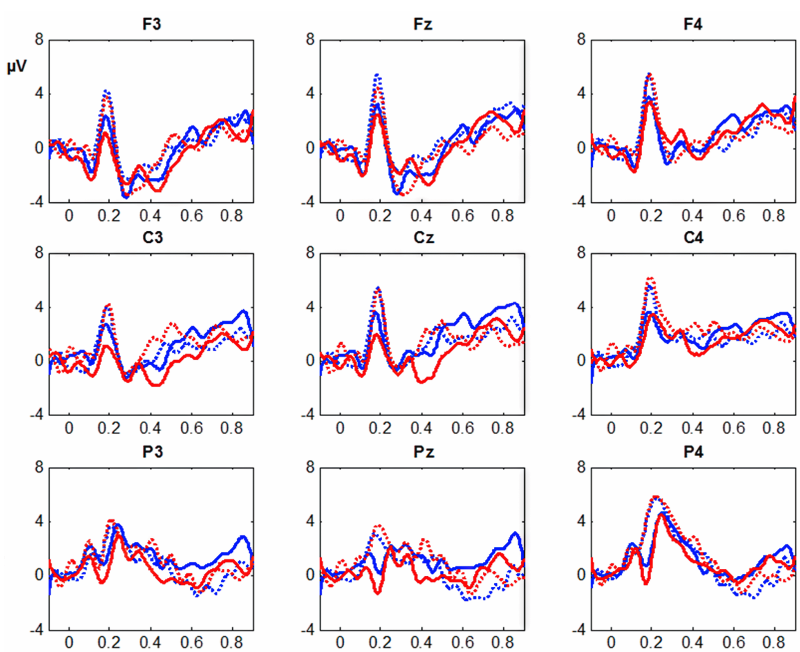
CSA, interpretation task, AP, and LAT patterns on the N1 latency. The interaction effect for the interpretation task, AP, and LAT patterns yielded an F ratio of $F(2, 52) = 3.51$, $p < .05$, *partial* $\eta^2 = .12$, indicating a significant difference between implication (Fr $M = .123$) and no-implication texts (Fr $M = .113$) on frontal right. There was a significant difference between frontal right and central right ($M = .113$) for implication texts.

3.b.1.8. P2 amplitude A repeated factorial ANOVA was conducted to compare the main effects of the CSA, interpretation task, AP, and LAT patterns; the interaction effect between the CSA, interpretation task, AP, and LAT patterns on the P2 amplitude (Figure 2). The interaction effect for AP and LAT patterns yielded an F ratio of $F(4, 104) = 5.83$, $p < .01$, *partial* $\eta^2 = .18$, indicating a significant difference between on central right ($M = 5.07$) and middle ($M = 4.74$) and on the parietal right ($M = 7.04$) and middle ($M = 5.59$).

The interaction effect for the CSA, interpretation task and AP pattern was significant $F(2, 52) = 4.37$, $p < .05$, *partial* $\eta^2 = .14$, indicating a significant difference between frontal (ACS $M = 3.99$; HCS $M = 4.23$), central (ACS $M = 5.34$; HCS $M = 4.89$) and parietal (ACS $M = 6.41$; HCS $M = 6.46$) areas in the Analytic CS and in the Holistic CS groups for no-implication texts. There was also a significant difference in the holistic CS group for implication texts between parietal ($M = 7.34$), frontal ($M = 4.18$) and central ($M = 5.34$) areas.

3.b.1.9. P2 latency A repeated factorial ANOVA was conducted to compare the main effects of the CSA, interpretation task, AP, and LAT patterns; the interaction effect between the CSA, interpretation task, AP, and LAT patterns on the P2 latency (Figure 2). The main effect for AP pattern yielded an F ratio of $F(2, 52) = 14.24$, $p < .01$, *partial* $\eta^2 = .35$, indicating a significant increase from the frontal area ($M = .215$) to the parietal area ($M = .226$) (and central area ($M = .220$).

3.b.2. OIP records received during answering to texts (Figure 3).



3.b.2.1. LPP amplitude A repeated factorial ANOVA was conducted to compare the main effects of the CSA, interpretation task, AP, and LAT patterns; the interaction effect between

Figure 3. ERP records received during answering to texts. (Dotted blue: Analytic CS & No implication; dotted red: Holistic CS & No implication; solid blue: Analytic CS & Implication; solid red: Holistic CS & Implication)

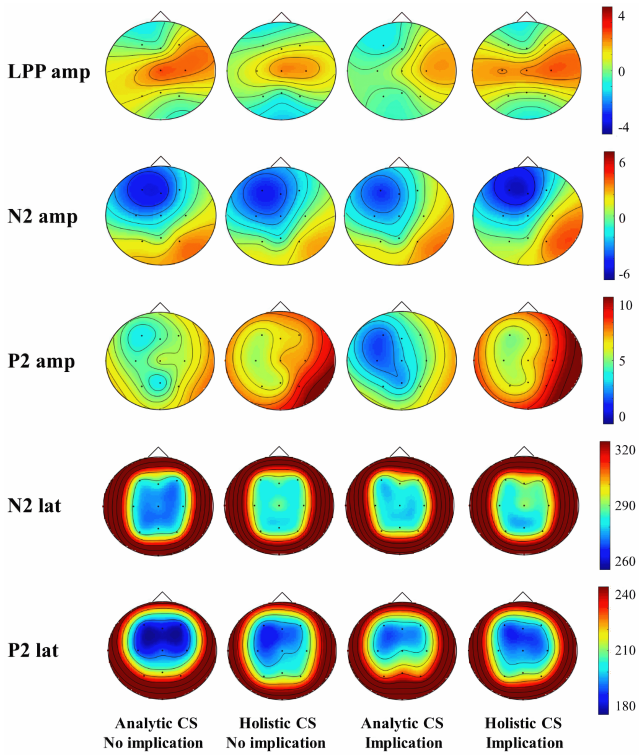


Figure 4. LPP, N2, P2 amplitude and latency records received during answering to texts.

the CSA, interpretation task, AP, and LAT patterns on the LPP amplitude (Figure 4). The interaction effect for AP and LAT patterns yielded an F ratio of $F(4, 104) = 6.85$, $p < .01$, *partial* $\eta^2 = .21$, indicating a significant difference among central (right $M = 1.95$; middle $M = 1.70$; left $M = 1.03$) frontal (right $M = .89$; middle $M = .06$; left $M = .28$) and parietal areas (right $M = .16$; middle $M = .10$; left $M = .20$). The interaction effect for the CSA, interpretation task, AP and LAT pattern was significant $F(4, 104) = 2.51$, $p < .05$, *partial* $\eta^2 = .09$, indicating a significant difference on central (right $M = 2.17$, middle $M = 2.36$) and frontal (right $M = 1.28$, middle $M = .02$) areas in the Analytic CS group between implication and no-implication (C right $M = 1.60$, middle $M = .62$; F right $M = .80$, middle $M = .29$) texts. There was a significant difference in the central area between implication ($M = 2.28$) and no-implication ($M = 1.76$) texts for the Holistic CS group.

3.b.2.2. N2 amplitude A repeated factorial ANOVA was conducted to compare the main effects of the CSA, interpretation task, AP, and LAT patterns; the interaction effect between the CSA, interpretation task, AP, and LAT patterns, on the N2 amplitude (Figure 4). The main effect for AP patterns yielded an F ratio of $F(2, 52) = 33.91$, $p < .01$, *partial* $\eta^2 = .57$, indicating a significant difference among parietal ($M = .70$), central ($M = -1.52$) and frontal ($M = -3.52$). The main effect for LAT patterns yielded an F ratio of $F(2, 52) = 55.74$, $p < .01$, *partial* $\eta^2 = .68$, indicating a significant difference between the left ($M = -2.27$) and the middle ($M = -2.32$). The interaction effect for AP and LAT patterns yielded an F ratio of $F(4, 104) = 8.25$, $p < .01$, *partial* $\eta^2 = .24$, indicating a significant difference between central left ($M = -2.62$) and middle

($M = -2.34$) and on the frontal left ($M = -4.59$) and middle ($M = -4.14$). The effect on thr parietal middle ($M = -.48$) is high. The interaction effect for the CSA, interpretation task and AP pattern was significant $F(2, 52) = 5.29$, $p < .05$, *partial* $\eta^2 = .17$, indicating a significant difference among frontal ($M = -3.96$), central ($M = -1.65$) and parietal ($M = 1.15$) areas in the Analytic CS group for no-implication texts. There was also a significant difference among frontal ($M = -2.63$), central ($M = -1.40$) and parietal ($M = .55$) areas in the Analytic CS group for implication texts. The same results were obtained for HCS no-implication and implication groups (no-imp Fr $M = -4.06$; C $M = -1.05$; P $M = .89$; imp. Fr $M = -3.43$; C $M = -1.97$; P $M = .21$).

3.b.2.3. N2 latency A repeated factorial ANOVA was conducted to compare the main effects of the CSA, interpretation task, AP, and LAT patterns; the interaction effect between the CSA, interpretation task, AP, and LAT patterns on the N2 latency (Figure 4). The main effect for LAT patterns yielded an F ratio of $F(2, 52) = 5.83$, $p < .05$, *partial* $\eta^2 = .18$, indicating a significant difference between the left ($M = .289$) and the right ($M = .290$) with the middle ($M = .285$).

3.b.2.4. N1 amplitude A repeated factorial ANOVA was conducted to compare the main effects of the CSA, interpretation task, AP, and LAT patterns; the interaction effect between the CSA, interpretation task, AP, and LAT patterns on the N1 amplitude. The main effect for AP patterns yielded an F ratio of $F(1, 26) = 14.59$, $p < .01$, *partial* $\eta^2 = .36$, indicating a significant difference between frontal ($M = -2.96$) and central ($M = -1.90$). The main effect for LAT patterns yielded an F ratio of $F(2, 52) = 5.81$, $p < .01$, *partial* $\eta^2 = .18$, indicating a significant difference between the left ($M = -2.69$) and the middle ($M = -2.60$) with the right ($M = -2.00$).

3.b.2.5. N1 latency A repeated factorial ANOVA was conducted to compare the main effects of the CSA, interpretation task, AP, and LAT patterns; the interaction effect between the CSA, interpretation task, AP, and LAT patterns on the N1 latency. The main effect for AP patterns yielded an F ratio of $F(1, 26) = 6.68$, $p < .05$, *partial* $\eta^2 = .20$, indicating a significant difference between frontal ($M = .114$) and central ($M = .110$). The interaction effect for interpretation task and AP patterns yielded an F ratio of $F(1, 26) = 6.17$, $p < .05$, *partial* $\eta^2 = .19$, indicating a significant difference between on central ($M = .106$) and on frontal ($M = .115$) for no-implication texts. The interaction effect for the interpretation task and LAT patterns yielded an F ratio of $F(2, 52) = 7.43$, $p < .01$, *partial* $\eta^2 = .22$, indicating a significant difference between the right ($M = .110$), the middle ($M = .114$) and the left ($M = .116$) for implication texts. The interaction effect for the CSA, interpretation task and AP pattern was significant $F(2, 52) = 5.07$, $p < .05$, *partial* $\eta^2 = .16$, indicating a significant difference between implication texts (left $M = .121$; middle $M = .115$) and no-implication texts on the left ($M = .108$) and on the middle ($M = .109$) areas in the Holistic CS group.

3.b.2.6. P2 amplitude A repeated factorial ANOVA was conducted to compare the main effects of the CSA, interpretation task, AP, and LAT patterns; the interaction effect between the CSA, interpretation task, AP, and LAT patterns on the P2 amplitude (Figure 4). The interaction effect for the interpretation task and LAT pattern was significant $F(2, 52) = 6.39$, $p < .01$, *partial* $\eta^2 = .20$, indicating a significant difference on left and middle between implication (L $M = 4.03$; M $M = 4.56$) and no implication (L $M = 4.95$; M $M = 5.45$) texts. The interaction effect for AP and LAT patterns yielded an F ratio of $F(4, 104) = 6.75$, $p < .01$, *partial* $\eta^2 = .21$, indicating a significant difference between central left ($M = 4.27$), right ($M = 6.47$) and middle ($M = 5.43$) and parietal left ($M = 5.16$), right ($M = 6.97$) and middle ($M = 4.56$). The interaction effect for the interpretation task, AP, and LAT patterns was significant $F(4, 104) = 3.54$, $p < .05$, *partial* $\eta^2 = .12$. The P2 amplitude on the frontal (L $M = 4.56$; R $M = 5.94$; C $M = 5.48$) and

central (L $M = 4.88$; R $M = 6.45$; C $M = 6.13$) areas is smaller than the right and middle for the no-implication texts. On the parietal (L $M = 5.40$; R $M = 7.16$; C $M = 4.74$), it is higher on the right than on the left and middle. The P2 amplitude wave increases from the left to the right in the frontal (L $M = 3.53$; R $M = 6.05$; C $M = 4.58$) and central (L $M = 3.66$; R $M = 6.48$; C $M = 4.72$) areas for the implication texts. In parietal (L $M = 4.91$; R $M = 6.78$; C $M = 4.38$), it is higher on the right than on the left and middle, similar to the no-implication texts.

3.b.2.7. P2 latency A repeated factorial ANOVA was conducted to compare the main effects of the CSA, interpretation task, AP, and LAT patterns; the interaction effect between the CSA, interpretation task, AP, and LAT patterns on the P2 latency (Figure 4). The main effect for the interpretation task yielded an F ratio of $F(1, 26) = 5.37$, $p < .05$, *partial* $\eta^2 = .17$, indicating a significant difference between implication ($M = .206$) and no-implication ($M = .201$) texts. The main effect for AP patterns yielded an F ratio of $F(2, 52) = 48.73$, $p < .01$, *partial* $\eta^2 = .65$, indicating a significant difference between the parietal area ($M = .218$) and frontal area ($M = .194$) and central area ($M = .198$). The main effect for the LAT patterns yielded an F ratio of $F(2, 52) = 4.91$, $p < .05$, *partial* $\eta^2 = .16$, indicating a significant difference between right ($M = .207$) and left ($M = .203$) and middle ($M = .202$). The interaction effect for CSA and AP patterns yielded an F ratio of $F(2, 52) = 5.88$, $p < .01$, *partial* $\eta^2 = .18$, indicating a significant difference in the parietal area between the Analytic ($M = .225$) and Holistic ($M = .212$) CS groups.

2 General Discussion

When the study was evaluated, it was observed that individuals who were inclined to the holistic cognitive style are better at understanding and interpreting indirect meanings (meanings that include implication) than those who were inclined to the analytic cognitive style. It can be seen (Table 2) that individuals with the holistic cognitive style tend to evaluate the implied comments more quickly, since context evaluation is at the forefront (Kagitcibasi, 2010). It can be said that individuals with a tendency towards the analytic cognitive style, especially when evaluated according to the situations in which physiological measurements are taken into consideration (Figures 1 and 3), evaluate the parts that make up the whole separately (Kagitcibasi, 2010), which can be said to emerge during the evaluation of the implied comments here. The fact that the LPP amplitude indicated for language processing (Hillyard & Kutas, 1983; Ji et al., 1998) was the highest during the evaluation of the implied comments, especially in the individuals who were inclined to the analytic cognitive style, may be explained by the fact that these individuals direct their attention to the details in the texts.

The study shows that individuals choose comments that contain more implicitness in parallel with the increase in their indirectness and interpretation scores (Table 1). In addition, it was observed that the interpretation scores were inversely related to the tendency to use the analytical cognitive style. This is supported by the fact that those who are inclined to the holistic cognitive style during speech perception in the study are more attentive and they comprehend more easily than those with a tendency towards the analytical cognitive style when implied. This study supports the theory that the less individuals tend to use the analytical cognitive style, the better they interpret implied situations. It has been shown that individuals who are inclined to the holistic cognitive style in the meaning interpretation task prefer more suggestive interpretations.

Individuals who tend towards the analytical cognitive style have the highest P3 amplitude and LPP (Figure 2). When this situation is evaluated, it can be said that these individuals focus their attention more on the task when asking questions for texts (Sutton et al., 1965) and they do more processing when evaluating implied comments (Hillyard & Kutas, 1983; Ji et al., 1998). At the same time, this latency occurs later in individuals in the analytical cognitive style group compared to individuals from the holistic group (Figure 1). Individuals in the holistic cognitive

style group evaluate the texts in the implied interpretation task faster than the context, and then these individuals direct their attention less on whether the text contains hints or not. In addition, P2 amplitude was shown to be higher in the holistic cognitive style group. In this case, it can be said that these individuals do more sensory scanning in terms of evaluating the context (Figure 2). It was observed that the P2 amplitude was greater in the texts containing implication and the latency occurred later (Figure 2). This suggests that more sensory scanning (Barry et al., 2000) is used to collect more clues while asking questions for implied texts.

In the analytic cognitive style group, lower LPP were recorded in the midline of the central and parietal than in the other conditions in the recordings taken during the responses to the implied texts (Figure 4). It can be seen that less processing (Hillyard & Kutas, 1983; Ji et al., 1998) is used for implied texts in the analytical group (Figure 3). This suggests that those who are inclined to the analytical cognitive style may still continue to make a cognitive assessment of their decisions outside of their attention while they are responding. The fact that the P2 occurs late in individuals who are inclined to the analytical cognitive style while they are responding to the questions asked for the implied texts supports this conclusion (Figure 4). The fact that the P2 amplitude was higher when the questions asked for the non-implicit texts were answered also suggests that sensory scanning (Barry et al., 2000) continues in terms of evaluating the texts.

3 Conclusions

The study is very new in the field in terms of researching subjects related to psychology, physiology and communication, and in terms of unifying these three disciplines. Few studies have been found covering the topics discussed here. This study can be a guide for such interdisciplinary studies.

The fact that individuals perceive each other correctly in mutual communication is an indicator of healthy communication. In particular, it is necessary to consider how the spoken language can be perceived by the the other person during conversation, and the words chosen while speaking should be arranged accordingly. Generally, people interpret and evaluate what they hear and see in their own way, as they look at events, situations, etc. from their own perspective while they are speaking. In addition, stimuli in the environment always determine what individuals should pay more attention to. In some cases, even if the stimuli are directly related to what is being said at that moment, what gets more attention may be the unspoken (the implied) meaning and people may face the problem of misunderstanding each other. This may lead to the selection of different preferences, especially during the resolution of disputes. Therefore, if people can get to know each other well enough; in other words, if they can be aware that each other's cognitive styles are different and therefore they can think differently, they will be able to form their behaviors in this direction and to conduct communication in a healthy way. The cognitive styles individuals are inclined to, whether they are males or females; are crucial for them to correctly perceive the individuals they are trying to communicate with.

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The publication was financed at the authors' expense.

The authors declare that they have no competing interests.

All the authors participated equally in preparing conception and academic editing of this article.

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Publisher: Institute of Slavic Studies, Polish Academy of Sciences

Publishing history: Received 2022-06-28; Accepted 2023-10-09; Published 2023-12-31.