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N400 and ethnic implicit bias.

An electrophysiological investigation

on stereotype-based mental representations

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Index

Chapter 1

1. General Introduction

1.1 Premises

The mere fact of knowing a person's ethnicity or nationality may implicitly influence our attitudes, feelings, and behaviour in a biased way, even if this is opposite to our declared beliefs. Human biases and stereotypes have highly elaborate roots that stem from a multidimensional combination of history, geopolitics, social structures, intergroup processes, and social identities (Amodio and Cikara, 2021). Multiple disciplines have addressed the topic from a different perspective. Research in social cognition investigates how people acquire, store and process social stereotypes and the contributions of social neuroscience have significantly increased our knowledge of how stereotypes function at the individual level (Banaji et al., 1996; Kubota et al., 2012; Amodio et al., 2021, 2014). The approach to stereotypes of the social neuroscience investigates the cognitive processes and neural underpinnings of bias integrating neuroscience with the social psychology of prejudice and stereotyping (Amodio and Cikara, 2021).

Stereotypes represent a peculiar type of social knowledge that often regulates implicit associations and social interactions. They are cognitive representations deeply-rooted in our knowledge, where a predetermined set of concepts and characteristics is associated to a specific social group (Dovidio et al., 1986). Stereotypes, indeed, refer to specific beliefs about a group, such as what members of a group look like, how they behave, or their abilities. They represent the cognitive component of intergroup bias and differ from prejudices in such nature. Indeed, prejudice consists in a more evaluative and emotional response and refers to the attitudes and feelings that people have towards members of other groups based on preconceptions (Amodio, 2014).

Stereotypes provide a pre-established set of semantic information about the world, that may be automatically triggered anytime we encounter a stereotype-conveying context, such as a phrase, word or even a voice (Dovidio et al., 1986; Siyanova-Chanturia et al., 2012; Proverbio et al., 2017; Van Berkum et al., 2008). Stereotypes provide a frame to interpret and form expectations about

other people's behaviour, crucial and adaptive in person perception and impression formation processes, and to guide our actions (Bartholow and Dickter, 2007; Macrae and Bodenhausen, 2000). Although evolutionarily efficient and adaptive in several occasions, certain stereotype based generalizations and inferences on the social world often mediate intergroup relations and represent the basis for discriminatory behaviours and attitudes (Otgaar et al., 2011). Such effects involve for instance implicit associations relative to a person's race and ethnicity, but also their sex, gender, age, sexual orientation, etc. The term "implicit bias" is used to describe the presence of biased attitudes towards other social groups or the association of stereotypes with them, without conscious awareness. Race and ethnicity represent one of the prime area for implicit bias. It is to be noted that they are concepts often confused despite their differences. The concept of race generally refers to a group of people who have in common some visible physical traits, such as skin colour, hair texture or facial features. Modern researchers altogether agree that the concept of race has no biological validity and relating it solely to phenotypic traits doesn't account for its social reality. Indeed, scholars examine race as a social and cultural, rather than biological, phenomenon. Ethnicity, on the other hand, is a more multifaceted concept, which encompasses cultural factors and the identity of an individual including kinship, religion, language, shared territory and nationality, and physical appearance (Dein, 2006). Therefore, racial stereotypes generally refer to a set of automatic mental representations associated to people based on specific physical traits, while ethnic stereotypes involve beliefs about typical characteristics of members of a given ethnic group or nationality, their status, societal and cultural norms. They both often permeate insidiously our social life and affect our feeling and actions.

As stated by the *American Psychological Association* (APA, 2021) racial bias is systemic, institutional, interpersonal, and internalized. Its effects range from daily interpersonal interactions to education, health, wealth and income.

Indeed, the matter of structural racism has become central in the present historical time. An increasing wave of social activism has started, prompt to disrupt and raise awareness towards stereotype-based mechanisms and the implicit bias embedded in society. A key role is played, for instance, by the *Black Lives Matter* movement, born in the USA and now active worldwide, even in

Italy, that has garnered widespread awareness, focusing on the equal treatment of Black people (Tometi and Lenoir, 2015).

The concern nowadays is not only towards overt racism, acted and supported by white supremacists or people defending racial and ethnic stereotypes, but it involves people who authentically claim to be horrified by these types of attitudes and nonetheless unconsciously reproduce biased patterns. The effects of stereotype-based assumptions and inferences often act implicitly, out of a person's awareness, and are grounded in social structures.

This has led sociology and politic scholars to claim that we are all racists (Lewis, 2018), there is no such thing as being "not racist" and that the heartbeat of racism is the denial to recognize that the whole society internalized and is pervaded by ideas that are racist and support racial hierarchies (Kendi, 2019).

Following these premises, the present work represents an investigation on the implicit neural processes and mechanisms underlying stereotype-based mental representations. The use event-related potentials (ERPs) enabled us to investigate and detect the presence of ethnic bias implicitly and directly in the active brain (Bartholow, 2010). This methodology allowed to bypass participants' awareness and problems typical of indirect behavioral methods, such as social desirability mechanisms

The project considered ethnicity-based implicit bias processes during language comprehension. Three studies have been conducted, the first one focused on the neural bases and temporal course underlying how race-based preconceptions are stored and activated at a neural level during sentence comprehension, the second one addressed the matter of how they can be modulated by exposure to counter-stereotypic training and the third explored how stereotype-based association can be triggered by voice context such as accent variations. Crucial attention has been given to the N400 response, an ERP component indexing the difficulty in accessing and integrating incoming semantically incongruent information with previous knowledge (Kutas & Hillyard, 1980).

The present thesis offers an attempt to fill a gap in ERP and N400 literature on ethnic bias and the neural basis of racial prejudice. Previous studies that approached ethnic bias from a neuroscientific perspective, by means of EEG/ERPs, often presented some methodological weaknesses. Indeed,

studies typically used simplistic paradigms, consisting mainly of simple representative images or words coupled together (prime and target) conveying a racial stereotype (e.g. Hehman et al., 2014; Wang et al., 2011; White et al., 2009). Such approaches were likely to reduce to simple dichotomies (e.g. positive/negative) the complexity of mental representations related to the vast variety of implicit biases. Here, instead, all studies presented linguistic complete and meaningful sentences. This allowed participants to easily access and shape a mental representation of the described scene and to form impressions about the characters based on their own expectancies and experiences. Furthermore, the present investigations considered stereotypes that involved numerous and different ethnic groups instead of single own vs. other race couples (e.g. Black/White) as more common in previous studies (Wang *et al.,* 2011; Hehman *et al.,* 2014). This approach allowed for a better generalization of results.

Moreover, chapter three presents a novel and unprecedented use of media-based counter-stereotypic training to modulate/reduce racial bias and expectancies, documented at neural level. Indeed, psychological studies have shown several promising approaches for reducing implicit racial bias such as counter-stereotypic training, exposure to individuals who defy stereotypes, intergroup contact and mindfulness-meditation techniques (e.g. Lueke and Gibson, 2015; Ramasubramanian et al., 2014; Blair et al., 2001; Soble et al, 2011; Allport, 1954). Nonetheless, to our knowledge this is the first attempt to document at neural level, by means of EEG/ERPs and the N400 effect, the effectiveness of such approaches.

Finally, chapter four presents a behavioral investigation on the role of speech accent variations in evoking stereotype-based expectancies, influencing the listener's way of interpreting the conversation and forming impressions on the speaker. The study sets a novel and unexplored ground for the investigation of the neural processes underlying the role of voice-based racial stereotypes in the implicit integration of sentence meaning and pragmatic contextual information during language comprehension.

1.2 The method: Language and the N400

Language is the primary tool for expression and communication across humankind and plays a crucial role in transmitting human culture (Shashkevich, 2019). Language is studied as a cultural, social, and psychological phenomenon. It is critical in determining how we perceive the world and can convey and perpetuate stereotypes in multiple ways. For instance, social psychologists showed that certain words are associated to certain stereotypes and that these can be automatically triggered whenever such words are encountered in the conversation (Banaji et al., 1996; Siyanova-Chanturia et al., 2012).

Interestingly, a line of psycholinguistic research on stereotypes has payed attention to the role of expectancies. Indeed, since stereotypes provide a frame to interpret, categorize and thus form expectations about other people's behaviour, studies showed that information that doesn't match stereotypical expectancies is processed slower than expected one. For example, more cognitive processing is required to process stereotype-unexpected information compared to expected one, thus researchers proposed that stereotypes and other expectancies increase the ease with which expectancy-consistent information can be processed (e.g., Sherman et al., 2000; Duffy and Keir, 2004; Cacciari and Padovani, 2007).

To tackle the topic from a neuroscientific perspective, social neuroscience has found that an effective and direct measure of such implicit cognitive processes was represented by event-related brain potentials (ERPs) (Bartholow, 2010). Indeed, ERPs have proved to be a valid measure to detect implicit expectancies, specially avoiding problems typical of self-report indirect behavioral methods, such as social desirability mechanisms.

Remarkable attention has been given to the N400 response, an ERP component related to a difficulty in accessing and integrating incoming information that is semantically inconsistent with previous knowledge (Kutas and Hillyard, 1980). The N400 response reflects violations of expectancies, both based on semantic and world-knowledge constraints. Indeed, lexical-semantic knowledge and general world-knowledge are both integrated in mental representations in the same time interval (around 400ms) during sentence comprehension (Hagoort et al., 2004). Moreover, several

researches suggested a relationship between ERP amplitude and the processing of unusual social information. Studies have showed that the inconsistency between a prime or context conveying a stereotype and a subsequent target can evoke the N400 component (e.g. Proverbio et al., 2009, 2017, 2018; Siyanova-Chanturia et al., 2012; Hehman et al., 2014; Hagoort et al., 2004; Wang et al., 2011; White et al., 2009; Ellemers, 2018; Pesciarelli, Scorolli, & Cacciari, 2019).

The present work applied the technical and theoretical method of language expectancies and event-related potentials, with a specific regard to the N400 response, to examine the neural underpinnings and the implicit way we process social information related to ethnic stereotypes. In particular, the finding of N400 responses to information violating a supposedly present ethnic bias would suggest the automatic activation of an implicit bias, revealing the actual association of an ethnic group to stereotypic social representations.

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Chapter 2

2. Measuring implicit mental representations related to ethnic stereotypes with ERPs: an exploratory study[1]

2.1 Introduction

The ability of the human mind to gather information and organize it into clusters of associations gives human beings an extraordinary advantage. The process of stereotyping perfectly fits and pander the need to order and simplify the complex social world in which we engage, giving a schematic structure to social knowledge in order to guide and predict behaviours (Macrae & Bodenhausen, 2000).

Even though the dynamics of social categorization (gender, age, ethnicity, etc.,) can lead to implicit biases and discriminatory behaviours, stereotyping primarily serves a survival and adaptive function (Otgaar et al., 2011). For instance, without stereotypes we would not know how to behave when encountering an elderly person, a baby, etc… It has been demonstrated that stereotype activation can directly influence and regulate behaviour and even cognitive processes such as memory performance (Hess et al., 2004; Bargh et al.,1996).

Stereotype is by definition a predetermined and fairly rigid association of a specific social group with a set of concepts, deeply-rooted in our knowledge on the social world, that can result in negative evaluations or biases against the out-group (prejudice) (Dovidio et al., 1986). Some studies (e.g. Ito & Urland, 2003) showed that when viewing pictures of own-race compared to other-race individuals, differentiating the in-group from the out-group is such an automatic process at the basis of our social functioning that can only take a fraction of a second at a neural processing level.

Implicit associations are often formed early in development by an associative learning process and can strongly influence behaviour even if sometimes very distant from explicitly reported equalitarian

[1] Adapted from Brusa, A., Bordone, G., & Proverbio, A. M. (2021). Measuring implicit mental representations related to ethnic stereotypes with ERPs: An exploratory study. *Neuropsychologia*, *155*, 107808.

values that are, instead, shaped later in development and derive from reflective learning process (Rudman et al., 2007).

These tacit associations seem to reside in semantic memory networks and to involve brain regions connected to social cognition processes, such as the representation of the self and of social groups (e.g. ethnic groups), and the ability to make inferences about the knowledge, beliefs and desires of the self and others (Amodio & Frith, 2006; Mitchell et al., 2006; Quadflieg et al., 2009; Freeman et al., 2010; Contreras et al., 2012). Indeed, the representation of stereotypes seems to be accompanied by the activation of some brain areas involved in mnemonic processes, in particular the temporal lobe and the inferior frontal gyrus, and of areas involved in the representation of social knowledge, social evaluations and mentalization, as the middle prefrontal cortex, the temporoparietal junction, the superior temporal sulcus and the anterior temporal cortex (Amodio, 2008; Saxe, 2010; Olson et al., 2013, Proverbio et al., 2017, 2018).

Although there are numerous dimensions through which developing social categorization, several neuroscientific studies have addressed the question from the perspective of racial discrimination. For example, studies on face processing revealed an enhanced preferential processing, visible at neural level, of ingroup vs. outgroup faces (Golby, 2001; Hart et al., 2000; Caldara et al., 2004; Hehman et al., 2014), and it has been shown that a stronger neural activation, underpinning a greater empathic response, is elicited by observing pain in people of the same racial group compared with people of another racial group (Contreras-Huerta et al., 2013; Xu et al., 2009).

The present investigation aimed to investigate, by means of the EEG/ERP technique, the implicit activation of stereotypical automatic representations related to different non-Caucasian ethnicities (Arabs, Africans, Asians, South Americans, etc.) in Caucasian observers and investigate the temporal and neuro-anatomical correlates associated.

Previous studies have shown that ERPs are sensitive to violations of race- and gender-based stereotypes (Proverbio et al., 2017, 2018; Ibanez et al., 2009; Amodio et al., 2013; Hagoort et al., 2007; Metzner et al., 2015; Correll et al., 2006) and remarkable attention has been given to the N400 response. The N400 component is related to a difficulty in accessing and integrating incoming semantically incongruent information with previous knowledge (Kutas & Hillyard, 1980), and

researchers have extended its meaning to the violation of stereotypical associations even related to world knowledge (Hagoort et al., 2004; Proverbio & Riva, 2009). In the context of social stereotypes the N400 response might therefore index the detection of information not corresponding to available world knowledge, including social attributes stereotypically associate to a social or ethnic group.

Indeed, the electrophysiological study by Wang and colleagues (2011) investigated through a priming paradigm the implicit stereotypical association between rural migrant workers of China and a set of negative attributes in Chinese subjects. The authors reported N400 ERP responses to the opposite association between the rural workers and positive attributes. Also Correll (2006), in a study were participants were required to take fast shoot/don't-shoot decisions in response to armed and unarmed Black or White targets, showed that Caucasian participants were faster at taking the decision to shoot to armed Afro-Americans compared to armed Caucasian individuals. Moreover, the ERPs reflected the automatic association between Black people and the use of arms, showing greater N400 responses to Black unarmed individuals compared to White unarmed ones. Hehman and colleagues (2014) furthermore confirmed that the N400 component can act as an index of stereotype accessibility in an interracial domain. Using a prime-target paradigm, the authors measured a greater N400 reactivity in response to trials in which the prime (face: Black/White) was incongruent with the stereotypical target (trait: positive/negative) than when primes and traits matched.

This phenomenon seems to work similarly also for other kinds of stereotypical knowledge, as for instance gender stereotypes. Indeed, White and colleagues (2009) showed that the onset of N400 component was guided by the violation of gender stereotypes, produced by the incongruent association of the categories "Man" and "Woman" with target words typically connected to one of the two genders. Similarly to the present study, Proverbio and colleagues (2017; 2018) used ERPs to measure, by means of a N400 response, the detection of a discrepancy between gender-based occupational stereotypes and non-stereotypical written material presented in an implicit task.

In this study, it was hypothesized that presenting violations of stereotypical associations of an ethnic group to a specific set of attributes (e.g. a Roma person dressed up in a sophisticated instead of shabby way, or an African person working as a surgeon instead of a peddler) would evoke greater

N400 responses in Caucasian subjects. In fact, Event-related potentials (ERPs) have proved to be a valid measure to detect the presence of implicit mental associations, specially avoiding problems related to self-report behavioural methods such as social desirability mechanisms. Moreover, the study aimed at exploring a possible correlation between neurophysiological measures indicating the presence of racial stereotypes and behavioural measures of the same construct. Previous studies have already shown a similar pattern of results (e.g. Izuma et al., 2019), as for instance a study by Phelps and colleagues (2000) which showed that differences in the activation threshold of the amygdala when viewing Black and Caucasian faces correlated with the individual scores obtained on the Implicit Association Test, thus allowing indirect and implicit measures of ethnic bias.

Conversely, as a counter part of the N400, a P300 effect was expected to be found in response to congruent words as opposed to unexpected or neutral ones. Previous literature (Roehm et al., 2007; Molinaro and Carreiras, 2010) has indeed already shown, in sentence reading paradigms, that highly predictable words elicit larger P300 responses, and therefore argued that the P300 component might reflect the integration of expected information that was pre-activated during sentence reading.

Moreover, considering the highly social value and the emotional impact of racial stereotypes and connotations, a late positive potential was expected in response to sentences involving other-race characters compared to own-race, neutral, members. Generally, the late positivity is known to be strongly influenced by the emotional value of a stimulus and by stimuli that are relevant from a motivational point of view, as opposed to stimuli perceived as neutral (Shupp et al., 2000; Citron, 2012; Keil et al., 2002). This effect has been reported in several studies involving emotional stimuli such as pictures (Cuthbert et al., 2000; Bradley et al., 2007; Schupp et al., 2000) and even words (Rostami et al., 2015; Fischler and Bradley 2006; Herbert et al., 2008; Naumann et al., 1997; Schacht and Sommer 2009). For instance, Cuthbert et al., (2000) showed participants a selection of unpleasant, pleasant and neutral pictures taken from the IAPS database and observed in fronto-central sites an LPP in response to emotionally arousing images compared to neutral ones, whereas Fischler and Bradley (2006) showed that emotionally evocative words and phrases elicited a late positive shift in frontal–central sites, compared to neutral stimuli.

In addition, relevant literature relating to post-N400 positivities was taken into consideration throughout the study. Indeed, as reviewed by Van Petten and Luka (2012), numerous electrophysiological studies suggest the presence of a post-N400 positivity concerning congruence and semantic relatedness in language prediction (e.g. Van Petten and Luka, 2006; DeLong and Kutas, 2020). According to the authors post-N400 positive potentials are common and can be divided into two distinct categories with different scalp topographies, parietal and frontal, the first mainly associated with semantic incongruence and the latter with congruence.

The studies on prejudice described above, typically used stimuli consisting mainly of simple representative images or words coupled together (prime and target) (e.g. Hehman et al., 2014; Wang et al., 2011; White et al., 2009). Here instead, (following Proverbio et al., 2017, 2018) complete and meaningful sentences were presented allowing participants to easily access and shape a mental representation of the described scene and to form an impression about the characters based on their own experiences. Moreover, the overall study's purpose was not explicit to participants and hardly guessable, since they were distracted by a fictitious experimental task and they were not required to perform any evaluation or decision making based on characters' race. Furthermore, the present investigation takes into account stereotypes that involve numerous and different ethnic groups instead of a simple dichotomy (Wang et al., 2011; Hehman et al., 2014), allowing for a better generalization of results.

2.2 Methods

2.2.1 Participants.

Twenty (10 males, 10 females) University students ranging in age from 18 to 35 years (M= 24.58, SD= 3.59), took part in the study. All of them were native Caucasian Italian citizens descending from Italian parents with no relatives belonging to a different ethnicity.

They had normal or corrected-to-normal vision, were right-handed as assessed by the Oldfield Inventory (M=0.77; SD=0.16) and reported no history of drug abuse or neurological or mental disorders.

Participants were, moreover, asked to fill in an Italian adapted version of the Pettigrew and Meertens' Subtle and Blatant Prejudice Scale (see Arcuri & Boca, 1996 for the Italian translation) to assess their prejudice toward immigrants. Responses to the questionnaire were provided on a 5-point Likert scale ranging from 'Not at all' to 'Very much' according to the agreement with the statements presented.

Experiments were conducted with the understanding and written consent of each participant according to the Declaration of Helsinki (BMJ 1991; 302: 1194), with approval from the Ethics Committee of University of Milano-Bicocca (CRIP).

The data from one subject were discarded for excessive recording artefacts, as the percentage of contaminated trials was 52.28%. Hence, 19 subjects were included in the final EEG data analysis.

2.2.2 Stimuli.

The stimulus material consisted in 285 sentences that could either violate (Incongruent condition), non-violate (Congruent condition) or be neutral (Neutral condition) with regard to the most prevalent stereotypical concepts concerning different ethnic groups in the Italian culture. Indeed, 95 sentences (Congruent) confirmed ethnic stereotypes such as "Some Senegalese boys put up a FIGHT" (in Italian "Alcuni ragazzi senegalesi hanno provocato una rissa"); 95 sentences (Incongruent) violated stereotypes expressing notions deviating from common thinking like ''The surgeon who operated on her is called AZIZ" (in Italian "Il chirurgo che l'ha operata si chiama Aziz"); 95 sentences (Neutral) had no reference to any ethnic stereotype, expressing instead neutral concepts related to Italian characters such as "Elisa bought a JACKET" (in Italian: "Elisa ha comprato una giacca") (see Appendix A for a full list of sentences). Sentences were created in a way so that the congruency with the prejudice was made explicit only at the very end by the terminal word. The ethnic groups mentioned in Congruent and Incongruent sentences were various (Eastern European, Arabs, African, Asian, South American, Roma) and were balanced between conditions.

Moreover, 24 extra sentences sharing the syntactic, semantic and lexical characteristics with the previous sentences acted as target stimuli. They all ended with an animal name as the terminal

word (e.g. “That man was assaulted by a TIGER”, in Italian “Quel signore è stato assalito dalla tigre”) for the fictitious experimental task.

For ERP averaging of all stimulus types, EEG epochs were time-locked to the terminal words. They were balanced across categories in length and frequency of use as assessed by the CoLFIS database by Bertinetto et al. (2006). Statistical comparisons (ANOVAs) performed on the mean frequency of use of terminal words across the Congruent, Incongruent and Neutral conditions showed no difference ($F(2,210) = 0.49$, $p = 0.95$) whatsoever (Congruent = 85.26, SD = 170.31; Incongruent = 85.81, SD = 129.33; Neutral = 89.42, SD = 121.08). A further ANOVA performed on mean word length (# of letters) showed balance across stimulus classes ($F(2, 218) = 0.33$, $p = 0.71$): the length was on average 7.57 letters (SD = 2.42) for Congruent, 7.72 letters (SD = 2.40) for Incongruent words and 7.47 (SD = 2.32) for Neutral terminal words. Terminal words were also balanced for word category (# of proper names, adjectives, verbs, nouns and adjectives used as nouns) and for concrete/abstract value (Table 2.1). Terminal words were equiluminant across experimental categories as determined by means of a Minolta CS-100 luminance meter. The mean luminance values of terminal words in the Congruent, Incongruent and Neutral classes were subjected to an ANOVA. The category factor didn’t result statistically significant ($F(2,188) = 0.42$, $p = 0.66$) (Congruent = 4.67 cd/m^2, SD = 0.66; Incongruent = 4.71 cd/m^2, SD = 0.50; Neutral = 4.64 cd/m^2, SD = 0.43).

Condition	Lenght	Frequency of use	Word category					Concreteness		Luminance
	# of letters		# noun	# adj.	# ver	# pr. nm	# adv	# concr	# abstr	cd/m^2
Incongruent	M=7.6; SD=2.31	M=89.11; SD=133.17	54	25	7	8	1	57	38	M=4.71; SD=0.50
Congruent	M=7.56; SD=2.44	M=77.93; SD=154.87	55	24	13	2	1	53	42	M=4.67; SD=0.66
Neutral	M=7.56; SD=2.44	M=92.02; SD=126.67	56	28	7	3	1	56	39	M=4.64; SD=0.43

Table 2.1. *Orthographical and lexical properties of stimulus material. Terminal words were balanced across conditions in length, frequency of use, word category, concreteness and luminance. Adj.=adjective, pr.nm.=proper name, adv.=adverb, concr.=concrete, abstr.=abstract.*

2.2.3 Stimuli Validation.

To determine whether the sentences confirmed, violated or were neutral in respect to common sense prejudices for the specific population (university students in the Milan metropolitan area), the stimuli underwent a previous validation. A written questionnaire containing 330 sentences was administered to 20 native Caucasian Italian volunteers (10 females and 10 males) ranging in age between 18 and 35 years. Participants had to indicate on a 3-point scale what their reaction to the sentence was. They were asked to indicate whether each sentence was expected or unexpected on a scale from 0 to 2 where 0 = “I kind of saw that coming”, 1 = “I don’t know”, and 2 = “Actually, I was a bit surprised”. Based on the results, 45 sentences were discarded and 5 were modified obtaining a final number of 95 Incongruent sentences rated from 1.35 and 2, 95 Congruent sentences rated from 0 and 0.65 and 95 Neutral sentences rated between 0.6 and 1.1.

2.2.4 Procedures.

Participants were comfortably seated in an electrically and acoustically shielded cubicle.

The instructions for the experiment were presented on written paper. Sentences were presented on a PC screen placed 100 cm in front of the participants, who were asked to fixate the centre of the screen where a red dot served as fixation point. They were instructed to sit relaxed but still, avoiding any head or body movements as well as ocular saccades and blinks. The task consisted of responding as quickly and accurately as possible to the terminal word of sentences when it represented an animal, by pressing a joypad key with the index finger of the right or the left hand. The response hand was alternated across trials. The paradigm was implicit in that participants were unaware of the overall study purposes and no judgement about stereotypes was required. Response time to target terminal words was recorded to control the attentive state and accuracy of participants. Sentences were presented with *Eevoke v2.2 (*ANT Neuro, Hengelo, The Netherlands) in a randomized order across 8 mixed sequences. Each sentence was presented for 1000 ms at the centre of the screen arranged in a maximum of three short rows and followed, after an ISI of 700 ms, by the terminal word which was presented for 1000 ms in uppercase. The ITI was 1200 ms. The average size of terminal words was 4.47 cm x 0.8 cm, implying a visual angle of 2°33’40” x 2°33’40”

(minimum length = 1.5 cm, maximum length = 7.9 cm). The text was printed in yellow on a black background. An example is shown in figure 2.1.

The sequence order of presentation and response hand order were randomized across subjects. Prior to the beginning of the formal experiment, two training runs were administered to participants to allow them to familiarize with the procedure. Each experimental run lasted 2 min and 40 s and was followed by a 30-s pause. A longer pause was allowed at about half the recording time. Each experimental sequence started with the presentation of 3 warning signals of 700 ms of duration (‘‘Ready, Set, Go!”) and ended with ‘‘thank you” word on the screen. Both the warnings and thanks were typed in uppercase characters.

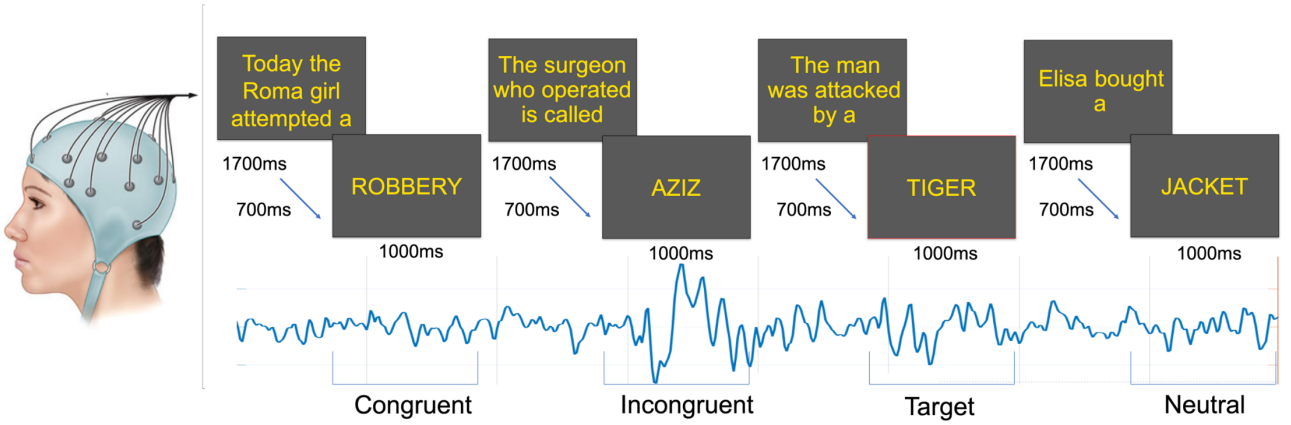

Figure 2.1. *Experimental paradigm. EEG signals were recorded while participants read sentences that could either violate (Incongruent condition), non-violate (Congruent condition) or be neutral (Neutral condition) with regard to ethnic stereotypes. Participants had to respond by pressing a button to filler target sentences ending with an animal name.*

2.2.5 EEG recording and Analysis.

EEG data were recorded using a standard EEG cap with 128 electrodes located according to the 10–5 International System (Oostenveld & Praamstra, 2001) using *EEProbe v2.2* software (ANT Neuro, Hengelo, The Netherlands) at a sampling rate of 512 Hz (a band-pass filter of 0.16-70 Hz was used, with a roll-off slope of 24 dB/octave). Horizontal (hEOG) and vertical (vEOG) eye movements were also recorded and linked mastoids served as the reference lead. Electrode impedance was maintained below 5 KOhm. Computerized artifact rejection and manual eye-

inspection was performed to remove EEG segments contaminated by ocular artifacts (saccades and blinks), muscle-related potentials, or amplifier blockages. The computerized artefact rejection criterion was a peak-to-peak amplitude exceeding 50 μV. The rejection rate was ~20% and the average number of trials per condition that went into ERP averaging remained quite high: 70.75 for congruent, 72.8 for incongruent and 71.2 for neutral.

EEG epochs were synchronized with the onset of the terminal word. Evoked response potentials (ERPs) were averaged off-line from 100 ms before to 1000 ms after stimulus onset and an off-line filter (band-pass 0.16-30 Hz) was applied to the ERPs.

The mean amplitude area of the N400 response was recorded from anterior and fronto-central sites (AFF1, AFF2, AFz, Fz) in the 300- to 500-ms temporal window. The mean amplitude area of the P300 was recorded from anterior and fronto-central sites (AFF1, AFF2, AFz, Fz) in the 500- 600-ms time window. The mean amplitude area of the frontal positivity (fLP) was recorded from anterior-frontal sites (AF3, AF4, AFF1, AFF2, AFz) in the 650- 800-ms time window. ERP analyses were performed using *EEprobe v2.2* software (ANT Neuro, Hengelo, The Netherlands). The electrode clusters and time windows were selected on the basis of previous literature (Proverbio et al., 2017, 2018, 2020; White et al., 2009; Hehman et al., 2014; Wang et al., 2011; Correll et al., 2006; Zhang et al., 2015) and on where they matched the strongest scalp recorded activity of N400, P300 and frontal positivity (fLP) potentials. Although supported by solid literature, such non-independent selective criteria may represent, according to some authors, a study limit considering the risks of highlighting spurious effects (e.g., Kriegeskorte et al., 2010).

For each ERP component, the mean area amplitude values were subjected to repeated-measures ANOVAs whose factors of variability were condition (congruent, incongruent, neutral) and electrode (depending on the component of interest). Fisher (LSD) post-hoc comparisons were used. The effect size for the statistically significant factors was estimated using partial etasquared (ηp^2) and the Greenhouse-Geisser correction was applied to account for non-sphericity of the data. Behavioural data were not statistically analysed, but response time and accuracy were collected as a record. All the ANOVAs were performed using Statistica software (version 10) by StatSoft.

A standardized weighted low-resolution electromagnetic tomography (swLORETA; Pasqual-Marqui *et al.,* 1994; Palmero-Soler *et al.,* 2007) was performed on the ERP Difference Wave relative to N400 potentials, computed by subtracting ERP response to Congruent words from ERP response to Incongruent words in the N400 time window, using ASA4 Software.

Moreover, a *Pearson* correlation analysis was performed on the results of the Subtle and Blatant Prejudice Scale and the Difference wave (Incongruent - Congruent) of the N400.

2.3 Results

2.3.1 Response Time.

Descriptive analyses of behavioural data showed that participant had an average Response Time to the target terminal words of 690 ms (right hand: 689.3 ms; left hand: 704.9 ms). Moreover, the average accuracy of their response was quite high (hits: 98%), indicating the attentive state of participants throughout the experiment.

2.3.2 Subtle and Blatant Prejudice Scale.

A single prejudice score was computed by averaging the responses on all the items of the Subtle and Blatant Prejudice Scale. The prejudice score could range from 1 (minimum prejudice) to 5 (maximum prejudice). Overall, the mean prejudice score for our sample was 2.10 (SD = 0.32) which is significantly lower than the scale midpoint (3) ($t(18) = -12.24$; $p < 0.001$). Thus, we can presume that prejudice level in the present sample was rather small.

Considering separately the two subscales (Blatant and Subtle), participants obtained an average Blatant Prejudice score of M = 1.66 (SD = 0.33) and Subtle Prejudice score of 2.55 (SD = 0.44). A paired t-test assessed that the scores obtained in the two subscales were significantly different from each other ($t(18) = -8.72$, $p < .001$). A graphic representation of the questionnaire scores is showed in figure 2.2. The correlation between the two subscales (Blatant and Subtle) was not significant ($r(19) = 0.36$, $p = .13$).

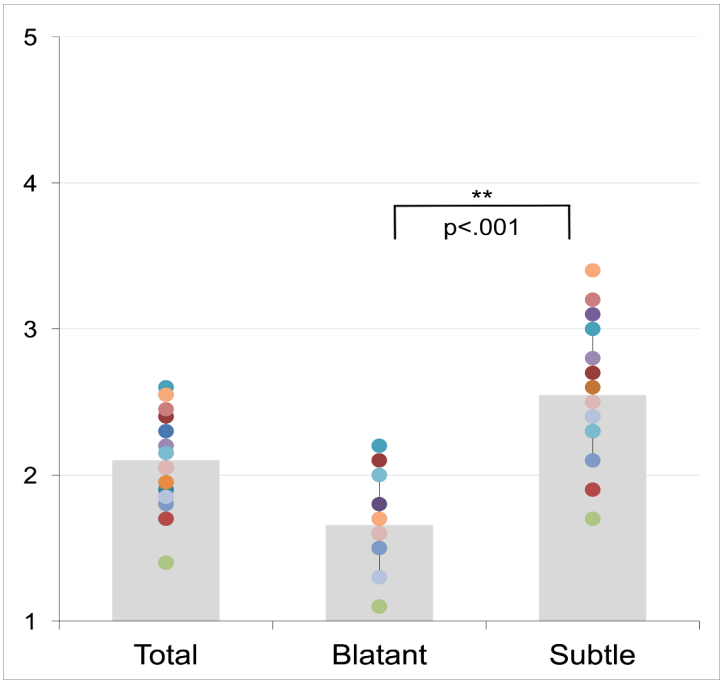

Figure 2.2. *Subtle and Blatant Prejudice Scale. Responses to the questionnaire were provided on a 5-point Likert scale where 5 indicated maximum prejudice and 1 minimum prejudice. The response given to the implicit scale (subtle) were on average significantly higher than those provided at the explicit level (blatant scale).*

2.3.3 N400 response (300-500ms).

The ANOVA performed on the N400 amplitude recorded over the anterior-frontal electrodes AFF1, AFF2, AFZ and FZ in the 300-500 ms time window, revealed a significant effect of condition (Congruent, Incongruent, Neutral) ($F(2, 36) = 5.23$, $p < 0.05$, $\varepsilon = 1$, $\eta p^2 = 0.23$). As visible in figure 2.3 and 2.5, a greater negativity was recorded in response to incongruent terminal words (violating ethnic stereotypes) (0.93 μV, SE = 0.47) compared to Congruent (1.73 μV, SE = 0.45) and Neutral (1.60 μV, SE = 0.41) terminal words.

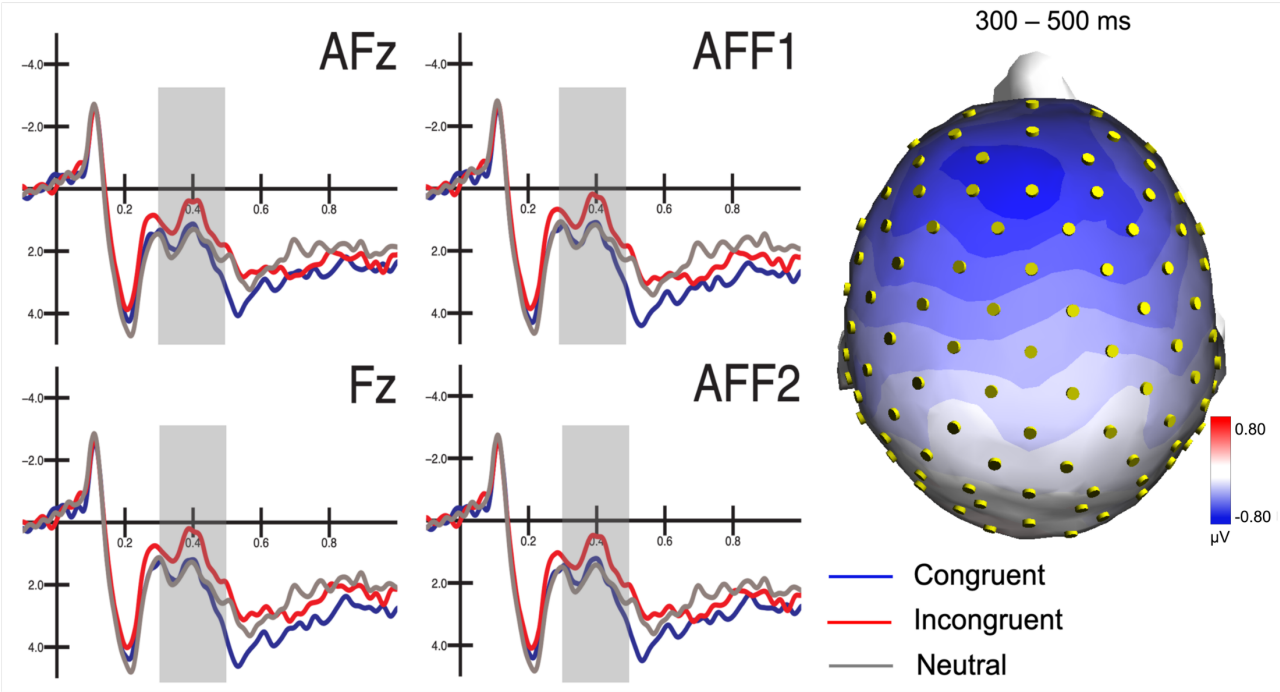

Figure 2.3. *ERP waveforms recorded at anterior sites in response to the three stimulus types. On the left is displayed the topographical distribution (top view) of the differential voltage (Incongruent – Congruent) recorded between 300–500 ms post-stimulus, corresponding to the N400 time-window.*

2.3.4 Correlation between neurophysiological data and racism questionnaire.

The correlation between the individual score obtained at the implicit (Subtle) prejudice scale and the individual Difference Wave computed by subtracting the response to the Congruent condition from the one evoked by Incongruent condition in the N400 time window showed a moderate linear correlation, visible in figure 2.4, on the frontal electrodes AFF2 ($r = -0.46$, $p = 0.048$) and AFZ ($r = -0.47$, $p = 0.043$). Correlations were statistically-significant before correction for multiple comparisons but not after. The larger the Difference Wave amplitude, the higher the implicit prejudice scores of participants at the questionnaire.

In turn, no significant correlation was found between the N400 DW values and scores obtained at the explicit (Blatant) prejudice scale.

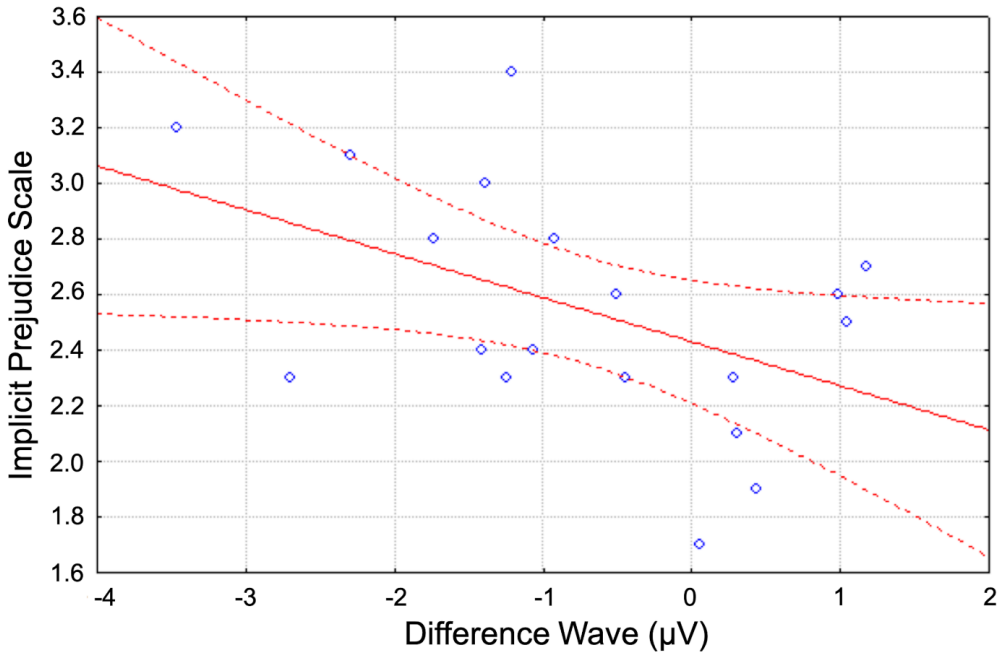

Figure 2.4. *Correlation between neurophysiological data and racism questionnaire. The figure shows the correlation between the average individual scores obtained at the implicit racial prejudice scale and the individual difference-wave amplitudes (Incongruent minus Congruent) recorded on the anterior-frontal electrode AFZ in the N400 latency range.*

2.3.5 P300 response (500-600ms).

The ANOVA performed on the P300 component amplitude values, measured in the 500-600 ms time window over the electrodes AFF1, AFF2, AFZ and FZ, revealed a significant effect of condition (Congruent, Incongruent; Neutral) ($F(2, 36) = 8.66$, $p < 0.001$, $\varepsilon = 1$, $\eta p^2 = 0.32$) with a larger P300 to Congruent (3.61 μV, SE = 0.43) than Incongruent (2.54 μV, SE = 0.41) and Neutral terminal words (2.74 μV, SE = 0.45). The ANOVA also showed a significant effect of the electrode ($F(3, 54) = 3.92$, $p < 0.05$, $\varepsilon = 1$, $\eta p^2 = 0.18$) indicating that the positivity measured was greater over the electrodes AFF1 (2.97 μV, SE = 0.38), AFF2 (3.07 μV, SE = 0.40) and FZ (3.11 μV, SE = 0.40) than the one measured on the electrode AFZ (2.71 μV, SE = 0.44). The effect is visible in figure 2.5 A and B.

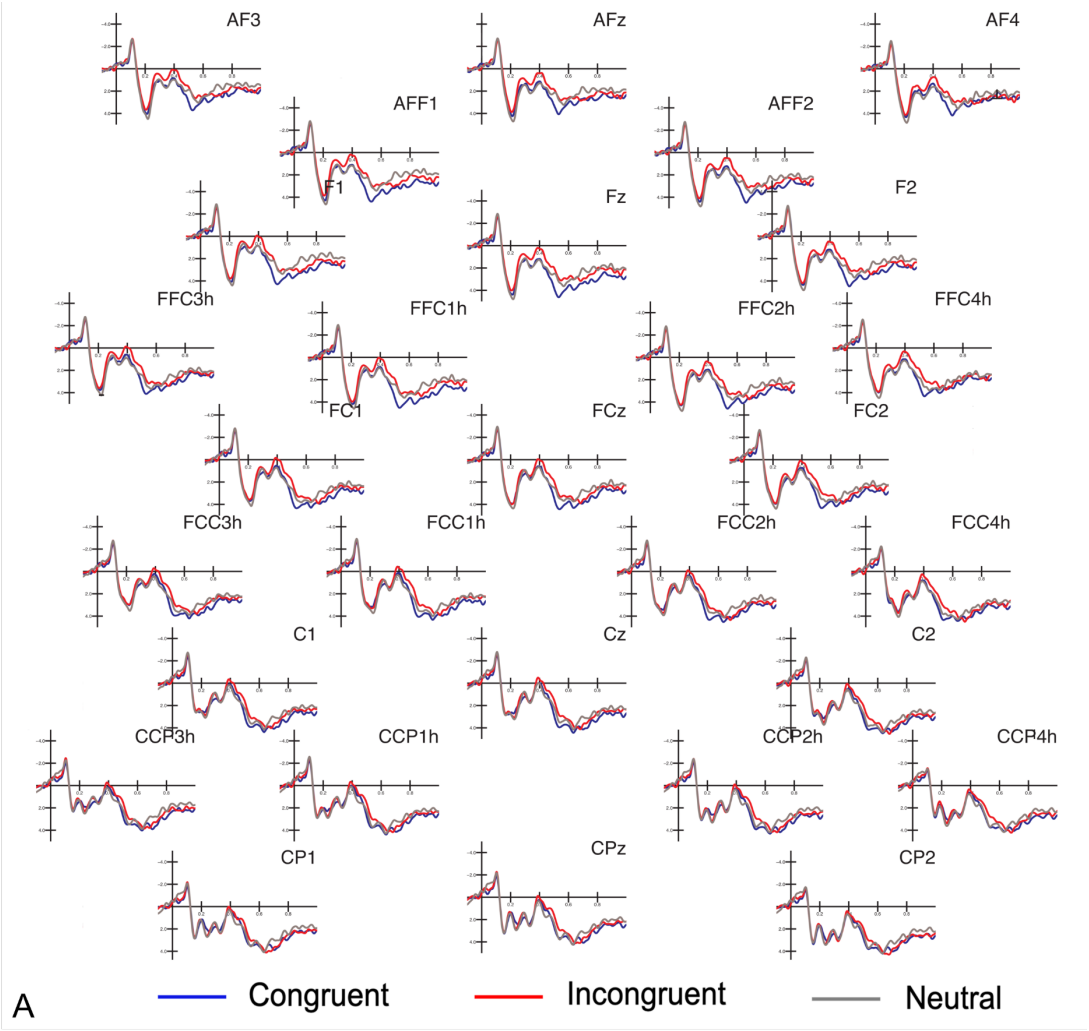

Figure 2.5. *A. Grand-average ERP waveforms recorded at anterior, frontal and central sites in response to Incongruent, Congruent or Neutral sentences with respect to ethnic stereotypes.*

2.3.6 Frontal positivity (650-800ms).

The ANOVA performed on the frontal positivity (fLP) amplitude values measured between 650-800 ms over the anterior electrodes AF3, AF4, AFF1, AFF2 and AFZ showed a significant effect of condition ($F(2, 36) = 4.62$, $p < 0.05$, $\varepsilon = 1$, $\eta p^2 = 0.20$), revealing a greater anterior-frontal positivity in response to Congruent (2.57 μV, SE = 0.49) and Incongruent (2.42 μV, SE = 0.39) compared to Neutral terminal words (1.77 μV, SE = 0.48).

The ANOVA also showed a significant effect of electrode ($F(4, 72 = 8.69$, $p < 0.001$, $\varepsilon = 1$, $\eta p^2 = 0.33$), with greater frontal positivity amplitudes over anterior frontal (AF4: 2.39 μV, SE = 0.42; AFF1:

2.34 μV, SE = 0.44; AFF2: 2.51 μV, SE = 0.42) than anterior frontal electrodes (AF3: 1.84 μV, SE = 0.43; AFZ: 2.16 μV, SE = 0.44).

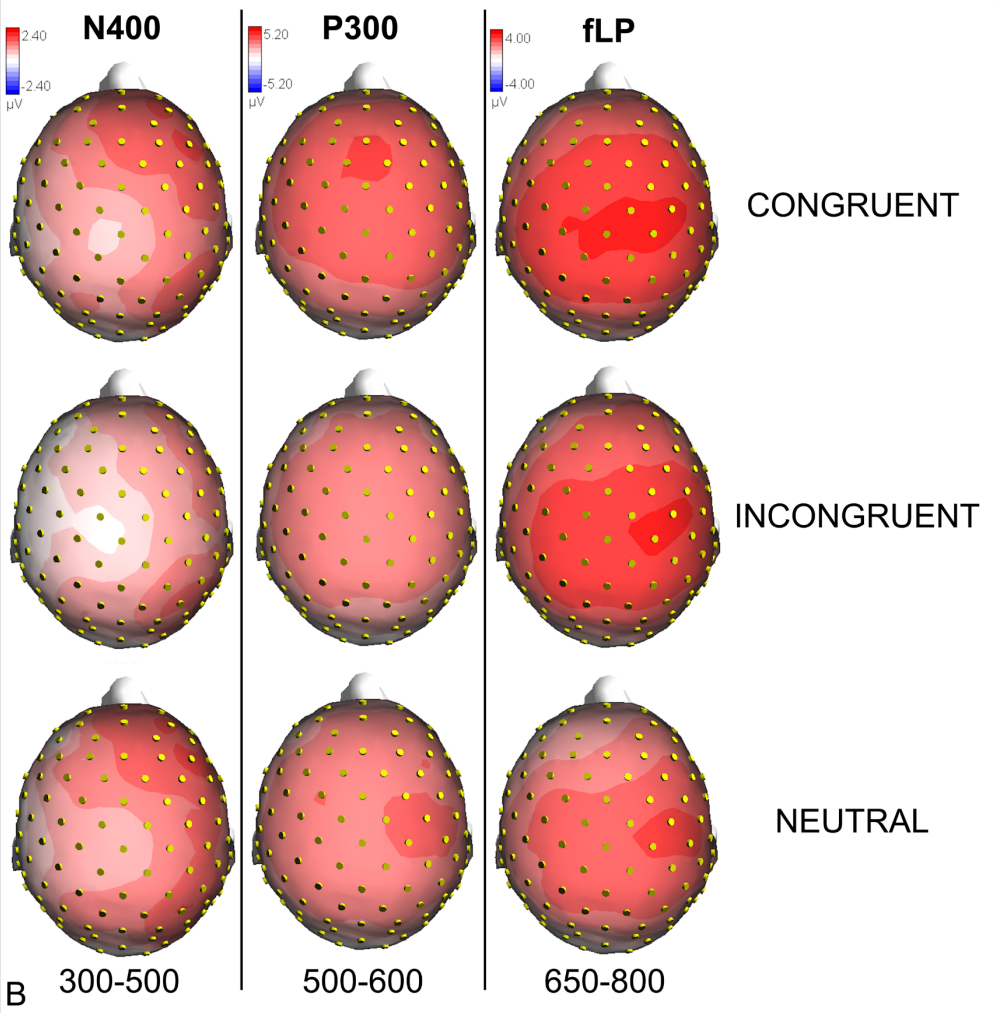

Figure 2.5 *B. Isocolor topographical maps showing the voltage distribution of brain potentials in the time windows corresponding to N400 (300-500 ms), P300 (500-600 ms) and frontal positivity (650-800 ms) peaks.*

2.3.7 swLORETA.

The swLORETA inverse solution, computed on the Difference Wave obtained by subtracting ERP waveforms elicited by Congruent stimuli from that induced by Incongruent stimuli in the time window between 300 and 500ms, allowed us to identify the intracortical generators of the N400 component, as visible in figure 2.6. In Table 2.2 are listed the significant electromagnetic dipoles explaining the

different voltage, ordered as a function of magnitude (in nA). The most active sources were the left Inferior Temporal Gyrus (ITG) (BA 20), the right Medial Frontal Gyrus (MFG) (BA 10), the Inferior Parietal Lobule and the Inferior Frontal Gyrus.

Magnitude	T-x	T-y	T-z	Hem.	Lobe	Gyrus	BA
6.33	**-59**	**-9**	**-22**	**L**	**T**	**Inferior Temporal**	**20**
5.27	-58	-35	-16	L	T	Inferior Temporal	20
5.13	51	-1	-28	R	T	Middle Temporal	21
6.25	**41**	**55**	**7**	**R**	**F**	**Middle Frontal**	**10**
5.92	-29	53	25	L	F	Superior Frontal	10
5.85	-29	55	7	L	F	Middle Frontal	10
5.77	-59	-40	25	L	P	Inferior Parietal Lobule	40
4.55	61	14	13	R	F	Inferior Frontal	44
4.46	51	-34	-24	R	T	Fusiform	20
3.97	-19	-97	-13	L	O	Lingual	18
3.73	-39	-86	-12	L	O	Inferior Occipital	18
3.26	21	-97	-13	R	O	Lingual	18

Table 2.2. *Source reconstruction of N400 response to stereotype violation. Talairach coordinates and localization of the active electromagnetic dipoles explaining the surface voltage (incongruent – congruent) recorded in the 300-500 ms time window, according to swLORETA inverse solution. Hem=Hemisphere; BA= Brodmann areas; T=Talairach; R=right; L=left.*

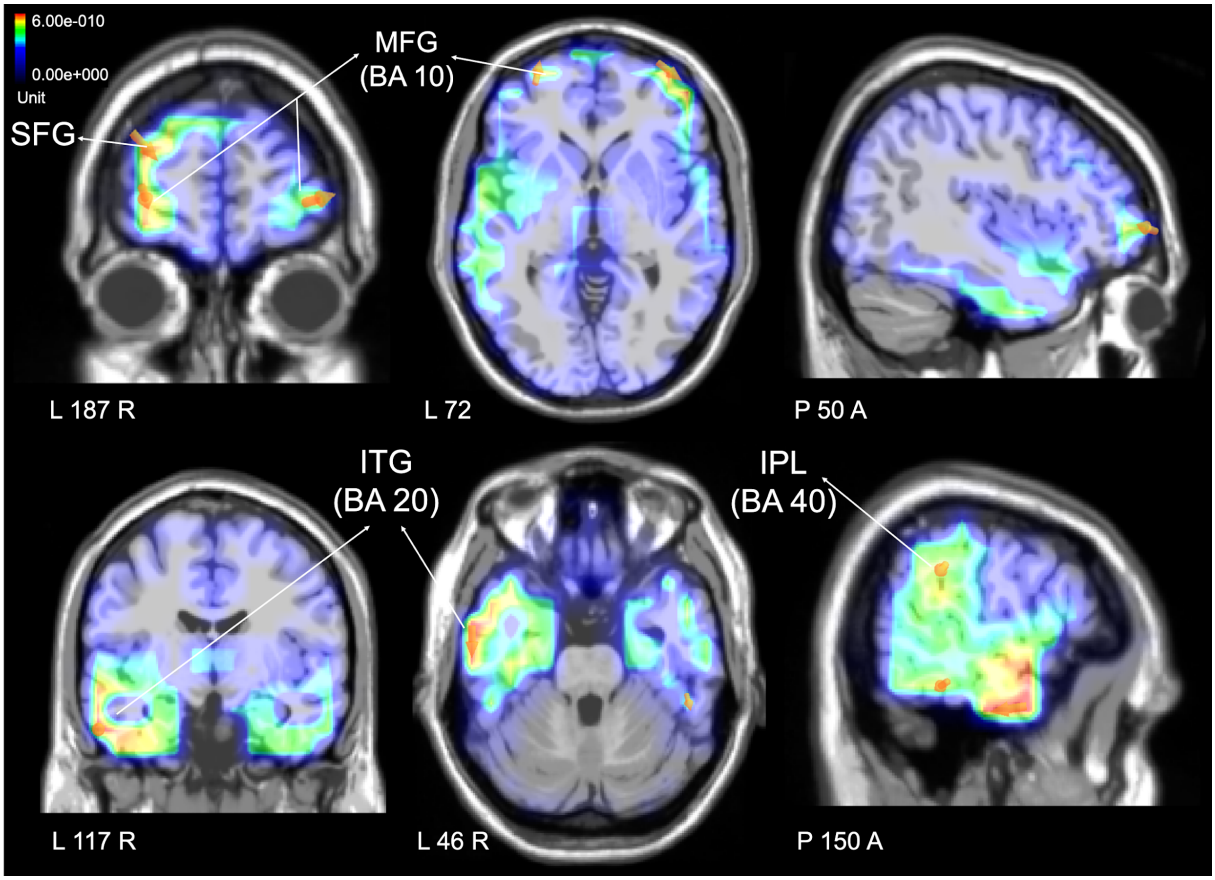

Figure 2.6. *swLORETA. Coronal, Axial and Sagittal views of the active sources relative to the incongruent minus congruent ERP difference-waves recorded in the 300–500 time-window, which corresponds to the N400 peak, according to swLORETA analysis. The most active brain areas engaged in representing racial prejudice were the left Inferior Temporal Gyrus (ITG, above) and the right Middle Frontal Gyrus (MFG, below).*

2.4 Discussion

The aim of the study was to investigate the timing and neural mechanisms underpinning the activation of implicit mental representations related to ethnic stereotypes. By means of EEG/ERPs, neural activity of participants was recorded during a sentence reading task involving stimuli that evoked mental representations that were either congruent, incongruent or neutral on regard of racial preconceptions.

The data showed a strong effect of stimulus incongruence (reflecting the presence of ethnic prejudices) on the amplitude of N400 response (300-500ms). Indeed, a greater negativity was found

in response to terminal words violating ethnic stereotypes, compared to words that confirmed them or were neutral in this regard. Although a small portion of the ERP literature questions the measurement of ERPs at the final word of a sentence, because of the possible effects of sentence wrap-up, the review by Stowe et al. (2018), largely support this methodology revealing that ERP responses to violations are not affected by this positivity. As well known in the electrophysiological literature, the N400 component is a negative deflection usually recorded at centro-parietal regions that is related to a difficulty in integrating incoming semantically incongruent information with previous knowledge (Kutas & Hillyard, 1980). In the present case, the N400 was measured over frontal regions and possibly reflected the violation of meanings mediated by context and by social knowledge. It can be hypothesized that N400 reflected a difficulty in integrating the linguistic information incongruent with pre-existing stereotypical knowledge about ethnic groups (Hagoort *et al.,* 2004). Hence, it is possible that the unusual association of positive values to characters whose ethnicity is more often linked to stereotypical negative assumptions (e.g. an African neurosurgeon leading a surgery team) were able to surprise the reader, as if it were an anomaly of a pre-established social rule.

In the assumption that stereotypes are a peculiar set of semantic associations stored in memory and belonging to the social cognition domain (Dovidio *et al.,* 1986) the pattern of N400 results is in line with numerous electrophysiological studies showing how incongruities between stereotypically associated social concepts elicit enhanced N400 component. Although the N400 distribution is typically found at centro-parietal sites (Kutas and Hillyard, 1980; Hagoort et al., 2004), in several studies the N400 was found to have a frontal distribution (Proverbio et al., 2017, 2018, 2020; White et al., 2009; Hehman et al., 2014; Wang et al., 2011; Correll et al., 2006; Zhang et al., 2015). Indeed, an anterior distribution of N400 responses (recorded at frontal and fronto-central sites) was found to be elicited by violation of ethnic prejudices (e.g., Hehman et al., 2014; Wang et al., 2011; Proverbio et al., 2020) and gender prejudice (Proverbio et al., 2017; 2018). The different and more anterior topographical distribution is possibly related to the role of the medial frontal cortex in representing social information about people such as prejudices and stereotypes, thus involving social information

rather than purely semantic one (Mitchell et al., 2006; Freeman et al., 2010; Amodio, 2014; Proverbio et al., 2017, 2018). Similarly, a frontal distribution for N400 was detected in the present investigation. On the other hand, it is worth mentioning an interesting line of research on event-related potentials and social prejudice that focuses on the negative slow wave (NSW), a component typically prominent over central or fronto-central electrode locations that has been associated with the implementation of self-regulatory cognitive control processes (Bartholow et al., 2006). Indeed, according to Bartholow and Amodio (2009), an anterior slow negative wave is a component associated with self-regulation processes and may reflect a behavioural response rather than the processing of a stimulus, such as controlling racial bias.

Nonetheless, because of its sensitivity to violations of social representations, the N400 can be regarded as a possible marker of social bias. Its onset has been associated with the inconsistency of the target with the previous context (prime) and the violation of individual expectations when the incoming information cannot be integrated with existing knowledge (Proverbio, 2008). Hehman and colleagues (2014) concluded that the reactivity of the N400 to congruent and incongruent prime-target associations was an index of both stereotype accessibility and interracial prejudice. In their study, a N400 response was measured when a face prime (Caucasian or Afro-American) was incongruent with the target trait (positive or negative) but not when primes and traits matched.

Moreover, as in our study, the N400 activity was evident despite the fact that stereotypes were unrelated to the experimental task, demonstrating that the N400 can be used as measure of stereotype accessibility bypassing social compliance issues. Although a possible limit of the present study relies in the lack of a post-study manipulation check to asses that subjects could not guess the aim of the study and were actually unaware of its purposes, it is reasonable to believe that the presence of a fictitious experimental task distracted participant and allowed to overcome compliance and desirability issues.

Indeed, in the present study it was assumed that the experimental task, that was detecting animal names, was stereotype-unrelated. Nonetheless, in the social psychology literature it is known that members of an out-group are frequently dehumanized or infra-humanized, often associating them

to animals or inanimate features. Thus, the task might have involuntarily focused participants' attention toward animals leading possibly to an uncontrolled effect in the results.

In line with our results, also Wang and colleagues (2011) showed through a priming paradigm that the N400 was modulated by the congruent or incongruent association between stereotypical attributes and pictures of Chinese rural workers compared to city dwellers, revealing a stereotype effect. Similarly, Jin and colleagues (2017) used the N400 response in a priming paradigm as an index to assess the presence of stereotypes towards the Uyghurs minority in China. Numerous similar evidences have been collected also in studies concerning gender stereotypes (e.g. Osterhout et al., 1997; White et al., 2009; Proverbio et al., 2017, 2918).

These studies altogether support the idea that, since humans automatically associate certain social categories to specific characteristics, the onset of the N400 would constitute an index of incongruent association between different characteristics and groups, that are not well represented in the social semantic memory unlike stereotypes, which in turn are more accessible congruent associations (Amodio, 2014; Contreras et al*.,* 2012).

The N400 response, implying the implicit activation of automatic associations of predetermined characteristics to specific social groups (Osterhout et al., 1997; Bartholow et al., 2001; Hehman et al., 2014; Wang et al., 2011; White et al., 2009; Proverbio et al., 2017, 2018), seems disjoint to explicit racial beliefs. Indeed, in this study a N400 reactivity was measured despite participants overall expressed equalitarian beliefs towards immigrants as assessed by the Subtle and Blatant Prejudice Scale. Although the scores obtained at the Blatant and Subtle scales differed from each other, revealing a slightly higher ethnic bias in the implicit scale, they were nonetheless medium to low in both cases (below 3 in a 1-5 scale). Therefore, considering that the sample of participants did not include subjects with high explicit racial bias, it is reasonable to hypothesize that the N400 amplitude measures didn't correlate with blatant prejudice for an inability to discriminate between participants' low scores. Stereotypical associations, that were effectively detected by EEG/ERP, are grounded in the cultural substrate of our society and are embedded in our common knowledge of the world regardless of consciously and actively learned values (Devine, 1989; Amodio, 2014). N400 amplitude measures showed a moderate correlation with the scores obtained at the questionnaire

scale measuring implicit, and not explicit, racial prejudice. When used in concert with behavioural measures, ERPs have provided researchers with a more complete approach to the study of cognitive processes (Coles, 1989). Other studies have found a correlation between electrophysiological measures and behavioural ones, supporting the ability of EEG/ERPs to overcome problems related to social desirability pressures and explicit self-report measures (Phelps et al., 2000; Hehman et al., 2014; Izuma et al., 2019).

Heheman and colleagues (2014), for instance, found a strong relationship between the N400 activity in response to incongruent stereotypes and racial prejudice self-report measures and the Implicit Association Test. Indeed, similarly to the present study, they observed a correlation between the N400 amplitude and the explicit bias of the participant. Also a neuroimaging study by Phelps and colleagues (2000) showed a correlation between the activation threshold of the amygdala when viewing Black and Caucasian faces and the results of the Implicit Association Test, allowing indirect and unaware measures of ethnic bias. The authors of the present study are aware of the risks of observing spurious correlations in a reduced sample, nonetheless these data together with previous evidences, highlight the importance of applying implicit behavioural and electrophysiological measures when addressing sensitive topics such as social stereotypes and prejudice.

The swLORETA inverse solution applied to the difference-wave (incongruent minus congruent) identified the main neural generators of the anterior N400 in the Inferior Temporal Gyrus (BA 20) and the Middle Frontal Gyrus (BA 10), which are known to be part of the social cognition network (Mitchell et al., 2006; Amodio and Frith, 2006) and to support processing and retrieval of information about other people and impression formation (e.g. Mitchell et al., 2006; Quadflieg et al., 2009; Proverbio et al., 2017).

According to the neuroimaging literature, the left inferotemporal cortex, together with the inferior frontal gyrus, is a brain region critical for general semantic knowledge (e.g. Bookheimer, 2002; Martin, 2007). As stereotypes are thought to reflect conceptual associations between social groups and a set of attributes, such associations are supposed to reside in regions of the lateral temporal lobe that underpin semantic memory (Quadflieg et al., 2009; Patterson et al., 2007; Quadflieg et al., 2011). Moreover, the anterior temporal lobe (ATL), which comprises also the anterior portion of the

Inferior Temporal Gyrus (ITG), has been shown to be implicated specifically in the representation of social knowledge such as information regarding other people (Zahn et al., 2007; Olson et al., 2013), including stereotype representations (Quadflieg et al., 2009; Proverbio et al., 2017; Contreras et al., 2012). For instance, Gallate and colleagues (2011) revealed by means of non-invasive brain stimulation that the ATLs play a contributory processing role in stereotyping, being it a semantic association process. Moreover, as suggested by Amodio (2014), the interacting communication of the ATL with regions of the medial prefrontal cortex (mPFC), that are involved in impression formation processes (Mitchell et al., 2006), could represent a network supporting social cognition processes, where information represented in the ATL is selected and used into mPFC to make inferences about other people.

Indeed, the second most powerful source (in order of magnitude) in our study was the right Medial Frontal Gyrus (BA 10) that, as part of the mentalizing network together with the TPJ, STS, precuneus and ATL (Saxe, 2006), is known to be involved in processes of attributing personal traits, mental states and intentions to others (Proverbio et al., 2016, 2018; Mitchell et al., 2006; Mahy et al., 2014; Milne et al., 2001). Moreover, this brain region has been implicated specifically in studies on gender and racial stereotyping, for example when inferring personal traits of people belonging to a minority group (Freeman et al., 2010), making stereotype-based judgements (Gilbert et al., 2012), representing social information that refers to others such as outgroup stereotyping (Mitchell et al., 2006) and representing negative gender biases related to the processing social attributes and occupational stereotypes (Proverbio et al., 2017; 2018). For instance, Mitchell and colleagues (2006) used functional neuroimaging while participants were required to make inferences about others mental states when the “other” was similar or dissimilar to oneself on regard of socio-political views. They observed that mentalizing about a similar other engaged a region of ventral mPFC linked to self-referential thought, whereas mentalizing about a dissimilar other engaged a more dorsal subregion of mPFC.

Other significantly active areas were the Inferior Parietal Lobule and the Inferior Frontal Gyrus, notoriously implicated in social cognition and Theory of Mind processes (Frith & Frith, 2001; Saxe, 2010).

While the N400 would represent the difficulty of integrating incoming information with pre-existing knowledge (Hehman et al., 2014; Wang et al., 2011; White et al., 2009; Proverbio et al., 2017, 2018), the P300 response is thought to represents an index of cognitive updating (Dovidio, 1986; Donchin et al., 1988; Sommer et al., 1998; Patel et al., 2005; Proverbio et al., 2008).

The present data showed that P300 component, reaching its peak between 500 and 600 ms at anterior frontal regions, was larger to sentences that were congruent rather than incongruent with ethnic bias. Congruent sentences (such as for example “The Chinese army is very obedient” or “The Polish lady works as a caregiver”) were coherent with previous subjective knowledge and mental stereotypical representations, therefore eliciting a greater P300 response. This result matches what was firstly suggested by Donchin and Coles (1988) and later corroborated by several studies (Freunberger and Roehm, 2016; Roehm et al., 2007; Molinaro and Carreiras, 2010; Vespignani et al., 2009) where the integration of expected information that was pre-activated by previous context into mental representations was reflected in the P300. In this vein, the P300 component reflects the detection of anticipated semantic information.

Moreover, these results are in line with what was found by Correll and colleagues (2006) in their study on racial bias where a greater anterior P300 was found in response to Black armed subjects compared to White armed individuals, indicating an automatic mental association between Black people and the use of weapons.

Finally, the present study found a larger anterior frontal positivity (fLP) in the time window between 650 and 800 ms, in response to phrases concerning ethnic groups different from that of the participants (Caucasian ethnicity). This effect seems to reflect an ingroup-outgroup discrimination with regard to ethnicity (Other Race Effect, ORE). Indeed, late positive potential (LPP) has been regarded as a relevant measure for affective processing and arousal in several studies (for a review, Weinberg et al. 2013). Herbert and colleagues (2007) argued that all kinds of emotional stimuli, even abstract and symbolic ones such as words, as part of our evolutionary heritage have an automatic and preferential processing. The authors investigated the influence of emotional content in reading and found an enhanced positive potential in response to pleasant adjectives compared to unpleasant and neutral ones. Rostami et al., (2015) found that high-arousing and positive valenced words

induced a larger LPP than low-arousing and negative valenced words, while Naumann and colleagues (1992) investigated the influence of structural and emotional processing and found that a fronto-central positive slow-wave was an index of affective processing functions.

In the present study, the frontal positivity was elicited by sentences depicting other-race individuals compared to own-race persons, reflecting a differential processing of concepts based on characters' race, possibly due to the emotional and arousing value of such stimuli. Indeed, this result matches what was found in the described researches and several additional studies which showed the impact of the emotional dimension on the LPP regardless of the stimulus value. For instance, Fischler and Bradley (2006) reviewed that an LPP sensitive to arousal (larger for pleasant and unpleasant compared to neutral words) was generally found during semantic evaluative tasks.

Moreover, the late positivity has been used to study social biases and ingroup/outgroup classification (Hurtado et al., 2009; Crites et al., 2010) in a study by Hurtado and colleagues (2009), where ERPs were recorded while indigenous and non-indigenous participants performed an IAT, categorizing faces (ingroup and outgroup) and words (positive and negative). The authors found a late positivity modulation in frontal areas in response to word stimuli that were compatible with prejudice towards Indigenous, only in Indigenous participants. These results suggested that the late positivity was sensitive to the arousal value of the stimuli, relevant according to membership type and compatible with prejudice.

This effect can be ascribed to a Other Race Effect, a phenomenon uncovered by cognitive psychologists who firstly highlighted that the ethnicity of the perceiver can influence cognitive processes, such as face encoding (Caldara et al., 2009; Ge et al., 2009; Ratner et al., 2013).

A further interpretation, might trace these later positivities to post-N400 positivities (PNP) with a frontal distribution (Van Petten and Luka, 2006; Federmeier et al., 2007; DeLong and Kutas, 2020;) given their frontal distribution and timing after the N400. PNPs are increasingly studied in linguistic prediction and researches suggest that post-N400 positivities, having an anterior scalp distributions, may occur when a surprising information overtakes a highly expected predictable. Van Petten and Luka (2012) reviewed several studies on sentence comprehension, which generally showed that frontal PNPs were associated to the contextual plausibility of unexpected sentence continuations,

such as unexpected plausible words (DeLong et al., 2012; Federmeier et al., 2007). Moreover, Ness (2018) linked the anterior PNP to an inhibitory process during context interpretation that may occur when congruent unexpected sentence continuations appear.

This interpretation may apply to our results considering that terminal words in sentences concerning other ethnicities (congruent and incongruent with stereotypes) created an overall unexpected context but were nonetheless considered plausible, in contrast to ethnic-neutral sentences. Such positive effect was mainly encountered early (500-600ms) in response to stereotype-congruent sentences highlighting the plausibility, although unexpected, of discriminatory sentences.

2.4.1 Conclusions

The N400 paradigm used in this study allowed to implicitly access the representation of social attributes such as racial stereotypes avoiding the activation of control processes related to prejudice suppression and inhibition caused by social desirability instances.

Moreover, the study revealed a correlation between electrophysiological measures and behavioural ones in the implicit assessment of racial stereotypes, suggesting that, when used jointly, these measures allow a more complete approach to the study of subtle cognitive processes.

Future studies should explore the possibility to modulate and regulate such deep and implicit stereotype knowledge and determine its impact on social behaviour.

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Chapter 3

3. Learning positive social information reduces racial bias as indexed by N400 response[2]

3.1 Introduction

Stereotyping is a cognitive process by which a specific set of attributes and beliefs is associated to a social group (e.g., Allport et al., 1954). Stereotypes are embedded within cultural systems and deeply impact how people interact with each other. They are learned and reinforced by numerous processes. They develop early in life, partly through associative learning processes (Rudman et al., 2007), so that even young children easily learn social stereotypes based on features that are salient for categorization such as gender, age, race or physical attractiveness (Bigler et al., 2006). If on one hand a key role is played by the influence and interactions with parents, friends and peer groups (Aboud et al., 1996; Shaller et al., 1999), the impact of media in the formation and maintenance of cultural stereotypes and prejudicial feelings toward out-groups seems to be preponderant (Brown, 1995). Several studies demonstrated that mainstream media has historically marginalized and underrepresented minority groups (Dill and Thill, 2007; Dixon and Linz, 2000; Ramasubramanian et al., 2007; 2014). For instance, researchers have suggested that the negative representation of African Americans and Latinos as criminal, aggressive and unintelligent in the media help reinforce hostile prejudice against these social groups (Dixon and Linz, 2000). Moreover, media representations have a strong impact on identity management strategies. Saleem et al. (2019) revealed that Muslim American students who viewed negative media representations of their religious group were less likely to desire acceptance by other Americans and more likely to avoid

[2] Adapted from Brusa, A., Pesič, A., & Proverbio, A. M. (2021). Learning positive social information reduces racial bias as indexed by N400 response. *Plos one*, *16*(11), e0260540.

interactions with majority members. Overall, stereotypes are often embedded in the cultural system people are immersed in and are shared within a given culture (Madon et al., 2001*)*.

Once established, stereotypes become hard to deconstruct and they can influence people's lives in a variety of ways, shaping attitudes (prejudice) and behaviours (discrimination), influencing for instance academic performance, career choices and salary gap.

Researchers have developed several techniques to improve attitudes toward outgroups that have been found to be effective. Kawakami and colleagues (2000) found that students who practiced responding in nonstereotypical ways to members of other groups became better able to avoid activating their negative stereotypes on future occasions. Moreover, when people are exposed to or are invited to think about counterstereotypic persons, for instance strong women (Blair et al., 2001) or Black role models (Bodenhausen et al., 1995), they became less prejudicial towards that social group.

Allport (1954) provided one of the first contributions in understanding what are the conditions that allow stereotypes to be modulated and prejudices to be reduced in the publication "The nature of prejudice". He formulated the "Contact Hypothesis", according to which to reduce prejudices and hostilities it is best to encourage contact between members of different groups. Allport additionally identified a series of conditions to be met so that contact can produce positive effects (e.g., Equality of status, Social and institutional support, Pleasant contact and Intergroup cooperation in order to achieve a common goal).

Following this line of thoughts, if on the one hand the media can reinforce certain prejudices and stereotypes, on the other they can be used as educational tool that can raise awareness and influence attitudes towards members of different social groups to reduce intergroup prejudices (Ramasubramanian et al., 2007; 2014; Paluck et al., 2009).

For example, Ramasubramanian and colleagues (2014) showed that activation of implicit racial stereotypes decreased when people were exposed to news stories disconfirming stereotypes and that there are media-based strategies to reduce accessibility to stereotypes. Also Soble and colleagues (2011) showed that a short video could modify the racial attitudes of white college students towards peers of colour. In the experimental design students were assigned to two

experimental groups: one group viewed a short documentary depicting the life of a Caucasian and an Afro American subject, followed by hidden cameras over the course of a day, the other group did not view any video. The authors found that the experimental group presented reduced prejudicial attitudes and reduced fear of minorities compared to the control group as assessed by the *Color-Blind Racial Attitudes Scale* (CoBRAS; Neville et al., 2000), the *Psychosocial Costs of Racism to Whites* scale (PCRW; Spanierman et al., 2004), and *the Quick Discrimination Index* (QDI; Ponterotto et al., 1995).

Because stereotypes often operate out of awareness, social psychologists and neuroscientists have developed methods for assessing them indirectly. Research using implicit measures suggest that stereotypes and prejudices are easily activated when we encounter members of different social groups (Barden et al., 2004).

To overcome issues related to social desirability, researchers have effectively studied the implicit activation of stereotypes at the brain level by means of EEG/ERPs. Several studies have shown that ERPs are sensitive to violations of race- and gender-based stereotypes (Hehman et al., 2014; Proverbio et al., 2017; 2018; Ibáñez et al., 2009; Amodio, 2014; Hagoort et al., 2004; Metzner et al., 2015; Correll et al., 2006; White et al., 2009; Wang et al., 2011; Amodio et al., 2014).

Specific attention has been paid to the N400 response, the negative deflection of the ERPs peaking around 400 ms, that indexes a difficulty in accessing and integrating incoming semantically incongruent information with previous knowledge (Kutas and Hillyard, 1980). The N400 response was found effective to explore the activation of conceptual/semantic associations related to world knowledge such as stereotypes using both visual or written stimuli (Hehman et al., 2014; Proverbio et al., 2017; 2018; Hagoort et al., 2004; Correll et al., 2006; White et al., 2009; Wang et al., 2011; Brusa et al., 2021; Kutas and Federmeier, 2011; Proverbio et al., 2009).

Moreover, the amplitude of the N400 response was found to be sensitive to several experimental manipulations. For instance, smaller amplitudes were recorded when the incoming information was more expected and therefore easier to process (Kutas and Federmeier, 2009).

Since sentence comprehension occurs accounting for one's knowledge, context and expectations deriving from prior knowledge can influence the processing of incoming information from the earliest

stages (Federmeier et al., 2000). Indeed, sentence comprehension can be facilitated when the right context is provided. For instance, Hald and colleagues (2007) investigated with ERPs the modulation of world knowledge comprehension by providing context. The authors found that when world knowledge incongruities (e.g. *The city Venice has many roundabouts and beautiful buildings*) were preceded by local context that made violations more acceptable (e.g., *The large and increasing amount of cyclists in the inner city of Venice had to be regulated. The city council decided 10 years ago to replace traffic lights with other road layouts that ease traffic flow*) the N400 was reduced compared to when the current discourse context accentuated the violation. The results fostered the claim that local discourse can modulate the integration of world knowledge information retrieved from memory.

Also Duffy and Keir (2004) investigated the effect of discourse context on processing of gender stereotypes during reading. After providing adequate disambiguating context, the effect of longer reading times in response to stereotype anomalies disappeared.

The modulation of the N400 effect by providing media-based context information was studied also by Jin and colleagues (2017). The authors explored the role of the media in emphasizing racial stereotypes, as reflected by the N400 effect. In particular, the authors studied the attitude of Han Chinese towards the Uygur minority using ERPs as an index of the cognitive and neural processes associated with the activation of stereotypes. The participants, all of Han ethnicity, were subdivided into two experimental groups: a priming group viewed a video that portrayed negative aspects of the Uygur group; while the control group didn't watch any video.

The paradigm consisted in the vision of unknown faces belonging to either the Han or Uygur ethnicity followed by a lexical decision task of positive or negative words, while recording EEG signal. The results showed that the priming group, who observed the video, unlike the control group, showed a greater N400 amplitude in response to positive adjectives associated with the presentation of Uygur faces compared to when the same faces were associated with negative adjectives.

The results demonstrated that negative media information might influence people judgments toward other groups and this effect is reflected in the deflection of the N400 amplitude.

As seen so far, previous literature has demonstrated that providing local context that is able to modulate expectation on the upcoming information and therefore facilitate the integration of semantic and social incongruities can modulate the N400 effect (Federmeier et al., 2000; Hald et al., 2007; Duffy and Keir, 2004; Jin et al., 2017). When considering social stereotypes, only few studies have investigated the role of local context on the N400 (e.g. Jin et al., 2017). Indeed, the study by Jin and colleagues (2017) demonstrated that local context provided in the form of media-driven information is able to play an influence on attitudes towards social groups modulating the N400 response. While their study showed that negative media driven information towards a social group can increase the N400 effect when associating the same social group to positive attributes, there aren't studies to our knowledge that have explored whether associating visual positive information to a social group could in turn reduce the N400 effect. Unlike the previously used paradigms, the emphasis here was on the possibility to measure a change in the representation of social attributes, due to the incoming of newly acquired knowledge. In other words, through the N400 paradigm we aimed at investigating whether it was possible to change mental ethnic stereotypes, by measuring their mutable effects, rather than just assessing their presence.

The paradigm used in the present study was similar to the one used in chapter 2 (Brusa et al., 2021) with sentences that could either violate (incongruent), non-violate (congruent) or be neutral with regard to stereotypical concepts concerning non-Caucasian ethnic groups. While our previous study allowed to implicitly access the neural representation of ethnic stereotypes avoiding the activation of control processes related to social desirability pressure, here the investigation aimed to confirm previous results and further explore, by means of EEG/ERPs technique, whether the previous exposure to positive and progressive social information about other-race members (e.g. Arabs, Africans, Asians, South Americans) in the form of a video documentary could modulate, in a group of Italian Caucasian participants, the access of such stereotypical representation, thus the detection of stereotypes incongruences in the subsequent sentence reading task, as marked by the N400 response.

It was hypothesized that, unlike participants in the control group who were exposed to a neutral video on flora and fauna, the participants exposed to the experimental video representing other-race

individuals associated to positive attributes (e.g. a Muslim activist marching for human rights or a Black Boeing's pilot), would present a smaller N400 effect in response to sentences that violated stereotypical assumptions compared to congruent and neutral sentences.

Based on studies on the influence of context on the N400 effect and the power of media to modulate stereotypical mental representation (Ramasubramanian et al., 2007; Paluck et al., 2009; Soble et al., 2011; Hald et al., 2007; Jin et al., 2019), it was hypothesized that watching a documentary could update, even if only temporarily, one's knowledge about the social world modulating their expectations, as revealed by the N400 effect.

As previously seen in several studies (e.g. Proverbio et al., 2017; 2018; Amodio, 2014, Brusa et al., 2021), the neural generators of the N400 response elicited by the violation of social stereotypes were hypothesized to reside in cortical structures that are involved in semantic knowledge and in brain regions connected to social cognition processes, such as the representation of social groups (e.g. ethnic groups), impression formation and processing and retrieval of information about other people (e.g. Proverbio et al., 2017; Brusa et al., 2021; Amodio and Frith, 2006; Mitchell et al., 2006; Freeman et al., 2010; Contreras et al., 2012). Indeed, the representation of stereotypes seems to be accompanied by the activation of some brain areas involved in mnemonic processes, in particular the temporal lobe (lateral and anterior) and the inferior frontal gyrus, and of areas belonging to the social cognition network, as the middle prefrontal cortex, the temporo/parietal junction, the superior temporal sulcus and the anterior temporal cortex (Proverbio et al., 2017;2018; Amodio, 2014; Brusa et al., 2021; Amodio, 2008; Saxe, 2010; Olson et al., 2013). Based on the previous literature we expected that the neural sources best explaining stereotype-dependent N400 potentials would involve regions of the social brain. The literature has especially highlighted the role of the right superior/medial frontal gyrus (SFG; BA 8) in representing social attributes and stereotypes (e.g., Amodio and Frith, 2006; Mitchell et al., 2006). While the typical semantic N400 response (which appears focused at centro/parietal scalp sites) seems to reflect mostly the activity of the anterior medial temporal lobe (AMTL) (e.g., McCarthy et al., 1995; Halgren et al., 2002), we hypothesized that the present anterior N400 would tap at social brain areas. Indeed N400 violations were not

semantic in nature but purely based on ingroup/outgroup social categorizations. The present findings will get further new lights on the cortical dynamics of social knowledge.

Moreover, as evidenced in our previous study (Brusa et al., 2021), the present study aimed to investigate post-N400 positivities related to congruence and language prediction (Van Petten et al., 2012; DeLong et al., 2020). Regardless of the group assigned, a P300 effect was expected to be found in response to sentences congruent with ethnic bias compared to incongruent and neutral ones, as already found in the previous study by Brusa and colleagues (2021). The P300 response, an index of contextual updating, has been shown to reflect the integration into mental representations of semantic information that was anticipated during sentence reading (Donchin, 1988; Roehm et al., 2007; Freunberger et al., 2016; Molinaro et al., 2010; Vespignani et al., 2009) and would fit the hypothesis that biased mental representations were more easily expected in the group of participants.

Furthermore, also replicating the results of our previous study (see chapter 2, Brusa et al., 2021), a late frontal positivity was expected to be found in both groups in response to sentences involving other-race individuals compared to own-race, neutral, characters. Indeed, the late positivity is a component sensitive to the emotional value of a stimulus and is commonly found in response to emotionally relevant and arousing stimuli compared to neutral ones (Cuthbert et al., 2000; Schupp et al., 2000; Rostami et al., 2016; Fischler et al., 2006; Herbert et al., 2008; Schacht and Sommer, 2009). For instance, Cuthbert and colleague (2000) revealed that emotionally arousing pictures evoked a larger positive amplitude compared to neutral ones, while Schacht and Sommer (2009), investigating the emotional influence on visual word processing, found a late ERP effect related to emotional (positive and negative) words processing compared to neutral ones. It was hypothesized here that sentences referring to OR individuals with either a stereotypical or counter-stereotypical content would be more emotionally relevant (thus evoking a larger frontal positivity) than own-race/neutral sentences.

3.2 Methods

3.2.1 Participants.

Forty (22 females, 18 males) volunteers aged between 18 and 35 years (M = 22.75, SD = 2.68) and ranging in education from 12 to 18 years of study (M = 16.15, SD = 1.46), participated in the experiment. Participants were randomly assigned to but demographically balanced across two experimental groups. The data from 4 participants were discarded for excessive recording artifacts. The final EEG data analyses therefore included thirty-six (n = 36) participants, of whom 18 (age = 22.59, SD = 2) belonging to the experimental group "People" and 18 (age = 22.50, SD = 3.29) to the control group "Nature". To avoid cultural differences, all volunteers were Italian by birth, Caucasian and with both Italian biological parents. They had normal or corrected-to-normal vision, were right handed as assessed by the Oldfield Inventory (Oldfield, 1971; M=0.89, SD=0.14) and reported no history of drug abuse or neurological or mental disorders.

Subjects were recruited through the Sona-System University portal and were granted university credits in exchange for their participation.

At the end of the experiment, participants were administered an adapted version of the Pettigrew and Meertens' Subtle and Blatant Prejudice Scale (see Arcuri and Boca, 1996 for the Italian translation), to assess the presence of racial bias towards immigrants. Response to the questionnaire were provided on a 5-point Likert scale ranging from 'Not at all' to 'Very much' according to the agreement with the statements presented.

All the participants expressed their understanding and written consent for the study according to the Declaration of Helsinki (BMJ 1991; 302: 1194), with approval from the University Ethics Committee (prot. n° RM-2019-178). Participants were informed of the general characteristics of the study (which was defined as an ERP study on reading). However, information about the study's hypotheses were only provided at the end of the experiment, minimizing the social desirability bias.

3.2.2 Stimuli for the video manipulation.

Prior to the EEG recording involving the language task, each subject, according to the experimental group assigned, was presented with one of two video documentaries, created *ad* hoc for the study using PowerPoint.

The two documentaries were comparable in the format, differing from each other only for the image content. They were featured the presentation of 95 colourful and copyright free-images, collected from the web. Each video lasted about 10 minutes (9'42'') and was musically accompanied by a romantic piano piece (Debussy -Arabesque N ° 1 -Arabesque N ° 2 -Clair De Lune).

The documentary presented to the experimental group (named "People of the world") showed images depicting the lives of multiple subjects belonging to various ethnic groups (e.g. Arabs, Afro-Americans, Roma) portrayed in situations and contexts violating discriminatory stereotypes (for instance, a female Afro-American astronaut at flight controls, a Muslim human rights activist during a protest, two Afro-American Airline pilots, an Arab woman wearing the hijab doing medical research, etc.). This type of "inverted bias" conformed to what was described in the incongruent sentences of the subsequent sentence reading task during EEG recording.

The control group viewed a documentary (named "Nature of the world") showing images depicting beautiful natural landscapes and different animal species, excluding human beings and their modified landscapes (for instance, a fjord landscape, two rabbits in a meadow, a seaside landscape, a goat climbing on alpine rocks, desert dunes, etc.).

3.2.3 Procedure for the video manipulation.

This manipulation occurred 20 minutes prior EEG recording. The video-documentaries were presented in free vision on a TV monitor placed at a distance of 100 cm, while people were comfortably seated and in the absence of any EEG recording at this stage. To monitor participants' attention while watching the documentary, they were instructed to watch the documentary attentively, because the content of the documentary would have been object of specific questions in a subsequent memory task, administered at the end of the video presentation. At this purpose, a paper and pencil questionnaire involving the mnemonic recall of some of the viewed content, based on 4 YES/NO questions (Table 3.1), was employed.

#	People Documentary	Nature Documentary
1	Is there an image of a woman throwing a basketball in the documentary? (Yes)	Is there an image of two rabbits in the documentary with their noses close together? (Yes)
2	Is there an image of a policeman in the documentary stopping a car on the street and looking at the driver? (Yes)	Is there an image of a dune in the desert with a palm tree in the foreground in the documentary? (Yes)
3	Is there an image of a woman on the beach cleaning a surfboard in the documentary? (No)	Is there an image of a rattlesnake in attack position in the documentary? (No)
4	Is there an image of a musician in the documentary while playing the saxophone in a club? (No)	Is there an image of a storm that hits the beach in the documentary? (No)

Table 3.1. *Example of questions related to the documentary content administered to participants right after the end of the video (memory test).*

3.2.4 Stimuli for the language task.

The linguistic task performed during EEG recording involved the reading of 285 sentences belonging to three experimental conditions based on their congruency in relation to typical ethnic stereotypes present in the Italian culture. The ethnic groups considered were various (Eastern Europeans, Arabs, Africans, Asians, South Americans, Roma) and were balanced between conditions.

The Congruent condition included 95 sentences that confirmed ethnic stereotypes, such as “Naadir is the leader of a group of REBELS ” (in Italian “Naadir è a capo di un gruppo di RIBELLI”); The Incongruent condition included 95 sentences that violated stereotypes expressing notions deviating from common prejudice; e.g., ‘‘Mustafa is part of a group of ALPINISTS” (in Italian: “Mustafa fa parte di un gruppo di ALPINISTI”); The Neutral condition included 95 sentences that expressed neutral concepts relative to Italian characters; e.g., “Mirco attends a group of ACTORS” (in Italian: “Mirco frequenta un gruppo di ATTORI”).

Sentences were created in a way so that the congruency with the prejudice was made explicit only at the very end by the terminal word.

Moreover, 24 extra sentences sharing the syntactic, semantic and lexical characteristics with the previous sentences acted as target stimuli. They all ended with an animal name as the terminal word (e.g. “That man was assaulted by a TIGER”, in Italian: “Quel signore è stato assalito dalla TIGRE”) for the fictitious experimental task.

The stimuli have been previously employed in another study by the present research group (34) and contextually balanced syntactically, semantically, lexically across conditions and validated in respect to common sense prejudices for the specific population (University students in the Milan metropolitan area).

For ERP averaging of all stimulus types, EEG epochs were time-locked to the terminal words.

3.2.5 Procedure for the language task.

Participants were blindly and randomly assigned to either the experimental (“People”) or the control (“Nature”) group by the researchers, preserving demographical balance across groups. Regardless of the group assigned, participants underwent the identical procedure that differed only for the documentary previously presented. After positioning the EEG headset, participants were invited to seat in an electrically and acoustically shielded cubicle at 100 cm from a PC screen and were asked to fixate its centre where a dot served as fixation point.

The experimental procedure involved two distinct subsequent sessions: the viewing of the documentary followed by the mnemonic recall questionnaire (without EEG recording) and the sentence reading task (with EEG recording).

In the first session, participants were provided written instructions that invited them to attentively watch the video documentary and later to answer a questionnaire. The documentary was presented on a PC screen using *Quicktime Player* and background music was reproduced through a pair of Sennheiser (202HD model) headphones. At the end of the presentation, the brief mnemonic questionnaire was provided (Table 3.1) and answers were collected to assess the attentive state of participants.

In the second session, where EEG signal was recorded during the sentence reading task, participants were instructed to sit relaxed but still, avoiding any head or body movements as well as ocular saccades and blinks.

Sentences were presented with *Eevoke v2.2* (ANT Neuro, Hengelo, The Netherlands) in a randomized order across 8 sequences of 2 min and 40 s each interspersed with a 30-s pause. Each sentence was presented for 1000 ms at the centre of the screen arranged in a maximum of three short rows and followed, after an ISI of 700 ms, by the terminal word which was presented for 1000 ms in uppercase. The ITI was 1200 ms. The average size of terminal words was 4.47 cm x 0.8cm, implying a visual angle of 2°33'40" x 2°33'40" (minimum length=1.5cm, maximum length = 7.9 cm). The text was printed in yellow on a grey background. An example is shown in figure 3.1.

The fictitious task consisted of responding as quickly and accurately as possible to the terminal word of sentences when it contained an animal name, by pressing a joypad key with the index finger of the right or the left hand. The response hand was alternated across trials. Participants were unaware of the overall study purposes and no judgement about stereotypes was required. Response time to target terminal words was recorded only to control the attentive state and accuracy of participants.

Two training runs were administered to participants to allow them to familiarize with the procedure. A longer pause was allowed at about half the recording time. Each experimental sequence started with the presentation of 3 warning signals of 700 ms of duration (''Ready, Set, Go!") and ended with ''thank you" word on the screen. Both the warnings and thanks were typed in uppercase characters. At the end of the second session, participants were administered the Subtle and Blatant Prejudice Scale.

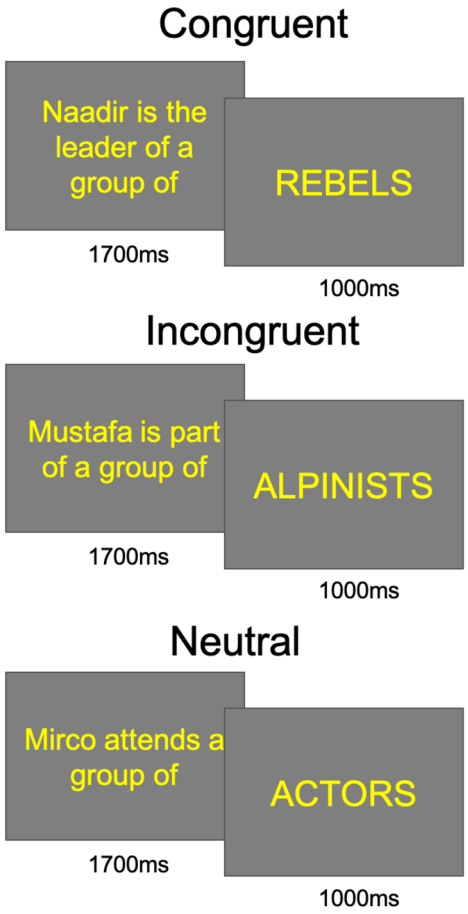

Figure 3.1. *Experimental paradigm. Example of Congruent, Incongruent and Neutral sentences used in the language task. ERPs were time-locked to terminal words which were presented in uppercase for 1000 ms.*

3.2.6 EEG recording and Analysis.

EEG data were recorded using a standard EEG cap with 128 electrodes located according to the 10–5 International System (Oostenveld and Pastrama, 2001) using *EEProbe v2.2* software (ANT Neuro, Hengelo, The Netherlands) at a sampling rate of 512 Hz (band-pass 0.016-70 Hz). Horizontal (hEOG) and vertical (vEOG) eye movements were also recorded and linked mastoids served as the reference lead. Electrode impedance was maintained below 5 KOhm. Computerized artefact rejection and manual eye-inspection was performed to remove EEG segments contaminated by ocular artefacts (saccades and blinks), muscle-related potentials, or amplifier blockages. The computerized artefact rejection criterion was a peak-to-peak amplitude exceeding 50 μV. The

rejection rate was ~18% in both groups and the average number of trials per condition that went into ERP averaging was 77.58 for congruent, 78.47 for incongruent and 77.86 for neutral.

EEG epochs were synchronized with the onset of the terminal word. Evoked response potentials (ERPs) were averaged off-line from 100 ms before to 1000 ms after stimulus onset and an off-line filter (band-pass 0.16-30 Hz) was applied to the ERPs.

The mean amplitude area of the N400 response was recorded from anterior, frontal and fronto-central sites (AFz, Fz, FCz) in the 350- to 550-ms temporal window. The mean amplitude area of the P300 was recorded from anterior and fronto-central sites (AFF1, AFF2, AFz, Fz, FCz) in the 500-600-ms time window. The mean amplitude area of the frontal positivity was recorded from anterior-frontal sites (AF3, AF4, AFF1, AFF2, AFz) in the 650- 800-ms time window. ERP analyses were performed using *EEprobe v2.2* software (ANT Neuro, Hengelo, The Netherlands). The electrode clusters and time windows were selected on the basis of previous literature (Hehman et al., 2014; Proverbio et al., 2017; 2018; Correll et al., 2006; White et al., 2009; Wang et al., 2011; Brusa et al., 2021; Zhang et al., 2018) and on where they matched the strongest scalp recorded activity of N400, P300 and frontal positivity potentials.

For each ERP component, the mean area amplitude values were subjected to repeated-measures ANOVAs whose factors of variability were group ("People", "Nature"), condition (congruent, incongruent, neutral) and electrode (depending on the component of interest). Fisher post-hoc comparisons were used. The effect size for the statistically significant factors was estimated using partial etasquared (η_p^2) and the Greenhouse-Geisser correction was applied to account for non-sphericity of the data. All the ANOVAs were performed using Statistica software (version 10) by StatSoft. Behavioural data from the fictitious task and the mnemonic questionnaire were not statistically analysed, but response time and accuracy were collected as a record.

A standardized weighted low-resolution electromagnetic tomography (swLORETA; Pascual-Marqui et al., 1994; Parmero-Soler, 2007) was performed on the ERP Difference Wave relative to N400 potentials, computed by subtracting ERP response to Congruent words from ERP response to Incongruent words in the N400 time window, using ASA4 Software.

3.3 Results

3.3.1 Memory task.

Behavioural data showed that the mnemonic recall of documentary contents was comparable in the two groups. On a total of four questions, the average number of correct responses was 3.61 (SD = 0.70) for the “People” group and 3.55 (SD = 0.62) for the “Nature” group, indicating a good attentive state at the documentary.

3.3.2 Language task.

Participants had an average Response Time (RT) to target terminal words of 625.48 ms (right hand = 627.73 ms; left hand = 625.52 ms). Moreover, the accuracy rate of responses was quite high (hits = 98%), suggesting that participants maintained an elevated attentive state throughout the experiment.

3.3.3 Subtle and Blatant Prejudice Scale.

The prejudice scores towards other race individuals could range from 1 (minimum prejudice) to 5 (maximum prejudice). A single overall prejudice score was computed for the two groups separately averaging all the items of the Subtle and Blatant Prejudice Scale. The mean scores were comparable in the two groups as assessed by the independent-sample t-test ($t(34) = 0.40$, $p = 0.33$) and it was 1.99 (SD = 0.35) in the “People” group and 2.04 (SD = 0.44) in the “Nature” group.

Moreover, in both groups the average score was significantly lower than the scale midpoint (3) (People: $t(17) = -12.31$, $p<.0001$; Nature: $t(17) = -9.17$, $p<.0001$), suggesting an overall low racial prejudice towards immigrants in the experimental population, regardless of the group assigned.

Considering the explicit and implicit (Blatant and Subtle) scales separately, participants in the “People” group obtained an explicit prejudice score of 1.58 (SD = 0.33) and implicit prejudice score of 2.39 (SD = 0.45), while the “Nature” group scored 1.58 (SD = 0.36) at the explicit prejudice score and 2.49 (SD = 0.59) at the implicit prejudice one. In both groups the explicit prejudice was

significantly lower than the implicit prejudice (People: t(17) = -9.44, p<.001; Nature: t(17) = -9.33, p<.001). A summary of results is presented in Table 3.2 and figure 3.2.

Prejudice	Group	Descriptives	T Statistic
Overall score	People	M= 1.99, SD= 0.35	t (34) = 0.40, p=.694
	Nature	M= 2.04, SD= 0.44	
Blatant Scale	People	M= 1.58, SD= 0.33	t (34) = 0.60, p=.552
	Nature	M= 1.58, SD= 0.36	
Subtle Scale	People	M= 2.39, SD= 0.45	t (34) = 0.00, p=1.000
	Nature	M= 2.49, SD= 0.59	
Group	Prejudice	Descriptives	T Statistic
People	Blatant	M= 1.58, SD= 0.33	t (17) = -9.44, p<.001
	Subtle	M= 2.39, SD= 0.45	
Nature	Blatant	M= 1.58, SD= 0.36	t (17) =-9.33, p<.001
	Subtle	M= 2.49, SD= 0.59	

Table 3.2. *Summary of the results of the T-test comparisons on the scores obtained at the Subtle and Blatant Prejudice Scale across the two experimental groups. M = mean; SD = standard deviation; t = T-test.*

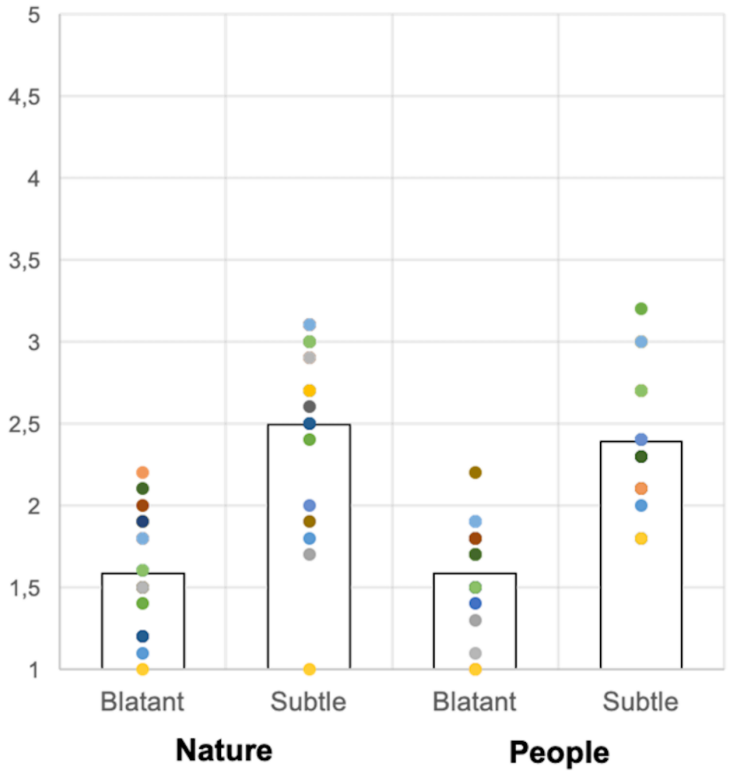

Figure 3.2. *Subtle and Blatant Prejudice Scale. Scores obtained on the Subtle and Blatant Prejudice Scale by the two experimental groups. Scores could range from 1 (minimum prejudice) to 5 (maximum prejudice); for both groups, explicit prejudice (blatant) was significantly lower than the implicit one (subtle).*

3.3.4 N400 response (350-550 ms).

The ANOVA performed on the N400 amplitude values recorded over the anterior, frontal and fronto-central midline sites (AFz, Fz and FCz) in the 350-550 ms time window, revealed a significant effect of the interaction between group ("People" and "Nature") and condition (Congruent, Incongruent, Neutral) ($F(2, 68) = 3.22$, $p < 0.05$, $\eta_p^2 = 0.09$). Pairwise comparisons revealed that in the "Nature" group a greater negativity ($p = 0.037$) was recorded in response to Incongruent (Nature: 2.11 μV, SE = 0.68; People: 1.12 μV, SE = 0.68) than Congruent (Nature: 2.85 μV, SE = 0.76; People: 0.93 μV, SE = 0.76) and also ($p = 0.01$) comparted to Neutral (Nature: 3.02 μV, SE = 0.78; People: 0.85 μV, SE = 0.78) terminal words, as visible in figure 3.3 and 3.4. A similar effect has not been recorded in the "People" group (respectively $p = 0.588$ and $p = 0.445$).

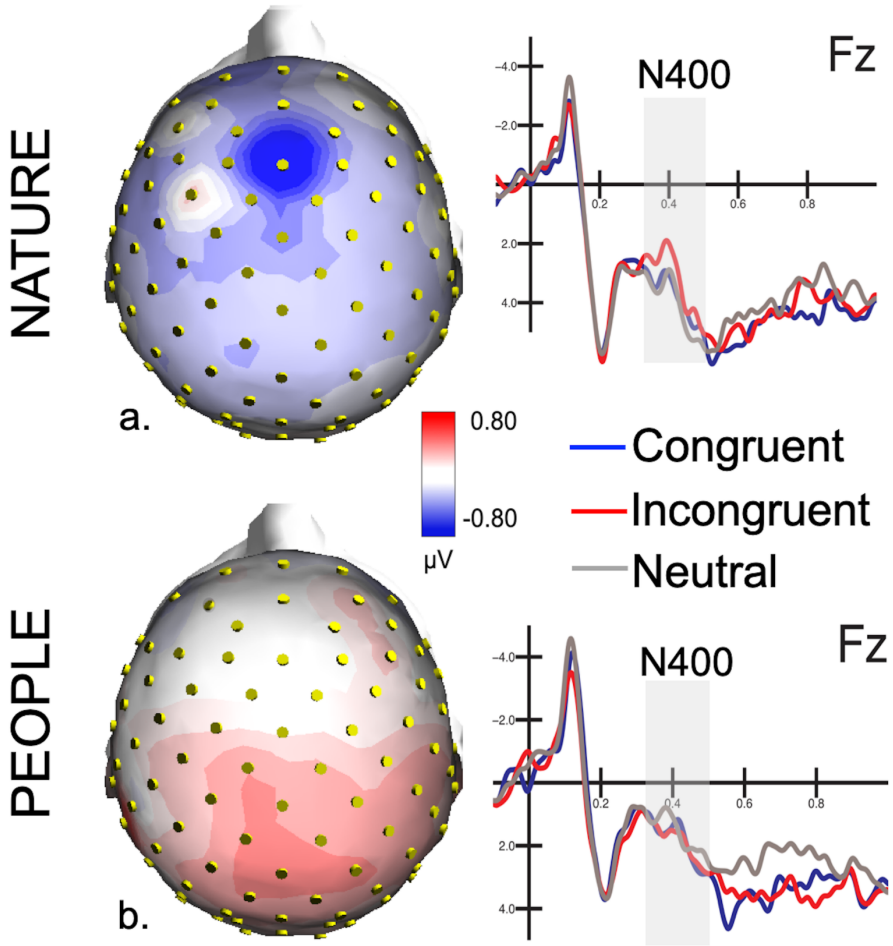

Figure 3.3. *N400 topographical map. Topographical distribution of the differential voltage (Incongruent – Congruent) recorded between 350 and 550 ms post-stimulus and ERP waveforms recorded at frontal sites in response to Congruent, Incongruent and Neutral sentences; The top figure (a) shows results in the "Nature" group; the bottom figure (b) in the "People" group.*

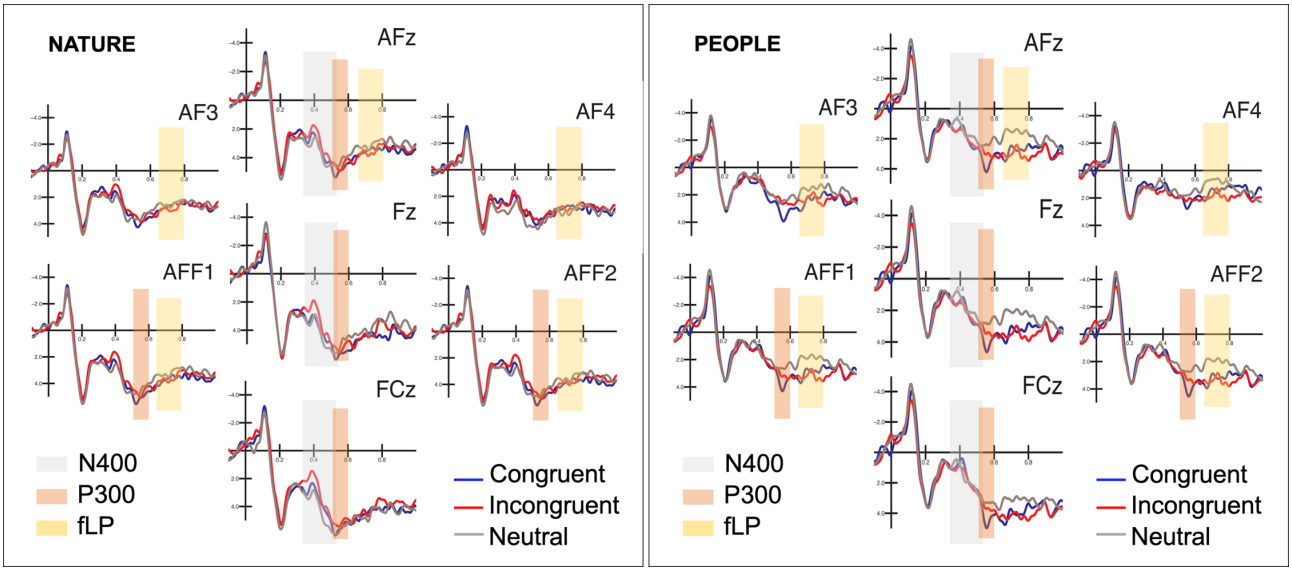

Figure 3.4. *Grande average ERP waveforms recorded at anterior frontal sites in response to Congruent, Incongruent and Neutral sentences. The time windows corresponding to the N400 (350-550 ms), P300 (500-600 ms) and frontal positivity (fLP; 650-800 ms) are highlighted. On the left recordings from the "Nature" group; on the right from the "People" group.*

3.3.5 P300 response (500-600 ms).

The ANOVA performed on the P300 amplitude values, measured between 500 and 600 ms over the anterior-frontal sites (AFF1, AFF2, AFZ, FZ and FCZ) showed a borderline significant main effect of condition ($F (2, 68) = 3.14$, $p = 0.05$; $\eta_p^2 = 0.08$), indicating that the P300 amplitude recorded in response to Congruent terminal words (4.18 μV, SE = 0.51) was overall greater ($p = 0.015$) than the one measured in response to Neutral terminal words (3.41 μV, SE = 0.53). Moreover, the analysis showed a significant interaction between condition and electrode ($F (8, 272) = 4.03$, $p < 0.005$; $\eta_p^2 = 0.11$), regardless of the experimental manipulation. Overall, the P300 amplitude was greater ($p < 0.001$) in response to Congruent than Incongruent and Neutral terminal words at all electrode sites; in turn the P300 response was larger ($p < 0.001$) to Incongruent than neutral terminal words at more anterior but not FCZ site ($p = 1$). P300 mean amplitude values are reported in Table 3.3 and showed in figure 3.4 and 3.5.

Finally, the analysis revealed a significant effect of the electrode ($F (4, 136) = 7.17$, $p < 0.001$, $\eta_p^2 = 0.17$), indicating that the P300 response was larger over the electrode FCZ (4.16 μV, SE =

0.50) compared to the electrodes AFF1 (3.59 μV, SE = 0.47; p = 0.001), AFF2 (3.74 μV, SE = 0.46; p = 0.040) and AFZ (3.44 μV, SE = 0.44; p < 0.001). The amplitude recorded over the electrode FZ (3.94 μV, SE = 0.51) was greater than the one recorded over the electrode AFZ (p = 0.008).

P300 (500-600 ms)

CONDITION	ELECTRODE	M	S.E.	C.I. -95%	C.I. 95%	N
Congruent	AFF1	4.02	0.53	2.95	5.09	36
Congruent	AFF2	4.18	0.52	3.13	5.23	36
Congruent	AFZ	3.89	0.50	2.88	4.90	36
Congruent	FCZ	4.49	0.51	3.45	5.52	36
Congruent	FZ	3.34	0.56	3.21	5.47	36
Incongruent	AFF1	3.57	0.45	2.64	4.49	36
Incongruent	AFF2	3.71	0.45	2.79	4.63	36
Incongruent	AFZ	3.44	0.43	2.56	4.32	36
Incongruent	FCZ	3.99	0.51	2.96	5.03	36
Incongruent	FZ	3.95	0.51	2.90	4.99	36
Neutral	AFF1	3.19	0.54	2.09	4.30	36
Neutral	AFF2	3.32	0.52	2.27	4.38	36
Neutral	AFZ	2.99	0.50	1.97	4.01	36
Neutral	FCZ	3.99	0.58	2.82	5.17	36
Neutral	FZ	3.53	0.57	2.37	4.69	36

Table 3.3. *P300 mean amplitude values recorded in the 500-600 ms time window in response to Congruent, Incongruent, and Neutral terminal words, at anterior and front-central sites (AFF1, AFF2, AFZ, FCZ, FZ). M = mean; S.E. = Standard Error; C.I. = Confidence Interval; N = sample size.*

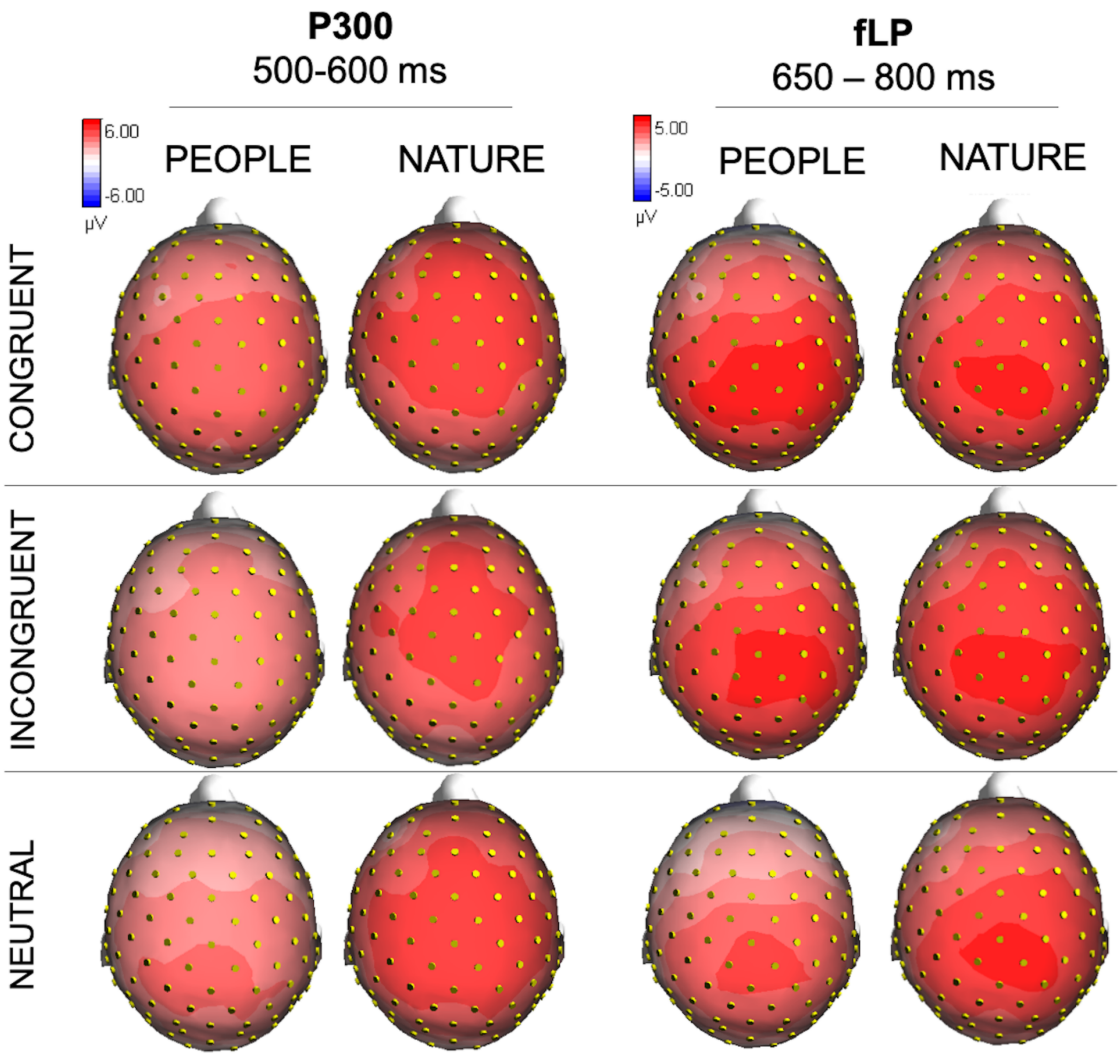

Figure 3.5. *P300 and fLP topographical maps. Isocolor topographical maps of the voltage distribution (top view) of brain potentials in the time windows corresponding to the P300 (500-600 ms) and frontal late positivity (fLP; 650-800 ms).*

3.3.6 Frontal positivity (650-800 ms).

The ANOVA computed on the mean area values of frontal positivity, measured between 650 and 800 ms over frontal-anterior regions (AF3, AF4, AFF1, AFF2, AFZ) didn't reveal any difference across the two experimental groups. It showed a significant effect of condition ($F(2, 68) = 4.57$, $p < 0.05$, $\eta_p^2 = 0.17$) such that the positivity measured in response to stimuli regarding OR individuals, either Congruent (2.61 µV, SE = 0.37; p = 0.026) or Incongruent (2.77 µV, SE = 0.36; p = 0.006),

was greater than the frontal positivity recorded in response to stimuli regarding own-race individuals, that is neutral words (1.97 μV, SE= 0.40).

The analysis also revealed a significant effect of electrode (F (4, 136) = 7.30, p <0.01, η_p^2 = 0.18), indicating greater positivity recorded over the electrodes AFF1 (2.75 μV, SE = 0.39), AFF2 (2.91 μV, SE = 0.38) and AFZ (2.60 μV, SE = 0.36) compared to the electrodes AF3 (2.09 μV, SE = 0.37; respectively p = 0.004; p <0.001; p = 0.027) and AF4 (1.90 μV, SE = 0.35; respectively p < 0.001; p <0.001; p = 0.003). Results are showed in figure 3.4 and 3.5.

3.3.7 swLORETA source reconstruction.

The swLORETA inverse solution, applied to the Difference Waves obtained by subtracting ERP waveforms elicited by Congruent from that elicited by Incongruent stimuli in the 350-550 ms time window, corresponding to N400 component, showed (figure 3.6) that the most active inner sources were the right superior frontal gyrus (SFG; BA 8) and the inferior temporal gyrus (ITG; BA 20). A complete list of all significant electromagnetic dipoles explaining the difference voltages are listed in Table 3.4.

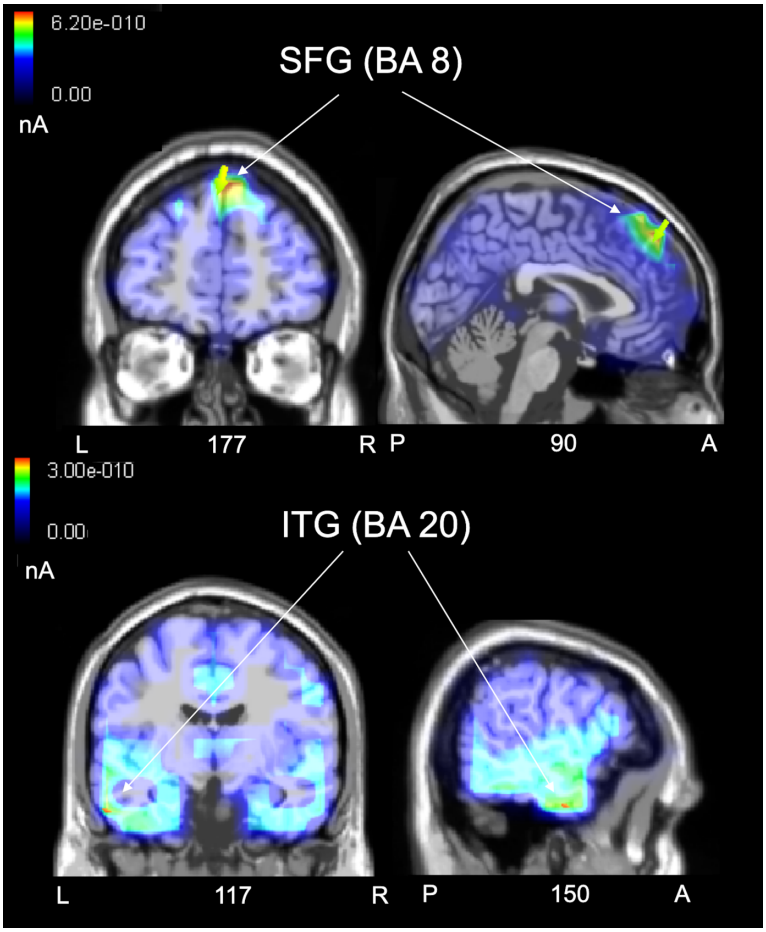

Figure 3.6. *swLORETA. The most active sources relative to the ERP difference-waves (incongruent minus congruent) recorded in the 350–550 time-window (N400) in the "Nature" group were the Superior Frontal Gyrus (SFG) and the Inferior Temporal Gyrus (ITG).*

Magn.	T-x	T-y	T-z	Hem.	Lobe	Gyrus	BA
6.42	1.5	40.5	50.7	R	F	**Superior Frontal**	8
2.62	60.6	-45.8	-9.5	R	T	Middle Temporal	37
2.62	-28.5	-90.3	20.8	L	O	Middle Occipital	19
2.50	-58.5	-8.7	-21.5	L	T	**Inferior Temporal**	20
2.16	40.9	-86.4	-12.4	R	O	Inferior Occipital	18

Table 3.4. *Source reconstruction of N400 response to stereotype violation. The table provides Talairach coordinates and localization of the active electromagnetic dipoles explaining the surface difference-voltage (incongruent – congruent) recorded in the 350-550 ms time window, according to swLORETA inverse solution. Magn. = Magnitude; Hem = Hemisphere; BA = Brodmann areas; T = Talairach; R = right; L = left.*

3.4 Discussion

The present investigation aimed to explore, by means of EEG/ERPs technique, whether the exposure to a video documentary representing positive and counter-stereotypical social information about other-race members could modulate, in a group of Italian Caucasian participants, the activation of implicit stereotypical representations associated to other-race (OR) people in a language task, as indexed by the N400 response.

The pool of participants of the study, all with Caucasian background, overtly presented a low prejudice towards OR people as assessed by the Prejudice Scale. Such overall low racial bias presented differences according to the explicitness of the scale used; indeed, the implicit scale revealed slightly higher prejudice scores compared to the explicit one. This result is in line with research that posits that implicit and explicit attitudes can be dissociated (Bargh, 1999; Dovidio et al., 1992). While explicit prejudice shapes deliberative responses which people are able to monitor, implicit attitudes are automatically activated and usually influence responses without a person's full awareness or control (Greenwald et al., 1995; Chen and Bargh, 1997). Therefore, these results highlight the presence, although little and below the scale midpoint, in our participants' group of an implicit racial bias that probably bypasses explicit learnt equalitarian values.

Participants were randomly assigned to two experimental groups and accordingly presented one of two video documentaries for the experimental manipulation.

As previously hypothesized, the previous observation of the experimental video documentary was associated to a smaller N400 response, as compared to the control video. Indeed, the results showed that the "People" experimental group, which observed several representations of OR individuals associated to positive social information, presented a smaller N400 effect in response to sentences that violated common racial stereotypes compared to the "Nature" control group.

On the other hand, similarly to our previous study, showing how the N400 response signalled the existence of implicit ethnic prejudices (Brusa et al., 2021), here the N400 response was larger to terminal words that were incongruent with racial stereotypes (compared to congruent and neutral ones) in the control group only witnessing a nature documentary. Therefore, the "Nature" control

group, which viewed the neutral video-documentary representing landscapes and animals, showed the typical N400 effect representing the pre-existing representation of race-biased social attributes (prejudices), as it was observed in the previous study (Brusa et al., 2021). Conversely, the “People” group who observed unbiased social information (progressive documentary) presented a lower N400 amplitude.

Although a possible limit of the present study might rely in the absence of a pre-intervention measure of the N400 effect to assert that the reduced N400 amplitude in the experimental group it is truly to ascribe to the experimental manipulation, based on previous literature (Proverbio et al., 2017; 2018; Brusa et al., 2021; Jin et al., 2017), it is reasonable to believe that being exposed to the un-biased and counter-stereotypical video documentary played a crucial role in the reduced N400 effect.

As well-known the N400 response is an ERP component sensible to the detection of semantic and conceptual incongruities; it reflects the integration of incoming information with pre-existing knowledge and it appears larger when such integration requires an effort due to unexpected content (Kutas and Hillyard, 1980). Several studies showed that when people are faced with information (in the form of images or sentences) that are incongruent with previous conceptual/semantic associations related to world knowledge, such as counter-stereotypical social knowledge, this incongruence is reflected in a greater N400 response (Hehman et al., 2014; Proverbio et al., 2017; 2018; Hagoort et al., 2004; Correll et al., 2006; White et al., 2009; Wang et al., 2011; Brusa et al., 2021; Kutas and Federmeier, 2011; Proverbio et al., 2009). This allowed researchers to assess the presence of implicit stereotypical mental representations in the population, revealing the sensitivity of ERPs as an implicit measure.

The present study further investigated whether these deeply grounded mental associations in the form of stereotypes could be modulated and its results are in line with the literature that highlights the role of contextual information in modulating the N400 response. Providing local context can indeed modulate expectations and facilitate the integration of incongruent content into mental representations, thus reducing the N400 effect (Hald et al., 2007; Duffy and Keir, 2004; Jin et al., 2017). Duffy and Keir (2004) have shown that offering adequate context to introduce information that are incongruent with gender stereotypes modulated the N400 in response to stereotype violations,

possibly facilitating their integration and reducing biased expectations. On the other hand, Jin and colleagues (2017), highlighting the role of media in shaping social attitudes, proved that exposing people to videos that show negative behaviours associated to a minority group (e.g. Uyghurs) can increase biased attitudes towards the same group as showed by a greater N400 effect in response to positive trait (compared to negative trait) associations to that group. The present study explored whether media exposure could also positively shape attitudes towards ethnic minorities, attenuating social bias, using the N400 response as a neural marker of this modulation. Abundant behavioural literature confirmed on one hand the impact of media in the formation and maintenance of stereotypes and prejudicial feelings toward out-groups (Brown, 1995; Dill and Thill, 2007; Dixon et al., 2000; Ramasubramanian et al., 2007) and on the other hand its ability to disconfirm stereotypes and modify racial attitudes (Ramasubramanian et al., 2014; Soble et al., 2011).

According to our findings, relying on the influence of context on the N400 effect and the power of media to modulate stereotypical mental representation (Ramasubramanian et al., 2007; Paluck et al., 2009; Soble et al., 2011; Hald et al., 2007; Jin et al., 2017; Menenti et al., 2009), we hypothesize that watching the experimental documentary possibly updated participants' mental representations modulating their expectations, as revealed at a neural level by the reduced N400 effect. While the effect observed was only a between-person effect and it was assessed after a short time (about 20 minutes) occurred between the video manipulation and the language task, future studies should approach the matter applying a within-person effect and eventually enquire the actual duration of such effect in the long-term memory.

Moreover, similarly to our previous ERP studies on ethnic and sexual prejudices (Proverbio et al., 2017; 2018; Brusa et al., 2021), the swLORETA computed to reconstruct the neural generators of the N400 response elicited by the violation of ethnic stereotypes in the control group “Nature” identified a networks of cortical structures involved in semantic knowledge and social cognition processes such as the inferior temporal gyrus (ITG; BA 20) and right superior frontal gyrus (SFG; BA 8).

This pattern of results fits well with available social neuroscientific literature that posits, indeed, that stereotypical associations reside in regions that underpin semantic memory, such as the anterior

and lateral temporal lobes (Quadflieg et al., 2009; Zahn et al., 2007; Patterson et al., 2007; Quaflieg et al., 2011). Moreover, in line with our results, Olson and colleagues (2013) proposed that the anterior portion of the inferior temporal gyrus (the anterior temporal lobe, ATL) plays a critical role in representing and retrieving social knowledge, including biographic memory about people and more generally memory for traits and social concepts. This, according to several authors, includes stereotype representations, considered to be social semantic associations (Proverbio et al., 2017; 2018; Quadflieg et al., 2009; Contreras et al., 2012; Gallate et al., 2011).

Another powerful source in terms of magnitude was the superior frontal gyrus (BA 8), a region often implicated in the representation of social attributes and theory of mind processes (TOM; Mitchell et al., 2006; Fletcher et al., 1995; Mahy et al., 2014; Proverbio et al., 2016). The medial prefrontal cortex (mPFC) has been found together with other regions belonging to the social cognition network to be a particularly important structure for the processing of social information (see Van Overwalle, 2009; Mitchell et al., 2002). Its activity has been primarily associated with impression formation about other people and mentalizing processes (Frith and Frith, 2006). Interestingly, in a recent study on the neural basis of prejudice, it was also found that the left superior frontal cortex was particularly involved in representing negative prejudices related to others (Proverbio et al., 2016).

Another interesting piece of data from the present study revealed, regardless of the group assigned, a greater P300 effect in response to sentences congruent with ethnic bias compared to incongruent and neutral ones, as previously seen also in the study by Brusa and colleagues (Brusa et al., 2021). The P300 response is an index of contextual updating and has been shown to reflect the integration into mental representations of semantic information that was pre-activated during sentence reading (Donchin, 1988; Roehm et al., 2007; Freunberger et al., 2016; Molinaro et al., 2010; Vespignani et al., 2009). In line with previous literature, it appears that in the present study Congruent sentences matched participants' previous knowledge and mental stereotypical representations, thus evoking a greater P300 response.

Similarly, a study by Correll and co-authors (2006) investigated the properties of the P300 component in a racial bias experiment and demonstrated a greater P300 response in the presence of black armed subjects (compared to White armed ones) due to the automatic association of Black

persons and the use of weapons. Here, both the experimental and the control group, showed a greater P300 in response to sentences that matched racial stereotypes compared to the other conditions. It is possible that, while learning through video documentary was able to facilitate the integration of upcoming stereotype-inconsistent content, hence reducing the N400 effect in response to incongruent stimuli, the P300 effect might possibly reflect that in both groups, regardless of the experimental video-manipulation, a terminal word confirmative of the stereotype was pre-activated, thus more expected, during sentence reading.

Furthermore, also in line with the results of our previous study on the measuring of implicit stereotypical mental representation (Brusa et al., 2021), a late frontal positivity was found in both groups to be sensitive to the ethnicity of the characters involved in the sentences. Indeed, a greater frontal positivity was recorded in response to sentences involving other-race individuals, both in a stereotypical and counter-stereotypical way, compared to own-race neutral ones. It is possible to assume that stereotype relevant content involving OR persons might represent for the reader a more emotionally relevant and arousing material compared to neutral content involving individual of the same ethnicity. This finding fits previous literature which suggests that the late positivity is a component sensitive to the emotional and motivational value of a stimulus. It was found in response to emotional and arousing pictures, both positive and negative, (Cuthbert et al., 2000; Schupp et al., 2000) or words (Rostami et al., 2016; Fischler et al., 2006; Herbert et al., 2008; Schacht and Sommer, 2009) compared to neutral ones. The arousal hypothesis fits with neuroimaging literature reporting how perception of other- vs. own-race people increases the activity of amygdala, a subcortical structure that reflects arousal triggered by fast unconscious assessment of potential threat (Ronquillo et al., 2007; Eberhardt, 2005; Lieberman et al., 2005). Moreover, in a study by Ito and colleagues (2004) on social perception processes a late positive potential marked the evaluative differentiation of racial ingroup and outgroup members. Indeed, several studies have investigated the neural processes underlying ingroup-outgroup discrimination, mainly using face stimuli. For instance, Hart and colleagues (2000) showed in an fMRI study that amygdala responses to human face stimuli were affected by the relationship between the perceived ethnicity of the facial stimulus and that of the observer. Moreover, greater fusiform activity has been found in response to faces of

one's own racial group (Golby et al., 2001). ERP research examining the N170 component, an index of face encoding, revealed differential processing of ingroup versus outgroup faces, even when groups were defined arbitrarily (Ratner et al., 2013). Also, the orbitofrontal cortex has been shown to play a broader role in group-based evaluations (Van Bavel et al., 2008).

In the present study, no significant difference was found between the two experimental groups (lack or presence of bias-free social documentary administration) in the amplitude of frontal positivity. Nonetheless, as visible in figure 3.4, the effect appears stronger in the "People" experimental group. It is possible that viewing the experimental documentary depicting hundreds of individuals of OR ethnic groups might influence and increase the ingroup-outgroup discrimination. This claim isn't supported by precise statistical data but deserves further analyses for reaching a specific conclusion. Overall, it is reasonable that adopting a larger sample size might overcome the possible limitations and strengthen the power of the present research inherent to the relatively small sample size.

3.4.2 Conclusions

The present study revealed the possibility that N400 effect reflecting pre-existing racial stereotypes, might be modulated and reduced through exposure to positive media-driven information about other race (OR) people. Here, the modulatory effect on the N400 response was tested about 20-40 minutes after the experimental manipulation, so that further follow-up studies should determine its duration in time by testing it after longer periods of time, such as one week or after one month. Moreover, the present results seem to point to a sovramodal interaction in social knowledge, such that a pictorial/filmic experience could modify event related potentials in a stereotype-based language task. Hence, these data possibly suggest that the N400 response may be a sovramodal marker for conceptual incongruence (for example, Proverbio et al., 2009; 2020; Dwivedi et al., 2021; Schnuerch et al., 2016) and that social knowledge is also sovramodal in nature.

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Chapter 4

4. Voices and prejudice: How people's voices/accent activate social stereotypes

4.1 Introduction

In addition to the linguistic content of speech, the human voice conveys several paralinguistic information about a person's identity, their background, and affective state that is relevant for communication (see for a review Campanella and Belin, 2007; Belin et al., 2004).

Linguistic theories (e.g., Chomsky, 1957; Grice, 1975), offer a distinction between the meaning of a sentence, that is context independent and concerns semantics, and the communicative context, including social and motivational aspects, concerning pragmatics. During language comprehension, people rapidly integrate the information conveyed by the semantics of a sentence with the social context, including the information inferred about the speaker. Given the role of human language in promoting social interpersonal interaction, researchers suggest that linguistic communication is intrinsically socially contextualized (e.g., Clark, 1996; Van Berkum et al., 2008). Among the several aspects of language pragmatics, the voice plays a socially relevant role and has received specific consideration from different research fields.

Indeed, the neuroscientific literature seems to suggest the existence of voice-specific responses in the brain and regions specifically involved in voice-processing and even more specifically in processing paralinguistic information in voice, such as regions in the right anterior STS (Belin et al., 2000; 2002; Levy et al., 2001, 2003). Belin and colleagues (2004) suggested a model of neuro-functional organization for voice processing where linguistic, affective, and identity information are processed in partially distinct cortical pathways.

Psycholinguistic research showed how different kinds of contextual constraint conveyed by voice can influence how listeners process language. For instance, studies have demonstrated that vocal cues can guide personal attributions about the speaker's gender, approximate age, social status,

emotional state and sexual orientation (Campanella and Belin, 2007; Sulpizio et al., 2015; Mullennix et al., 1995; Scherer, 1995, 1986; Ellis et al., 1989). Thanks to the ability to perform such attributions, listeners are able to adapt speech comprehension to context and to characteristics of the speaker (e.g., Trueswell et al., 2005; Hanna et al., 2004; for a review see Barr & Keysar, 2006).

Moreover, people's voices appear to represent powerful markers for listeners to socially classify, stereotype, and generate impressions on others (e.g., Giles and Billings, 2004; Ko et al., 2009; Krauss et al., 2002; Lambert et al., 1960). Listeners rapidly classify speakers making voice-based and often stereotype-dependent inferences (Giles and Billing, 2004; Ko et al., 2009; Van Berkum et al., 2008). For instance, Ko and colleagues (2009) provided evidence that stereotyping can occur on the basis of vocal cues. In their study, participants were presented with 12 résumés, either in text format or spoken by applicant voices that varied systematically in their relative vocal femininity. After each résumé, participants rated the applicant on warmth and competence scales. Their study showed that participants were able to easily make gender-stereotypic inferences based on the brief vocal clips, such that more feminine sounding targets were judged as less competent.

Therefore, linguists and sociologists have argued the importance of language attitude research and have been studying for a long time how people might form impressions on others based on vocal attributes (e.g., see Giles and Billings, 2004; Dragojevic, 2017). The attitudes we form based on others' language style can have relevant impact at many social levels, interpersonal, political, economic, and educational (Gluszek and Dovidio, 2010; Dovidio and Gluszek, 2012).

Indeed, several studies have turned their focus on the language variations of speech accents and their effect on interpersonal evaluations. Research have compared the effects of standard accents (e.g. the native accent) versus non-standard accents (e.g. foreign accents) on evaluations about the speakers (e.g., Giles and Billings, 2004; Gluszek and Dovidio, 2010; Dovidio and Gluszek, 2012; Lambert, 1960). In one of the first studies tackling this issue, Lambert and colleagues (1960) explored the attitudes between French and English Canadians in Montreal. The authors developed the Matched Guise Technique (MGT) to investigate attitudes towards speakers of different language varieties. The technique assumed that listening to specific speech dialects or accents could lead to social categorizations and thus stereotype-based inferences. Their study revealed that English

Canadians evaluated speakers of their own ethnic group more favorably than French Canadians; while the latter accentuated the trend of favoring the outgroup over their own.

In further studies, participants were typically presented with standard and/or non-standard accents and had to evaluate speakers on constructs such as solidarity (or social attractiveness), status (or competence), and dynamism (see Giles & Billings, 2004; Fuertes et al., 2012; Dragojevic and Goatley-Soan, 2020).

The construct of perceived status included evaluations about the speaker's intelligence, competence, education, and social class; the solidarity scale included evaluations of warmth, attractiveness and trustworthiness; while dynamism referred to speaker's level of activity and liveliness (see Giles & Billings, 2004; Fuertes et la., 2012; Fiske et al., 2002).

A meta-analysis by Fuertes et al., (2012) revealed that speakers with standard accents were rated more positively than speakers with non-standard accents. Indeed, standard-accented speakers were accorded higher ratings of status, solidarity, and dynamism than non–standard-accented speakers were. Moreover, their results showed that standard-accented speakers are rated significantly higher than non–standard-accented speakers in education, employment, and sales settings.

Hence, a consensus exists among language scholars that voice accents provide the listener with an intergroup frame for interpreting the conversation (see Tajfel and Turner, 1986) and that is related to the stereotypical traits associated with that voices (see Giles & Powesland, 1975).

Electrophysiological studies (e.g. Van Berkum et al., 2008; Hagoort et al., 2004, Hald et al., 2007; Proverbio et al., 2009, 2017, 2018; Brusa et al., 2021a, 2021b) have helped shedding light on the influence played by contextual information, including stereotype-dependent inferences, in language comprehension.

Several studies have addressed the issues related to the neural correlates and temporal course of semantic and contextual integration and demonstrated that language comprehension takes very rapid account of the a priori narrative discourse, including social context and world-knowledge. As exposed in previous chapters, EEG/ERP studies have focused consistently on the N400 response to reflect violations of expectation, both based on the constraint of the semantic context and the pragmatic knowledge of the speaker/reader, and to mark such integrative process.

Moreover, the amplitude of the N400 response was found to be sensitive to experimental manipulations, such us when the incoming information was more expected, thus easier to process (Kutas and Federmeier, 2009). Studies have showed that in sentence comprehension, previous knowledge, contextual information and expectations can influence the processing of incoming information from the earliest stages (Federmeier et al., 2000; Brusa et al., 2021b; Van den Bink, 2012; Hald et al., 2007; Duffy and Keir, 2004).

Particularly relevant is the study by Van Berkum and colleagues (2008). By means of scalp-recorded event-related potentials, the authors showed that listeners take into account speaker's identity as early as 200–300 ms after the beginning of a spoken word to make sense of what is being said. In their study, they asked people to listen to sentences whose content sometimes did not match voice-based inferences on the age, sex or social status of the speaker. Most of the anomalies presented violated social stereotypes associated to the speaker's voice (in terms of sex, social status and age attributed). The results showed that a greater N400 negativity was recorded in response to such anomalies, indexing once again that an early detection of semantic and contextual incongruities had occurred. Thus, when listening to sentences, both semantic and pragmatic violations evoked a N400 response.

The study presented in this chapter aimed to investigate how ethnic stereotypical representations are activated by accent-based inferences and how they are integrated with sentence meaning during language comprehension. Indeed, as evidenced by the literature review, vocal inferences about the speaker are immediately used in the interpretation of the utterance, in the same way as lexical semantic information (Van Berkum et al., 2008; van den Brink et al., 2012).

The aim of the study was indeed to explore whether the listener's ability to compute inferences based on the speaker's voice would evoke stereotypical mental representations used to make sense of what is being heard. In particular, the study used voices with standard accents (Italian) and non-standard accents belonging to non-Western ethnic groups (e.g. Chinese, Indian, Latin, Arabic, Eastern Europeans). Such voices spoke sentences that could match, violate or be neutral to a racial stereotype. Hence, it was hypothesized that listeners would perceive sentences that matched or

violated a stereotype more or less surprising according to the accent of the speaker and the stereotype-based inferences.

Moreover, the study aimed to explore whether voice-based information could influence the perceived competence and social attractiveness of the speaker as a function of stereotypical or counter-stereotypical sentence semantic. Although different researchers have employed different labels to these dimensions, social attractiveness is predominantly associated with solidarity traits such as friendly and pleasant, while competence is associated with traits such as intelligent and competent studies (Fiske et al., 2002; Fuertes et al., 2012). It was hypothesized that standard-accented speakers would overall receive higher ratings of competence and solidarity compared to non–standard accents as evidenced in previous studies (Fuertes et al., 2012). Moreover, we hypothesized that the ratings would vary according to the stereotype-congruence of the sentence pronounced.

Unlike the studies proposed in the previous chapters, in which the ethnicity and nationality of the characters in the sentences were explicitly conveyed by words (e.g. “The Ethiopian girl”), in this study the information on the character's ethnic background was conveyed by their voice.

In line with our previous results (see chapter 2 and 3), the present study represented a preliminary investigation to further explore in a subsequent EEG/ERPs investigation the neural processes (time course and neural substrates) involved in the automatic and implicit cognitive representation of ethnic stereotypes and prejudices activated by inferences based on the speaker's voice, as marked by the N400 ERP response.

4.2. Methods

4.2.1 Participants.

Eighty-five (n=85) Italian university students aged between 18 and 35 years old took part to the online study on a voluntary basis. They were invited through the online recruitment system of the

University of Milano-Bicocca (SONA-System) and received 0.3 university credits for their participation. The experimental sample size is based on power using the software G*Power (F tests - RM ANOVA within factors: Effect size f=0.2, α=.05, Power=.8). Participants were all Italian nationals and Italian was their mother tongue. Thirteen subjects who did not complete all parts of the questionnaire, one subject who provided nonsense responses to the control question suggesting low attention to the survey and one subject whose questionnaire response time was shorter than 900s were excluded from all analyses. The final sample size was composed of 70 native Italian nationals and speakers (60 females; 10 males), aged between 18 and 34 years old (M = 22.01, SD = 2.65). The sample had an education with an high-school degree or higher (30 subjects had an high-school degree, 37 a Bachelor degree and 4 had a Master degree). Their political orientation was assessed through a 7-point Likert scale (1 = extreme left; 2 = left; 3 = central-left; 4 = central; 5 = central-right; 6 = right; 7 = extreme right) and the average response led towards the central-left wing orientation (M = 3.14, SD = 1.26). All the participants expressed their understanding and consent for the study according to the Declaration of Helsinki (BMJ 1991; 302: 1194), with approval from the University Ethics Committee (prot. n° RM-2021-432).

4.2.2 Stimuli.

The stimulus material consisted of 186 audio-visual sentences, presented in the form of short videos, composed of both voices and written words.

More specifically, each video started with a spoken sentence presented acoustically with a neutral visual background and ended with the rapid appearance of a written word. The auditory spoken part of the sentence was on average 3.32 seconds long (SD = 0.70) and was delivered through the participant's earphones while a grey background showing a speaker-icon appeared on the screen. As soon as the auditory part ended, the terminal word appeared written in black capital letters (Arial font) in the center of the screen for 1 second (see figure 4.1 for a representation). The study took place online on the participant's computer. Although subjects were instructed to keep an eye-to-screen distance of about 50cm and to adjust the volume to an audible and comfortable level, visual angle of written words and intensity (dB) of auditory stimuli could not be controlled.

Videos were assembled using *iMovie* (Version 10.1.14, Apple Inc.) and had a duration that ranged between 2.47'' to 6.35''. The spoken part of the sentence provided contextual information on the speakers' nationality based on their voice accent (Italian or foreign), while the written terminal word modulated the experimental condition (congruent, incongruent, neutral). Indeed, the terminal word influenced the sentence meaning by revealing the presence (congruent condition), the violation (incongruent condition) or the neutrality (neutral condition) of a social stereotype associated to the speaker's nationality. Therefore, each sentence would appear stereotype-congruent, -incongruent or -neutral according to the association to the specific speaker's accent.

Specifically, 62 video-stimuli in which terminal word conveyed an ethnic bias belonged to the congruent condition (e.g., "I often get my own clothes from CARITAS[3]", in Italian "Vado a prendere spesso I vestiti dalla CARITAS" pronounced in an African accent; "I am proud to go to work in the JUDICIARY", in Italian "Sono orgogliosa di lavorare nella MAGISTRATURA", pronounced in an Asian accent; "I got a job in that INSURANCE company", in Italian "Ho trovato lavoro in quella compagnia di ASSICURAZIONI", pronounced in an Arabic accent), 62 containing a bias violation were indicated as incongruent (e.g., "This year we made a subscription to LA SCALA*", in Italian "Quest'anno abbiamo fatto l'abbonamento alla SCALA", pronounced in an African accent; "I learned quickly how to do a MANICURE", in Italian "Ho imparato velocemente come fare la MANICURE", pronounced in an Asian accent; "My mum has always been used to wearing the HIJAB", in Italian "Da sempre mia mamma è abituata a portare il VELO", pronounced in an Arabic accent), while the remaining 62 video-stimuli that were neutral to ethnic stereotypes composed the neutral condition (e.g., "I am waiting in line to buy the CARNET*", in Italian "Sono in coda per comprare il CARNET", "I became quite good at giving MASSAGES", in Italian "Sono diventata abbastanza brava a fare I MASSAGGI", "Laura and I went together to the MUSEUM", in Italian "Laura ed io siamo andare insieme al MUSEO", all pronounce by native Italian speakers).

[3] Caritas is a Christian Charity; The Teatro alla Scala, colloquially called la Scala, is the main opera house in Milan, Italy; The carnet is a train ticket consisting of multiple pre-paid, standard class tickets for a certain journey.

Indeed, in the congruent and incongruent videos, speakers presented voices with foreign accents that matched the stereotype (confirmed or violated), whereas neutral videos included voices with only Italian accents.

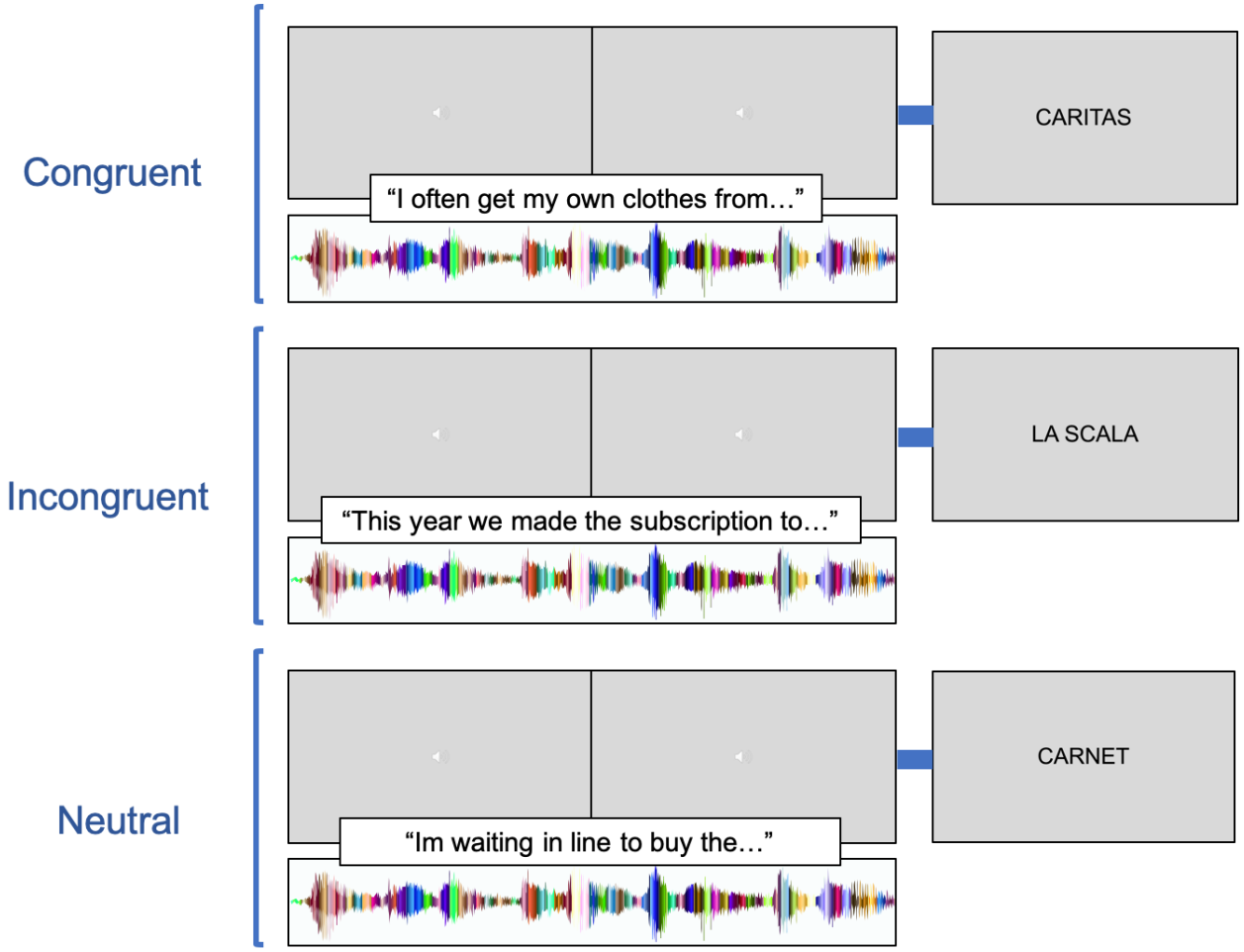

Figure 4.1. *Sketch of experimental procedure for the 3 conditions. In the congruent condition sentences confirmed social stereotypes, in the incongruent condition sentences violated social stereotypes, in the neutral condition sentences were non-inherent to social stereotypes. In the first two conditions the speaker has a non-native Italian accent (e.g., African), while in the neutral condition the speaker is native Italian.*

Foreign speakers were chosen based on six non-Western accents conveying nationalities for which there is an ethnic prejudice in Italy: Arabic, Latin, Chinese, Indian, African, and Eastern European (see Table 4.1 for more details).

The social stereotypes selected concerned different topics (e.g., culinary habits, lifestyle, sport, work, personality traits, appearance, home, etc.,), were specific for the six non-Western nationalities and were validated in a previous study by the authors (see chapter 2, Brusa et al., 2021).

The spoken sentences were recorded from 19 (7 males; 12 females) non-native Italian speakers (three Arabics, five Latin Americans, two Chinese, two Indians, four Eastern Europeans, three Africans) and 8 (5 females; 3 males) native Italian speakers, using a custom recording app on the speaker's smartphone device. Each speaker recorded several sentences that were subsequently selected based on the quality of the recording. Independent evidence about intelligibility of individual speakers wasn't collected, nonetheless some recordings had to be discarded due to a very bad quality of sound and intelligibility. The final selection of sentences per accent is presented in table 4.1. Voice recordings were then edited using *Audacity* software, and they were levelled to -70dB and normalized to 1dB.

Terminal words were balanced across condition in length and frequency of use as assessed by the CoLFIS database by Bertinetto et al. (2006). Statistical comparisons (ANOVAs) performed on the mean frequency of use of terminal words across the Congruent, Incongruent and Neutral conditions showed no difference ($F(2, 173) = 0.045$, $p = 0.956$, $\eta p^2 = 0.001$) whatsoever (Congruent = 123, SE = 21.1; Incongruent = 132, SE = 21.5; Neutral = 126, SE = 21.5). A further ANOVA performed on mean word length (# of letters) showed balance across stimulus classes ($F(2, 183) = 0.236$, $p = 0.79$, $\eta p^2 = 0.003$): the length was on average 7.74 letters (SE = 0.33) for Congruent, 8.06 letters (SE = 0.33) for Incongruent words and 7.92 (SE = 0.33) for Neutral terminal words. Terminal words were also balanced for word category (e.g., number of adjectives, verbs, nouns; see Table 2.1b for details) across conditions.

ACCENT	CONG.	INCONG.	NEUTRAL
African	15	15	0
Arabic	10	10	0
Chinese	8	8	0
Indian	7	7	0
E. European	8	8	0
Latins	14	14	0
Italians	0	0	62

SEX			
Male voices	33	33	29
Female voices	29	29	33
WORD CATEGORY			
Nouns	45	45	42
Adjectives	12	12	14
Verbs	4	4	5
Proper names	1	1	0
Adverbs	0	0	1

Table 4.1. *Sentence details. The table shows information on the 186 audio-visual stimuli across the three experimental conditions (Cong. = congruent, Incong. = incongruent, Neutral). The accent section indicates the number of sentences pronounced with each accent; Sex section indicates the number of sentences pronounced by a male or female voice; Word category refers to the number of terminal words belonging to each grammatical class.*

4.2.3 Procedure.

The study was conducted entirely online using *Qualtrics* software (Qualtrics, Provo, UT). After providing standard demographic information and granting informed consent, participants were presented a three-parts questionnaire. Each part randomly presented 62 stimuli and took about thirty minutes to finish. Participants could complete all parts separately over a week's time. After each sentence-stimulus was delivered, participants rated the speaker and the content they had just witnessed on expectation, comprehension, prestige and solidarity traits and indicated whether they thought the speaker was Italian/foreign and male/female. The study was introduced to participants as a multi-modal language task, providing only limited contextual information.

4.2.4 Questionnaire.

In the online questionnaire participants rated each stimulus on the sentence content and its speaker. *Expectation*. To determine whether the sentences represented (or violated) common stereotypes for the specific populations (university students in the Milan metropolitan area) participants were asked

to rate their expectation, such as how they reacted to the terminal word of the phrase ("Did you expect the sentence to end that way?"), using a 5-point scale (1 = not at all; 5 = very).

Processing fluency. The sentence stimuli were evaluated on the ease of understanding to determine the processing fluency ("Was the sentence easy to understand?"), using 5-point scales (1 = not at all; 5 = very).

Voice attributes. To evaluate the perceived status (or competence; see Cuddy et al., 2008; Giles and Billings, 2004) of the speaker, the questionnaire included ratings about the speaker's intelligence and competence, using a 5-point scale (1 = not at all; 5 = very). The perceived social attractiveness (or solidarity/warmth; see Cuddy et al., 2009; Giles and Billings, 2004) was evaluated indicating the speaker's friendliness and pleasantness, using a 5-point scale (1 = not at all; 5 = very).

Accent categorization. To assess whether speakers' accents were correctly identified, participants had to socially classify them as Italians or foreigners.

Sex categorization. Participants were asked to determine if the speaker was a male or a female, based on their voice timbre, to limit random answering.

4.2.5 Analysis.

Statistical analyses were performed using the *Jamovi* software (Version 0.9.6.8). Sex categorization data were analysed on the percentage of correct responses to evaluate possible random responses, while accent categorization data were analysed by a repeated measure ANOVA on the percentage of correct responses to evaluate whether accent categorization (Italian/foreign) differed across standard and non-standard accents.

The ratings assigned by participants at the five questionnaire measures were analysed first by means of separate mixed model analyses that included as fixed factor the stereotype congruency of the sentence (congruent, incongruent, neutral) and as random factor the subject and each sentence. Additional mixed model analyses were performed for each measure to examine how the ratings varied as a function of speakers' foreign accent (African, Arabic, Chinese, Eastern European, Indian, Latin) and the sentence congruency to the racial stereotypes (congruent and incongruent), including

as random effect the subject. Bonferroni post-hoc comparisons were performed. Moreover, Spearman correlations were computed to examine the relation between the different ratings.

4.3. Results

4.3.1 Sex categorization.

Regarding sex categorization responses, participants performed on average 99.39% (min=97.85; max=100%) of correct categorization, indicating a high level of attention throughout the questionnaire.

4.3.2 Accent categorization.

Foreign voices were correctly classified as foreign 88.15% of the time (range = 18.31% - 100%), while Italian voices were correctly classified as Italian 97.30% of the time (range = 84.51% - 100%). The repeated measure ANOVA performed on the percentage of correct accent categorization (Italian vs. foreign) revealed a significant difference ($F (2, 183) = 7.40$, $p <.001$, $\eta p^2 = 0.07$) across the three experimental conditions (Congruent, Incongruent, Neutral). Overall, Italian voices (Neutral condition) were categorized correctly (97.30%, SE=0.02) more easily than both foreign voices (Congruent 89.98%, SE=0.02, $t(183) = 2.51$, $p =.03$; Incongruent 86.32%, SE = 0.02, $t(183) = 3.78$, $p <.001$) (see figure 4.2a).

Moreover, the analysis showed significant differences according to the specific voice accent ($F (6, 179) = 8.21$, $p <.001$, $\eta p^2 = 0.22$): while African (89%, SE = .03), Chinese (98%, SE = .03), Indian (99%, SE =.04) and Latin voices (90%, SE = .03) received a percentage of correct responses equally similar to the one provided for Italian accents (97%, SE =.02), Arabic (81%, SE = .03) and East European voices (73%, SE = .04) received a significantly lower percentage of correct responses (see figure 4.2b).

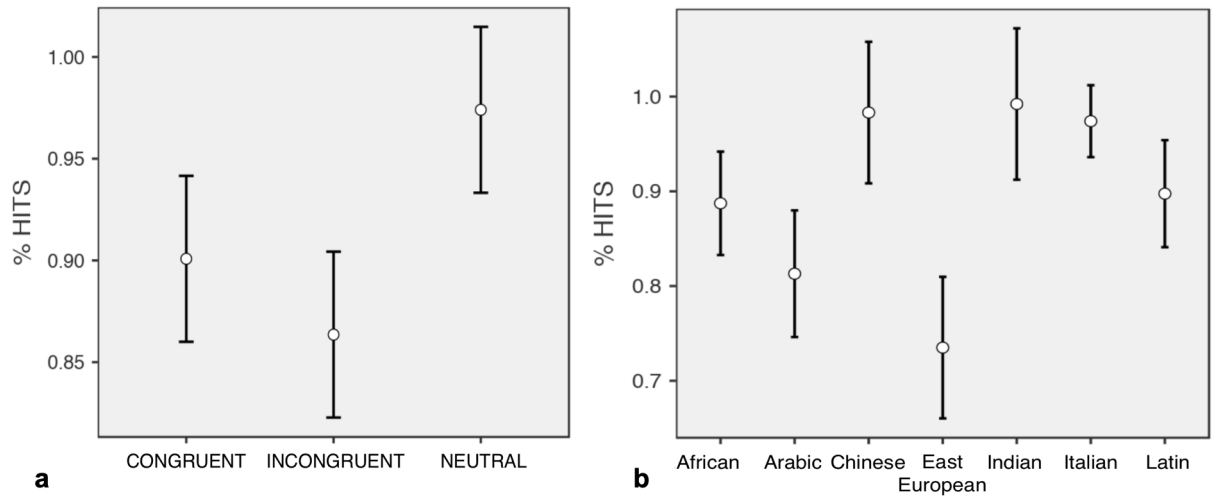

Figure 4.2. *Percentage of correct accent categorization.* ***a.*** *(Left) Correct accent categorization (HITS) across the three experimental conditions (congruent, incongruent, neutral).* ***b.*** *(Righ) Percentage of correct classifications as a function of voice accents.*

4.3.3 Expectation.

By means of linear mixed model analysis, the ratings obtained at the expectation scale were analyzed in function of the Stereotype factor (congruent, incongruent, neutral), including as random effect both the subjects and the sentence-stimuli.

As visible in figure 4.3, the analysis (R^2 = 0.48) revealed a main effect of stereotype (F (2, 183) = 75.41, p < .001), indicating that in the neutral condition sentence endings (neutral = 3.68, SE= 0.09) were overall more expected than those in the congruent (t(183) = 8.25, pBonferroni<.001) and incongruent conditions (t(183) = 12.00, pBonferroni<.001). Moreover, the endings of sentences violating the racial stereotype (incongruent = 2.67, SE = 0.09) were less expected (t(183) = 3.76, pBonferroni<.001) than the ones confirming the stereotypes (congruent = 2.98, SE = 0.09).

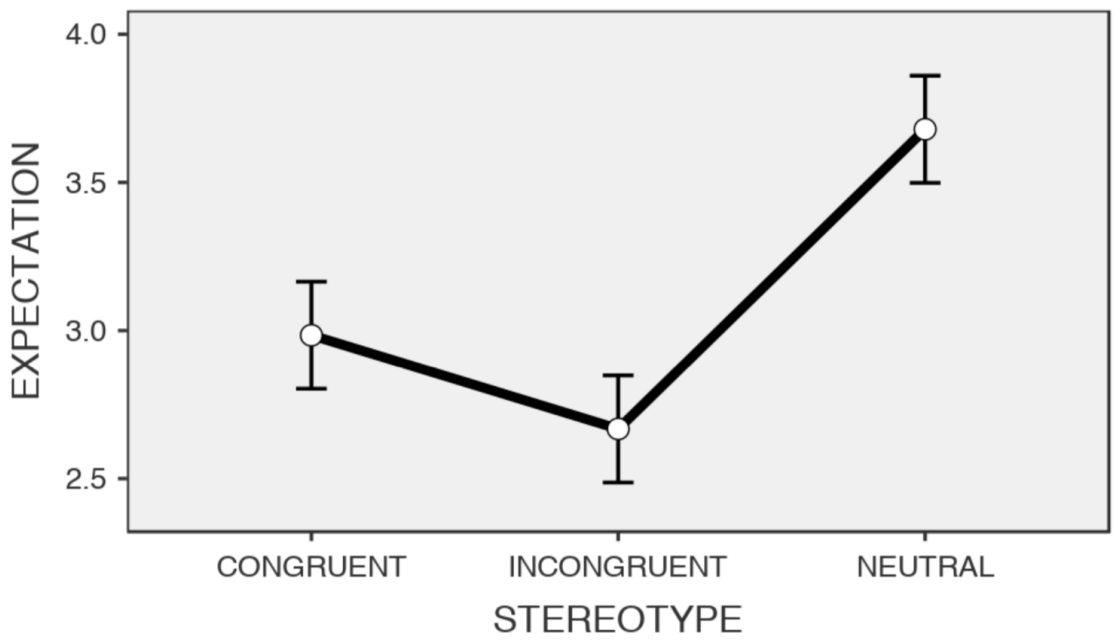

Figure 4.3. *The figure shows the average scores of expectation ("Did you expect the sentence to end that way?"; 1= not at all., 5=very much) attributed to sentences that were congruent, incongruent or neutral in regard to stereotypes.*

An additional mixed model analysis examined how the ratings of expectation varied as a function of speakers' foreign accent (African, Arabic, Chinese, Eastern European, Indian, Latin) and the sentence congruency to racial stereotypes (congruent and incongruent), including as random effect the subjects.

The analysis showed a main effect of accent ($F (5, 8599) = 17.63$, $p < .001$), stereotype congruency ($F (1, 8599) = 248.48$, $p < .001$) and of their interaction ($F (5, 8599) = 20.47$, $p < .001$), with a $R^2 = 0.26$. As evidenced in the previous analysis, sentences that violated racial stereotypes (expectation = 2.64, SE = .07) were less expected ($t(8599) = 15.8$, pBonferroni< .001) than stereotype-congruent sentences (expectation = 2.99, SE = .07).

Sentences spoken by voices with an Arabic (expectation = 2.73, SE =.07), Chinese (expectation = 2.66, SE =.07) and Indian accent (expectation = 2.78, SE =.07) were, regardless of the congruency, less expected than sentences pronounced by Latin (expectation = 2.95, SE =.07) and Eastern European accents (expectation = 2.92, SE =.07). Sentences spoken by African accents (expectation

= 2.83, SE = .07) were overall more expected than the ones pronounced by Chinese and Arabic accents, but less expected than the Latin ones (see table 4.1 for post hoc comparisons).

Comparison			Estimate	SE	test	df	$p_{bonferroni}$
ACCENT		ACCENT					
CHINESE	-	EAST_EUROPEAN	-0.2607	0.0421	-6.197	8599	< .001
CHINESE	-	INDIAN	-0.1149	0.0435	-2.639	8599	0.125
CHINESE	-	LATIN	-0.2904	0.0373	-7.788	8599	< .001
AFRICAN	-	CHINESE	0.1698	0.0368	4.610	8599	< .001
AFRICAN	-	ARABIC	0.1021	0.0343	2.974	8599	0.044
AFRICAN	-	EAST_EUROPEAN	-0.0909	0.0368	-2.467	8599	0.204
AFRICAN	-	INDIAN	0.0549	0.0385	1.425	8599	1.000
AFRICAN	-	LATIN	-0.1206	0.0313	-3.857	8599	0.002
ARABIC	-	CHINESE	0.0677	0.0399	1.696	8599	1.000
ARABIC	-	EAST_EUROPEAN	-0.1930	0.0399	-4.837	8599	< .001
ARABIC	-	INDIAN	-0.0472	0.0415	-1.139	8599	1.000
ARABIC	-	LATIN	-0.2228	0.0348	-6.394	8599	< .001
EAST_EUROPEAN	-	INDIAN	0.1458	0.0435	3.348	8599	0.012
EAST_EUROPEAN	-	LATIN	-0.0297	0.0373	-0.797	8599	1.000
INDIAN	-	LATIN	-0.1755	0.0389	-4.506	8599	< .001

Table 4.1. *Post Hoc comparisons for the accent factor at the expectation scale. SE = standard error; df = degrees of freedom.*

The interaction revealed that sentences that were congruent to stereotypes received higher ratings of expectation compared to incongruent sentences when spoken by all accents except Arabic, where the difference wasn't statistically significant (figure 4.4 and table 4.2 and 4.3).

Comparison			Estimate	SE	test	df	$p_{bonferroni}$
Stereotype ACCENT		Stereotype ACCENT					
Congruent CHINESE	-	Incongruent CHINESE	0.37321	0.0595	62.729	8599	< .001
Congruent AFRICAN	-	Incongruent AFRICAN	0.28571	0.0434	65.758	8599	< .001
Congruent ARABIC	-	Incongruent ARABIC	-0.04143	0.0532	-0.7785	8599	1.000
Congruent E. EUROPEAN	-	Incongruent E. EUROPEAN	0.45893	0.0595	77.136	8599	< .001
Congruent INDIAN	-	Incongruent INDIAN	0.76122	0.0636	119.682	8599	< .001
Congruent LATIN	-	Incongruent LATIN	0.26939	0.0450	59.898	8599	< .001

Table 4.2. *Post Hoc comparisons for the interaction between stereotype congruency and accent at the expectation scale. SE = standard error; df = degrees of freedom.*

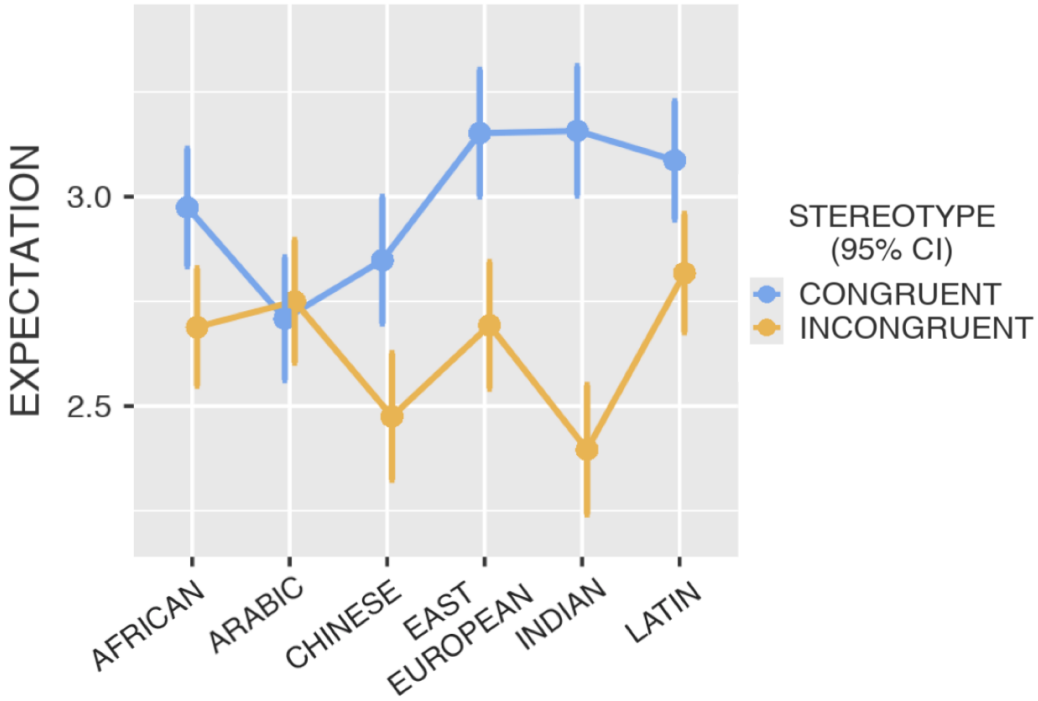

Figure 4.4. *The figure shows the average scores of expectation ("Did you expect the sentence to end that way?"; 1= not at all., 5=very much) attributed to sentences that were congruent or incongruent to stereotypes according to the accent of pronunciation.*

				95% Confidence Interval	
ACCENT	STEREOTYPE	Mean	SE	Lower	Upper
African	Congruent	2.97	0.07	2.83	3.11
Arabic	Congruent	2.71	0.07	2.56	2.86
Chinese	Congruent	2.85	0.08	2.70	3.00
East European	Congruent	3.15	0.08	3.00	3.30
Indian	Congruent	3.16	0.08	3.00	3.31
Latin	Congruent	3.09	0.07	2.95	3.23
African	Incongruent	2.69	0.07	2.55	2.83
Arabic	Incongruent	2.75	0.07	2.60	2.90
Chinese	Incongruent	2.48	0.08	2.32	2.63
East European	Incongruent	2.69	0.08	2.54	2.84
Indian	Incongruent	2.40	0.08	2.24	2.55
Latin	Incongruent	2.82	0.07	2.68	2.96

Table 4.3. *Marginal means of expectation scores of congruent and incongruent sentences sorted by accent of pronunciation. SE = standard error.*

4.3.4 Processing fluency.

By means of linear mixed model analysis, the evaluations on the ease of understanding (or processing fluency) of the sentences were analyzed in function of the Stereotype factor (congruent, incongruent, neutral), including as random effect both the subjects and the sentence-stimuli.

The analysis, as visible in figure 4.5, revealed a main effect of stereotype ($F(2, 183) = 77.62$, $p < .001$, $R^2 = .60$), indicating that neutral sentences, spoken with standard Italian accents, (fluency = 4.89, SE = .07) were easier to understand than congruent ($t(183) = 11.22$, pBonferroni<.001; fluency = 3.96, SE =.07) and incongruent sentences ($t(183) = 10.31$, pBonferroni<.001; fluency = 4.03, SE =.07), both pronounced by non-standard accents.

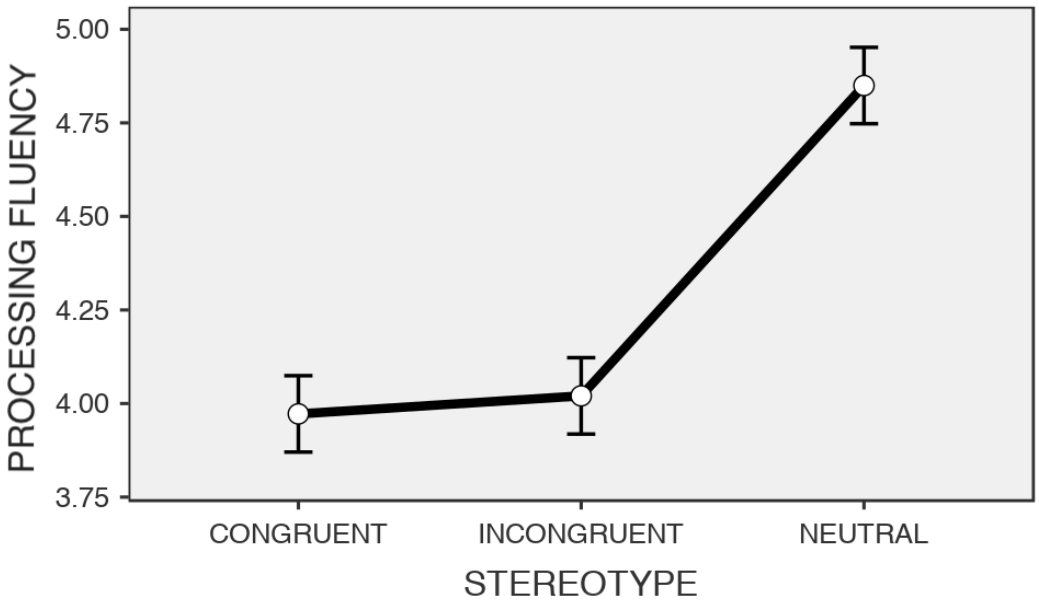

Figure 4.5. *The figure shows the average scores of processing fluency (1= not easy to understand, 5=very easy to understand) attributed to sentences that were congruent, incongruent or neutral in regard to stereotypes.*

An additional linear mixed model analysis was performed on the evaluation of the ease of understanding of sentences pronounced only by non-native Italian speakers, including as fixed factors the stereotype congruency (congruent, incongruent) and the accent (African, Arabic, Chinese, Eastern European, Indian, Latin), and as random effect the subject. The analysis ($R^2 = .32$)

revealed a main effect of stereotype (F (1, 8599) = 6.70, p = .010), indicating that sentences with a stereotype-incongruent content (fluency = 3.97, SE = .06) received higher scores of processing fluency (t(8599) = 2.59, pBonferroni = .01) compared to sentences with stereotype-congruent content (fluency = 3.92, SE = .06). Moreover, as represented in figure 4.6, the analysis revealed a significant effect of accent (F (5, 8599) = 174.27, p < .001), such that sentences spoken with Indian accents (fluency = 3.34, SE = .06) were the least easy to understand compared to all the others. Subsequently, sentences spoken by Chinese (fluency = 3.87, SE = .06) and Arabic accents (fluency = 3.97, SE = .06), resulted harder to understand compared to those pronounced in African (fluency = 4.14, SE = .06), and Latin accents (fluency = 4.09, SE = .06). Sentences pronounced by East European voices (fluency = 4.28, SE = .06) received the highest ratings of processing fluency, greater than all the other sentences (see table 4.4 for post hoc comparisons).

Comparison			Estimate	SE	test	df	$p_{bonferroni}$
ACCENT		ACCENT					
CHINESE	-	EAST_EUROPEAN	-0.4152	0.0350	-11.86	8599	< .001
CHINESE	-	INDIAN	0.5310	0.0362	14.65	8599	< .001
CHINESE	-	LATIN	-0.2261	0.0310	-7.29	8599	< .001
AFRICAN	-	CHINESE	0.2689	0.0307	8.77	8599	< .001
AFRICAN	-	ARABIC	0.1726	0.0286	6.04	8599	< .001
AFRICAN	-	EAST_EUROPEAN	-0.1463	0.0307	-4.77	8599	< .001
AFRICAN	-	INDIAN	0.7999	0.0321	24.95	8599	< .001
AFRICAN	-	LATIN	0.0427	0.0260	1.64	8599	1.000
ARABIC	-	CHINESE	0.0962	0.0332	2.90	8599	0.056
ARABIC	-	EAST_EUROPEAN	-0.3189	0.0332	-9.60	8599	< .001
ARABIC	-	INDIAN	0.6272	0.0345	18.18	8599	< .001
ARABIC	-	LATIN	-0.1299	0.0290	-4.48	8599	< .001
EAST_EUROPEAN	-	INDIAN	0.9462	0.0362	26.11	8599	< .001
EAST_EUROPEAN	-	LATIN	0.1890	0.0310	6.09	8599	< .001
INDIAN	-	LATIN	-0.7571	0.0324	-23.36	8599	< .001

Table 4.4. *Post Hoc comparisons for the accent factor at the processing fluency scale. SE = standard error; df = degrees of freedom.*

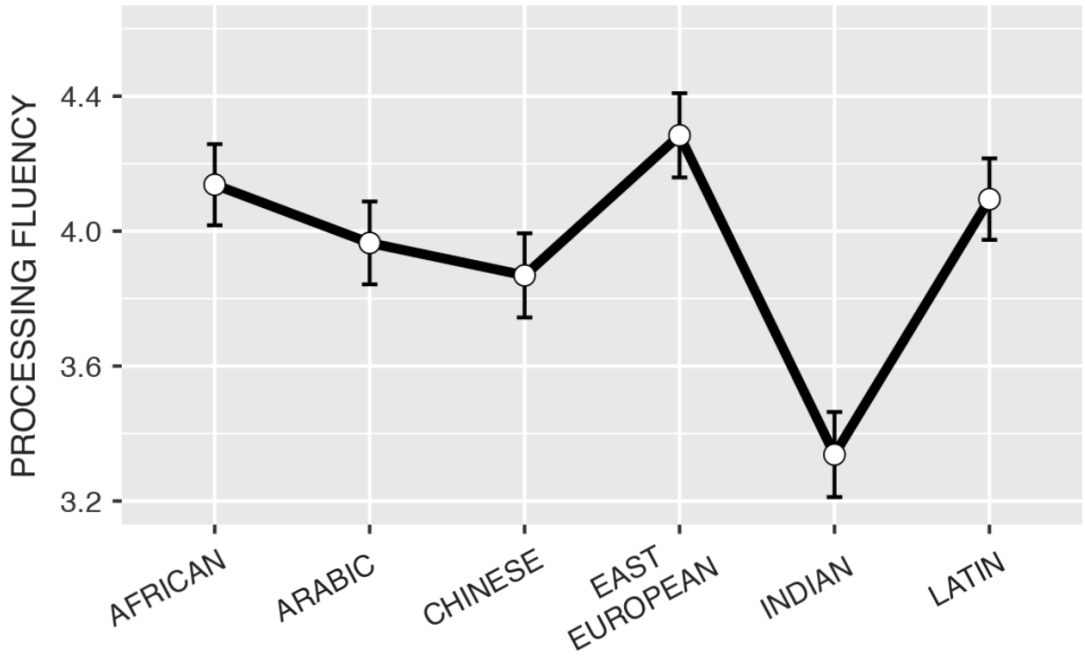

Figure 4.6. *The figure shows the average scores of processing fluency attributed to sentences according to the speakers' accents.*

In addition, a significant interaction between stereotype congruency and accent was found (F (5, 8599) = 2.23, p = .048), revealing that while sentences pronounced by African, Arabic and Eastern European, accents didn't receive different processing fluency ratings according to the stereotype congruency of the sentence, incongruent sentences pronounced with Latin and Chinese accents received higher scores of processing fluency compared to congruent ones. Contrarily, congruent sentences spoken with Indian accents where easier to understand compared to incongruent sentences (see table 4.5 and 4.6).

Comparison							
Stereotype ACCENT		Stereotype ACCENT	Estimate	SE	test	df	$p_{bonferroni}$
Congruent CHINESE	-	Incongruent CHINESE	-0.22679	0.0495	-45.800	8599	< .001
Congruent AFRICAN	-	Incongruent AFRICAN	-0.04667	0.0362	-12.905	8599	1.000
Congruent ARABIC	-	Incongruent ARABIC	-0.02429	0.0443	-0.5484	8599	1.000
Congruent E. EUROPEAN	-	Incongruent E. EUROPEAN	-0.01071	0.0495	-0.2164	8599	1.000
Congruent INDIAN	-	Incongruent INDIAN	0.30816	0.0529	58.215	8599	< .001
Congruent LATIN	-	Incongruent LATIN	-0.28776	0.0374	-76.877	8599	< .001

Table 4.5. *Post Hoc comparisons for the interaction between stereotype congruency and accent at the processing fluency scale. SE = standard error; df = degrees of freedom.*

				95% Confidence Interval	
ACCENT	STEREOTYPE	Mean	SE	Lower	Upper
African	Congruent	4.11	0.06	3.99	4.24
Arabic	Congruent	3.95	0.07	3.82	4.08
Chinese	Congruent	3.75	0.07	3.62	3.89
East European	Congruent	4.28	0.07	4.14	4.41
Indian	Congruent	3.49	0.07	3.36	3.63
Latin	Congruent	3.95	0.06	3.82	4.08
African	Incongruent	4.16	0.06	4.04	4.29
Arabic	Incongruent	3.98	0.07	3.85	4.11
Chinese	Incongruent	3.98	0.07	3.85	4.12
East European	Incongruent	4.29	0.07	4.16	4.42
Indian	Incongruent	3.18	0.07	3.05	3.32
Latin	Incongruent	4.24	0.06	4.11	4.36

Table 4.6. *Marginal means of processing fluency scores of congruent and incongruent sentences sorted by accent of pronunciation. SE = standard error.*

4.3.5 Expectation and Processing fluency

To evaluate the relation between the scores of expectation and those of processing fluency a Spearman correlation was performed and revealed a positive linear correlation between the two measures (rho = .32, p < .001) (figure 4.7).

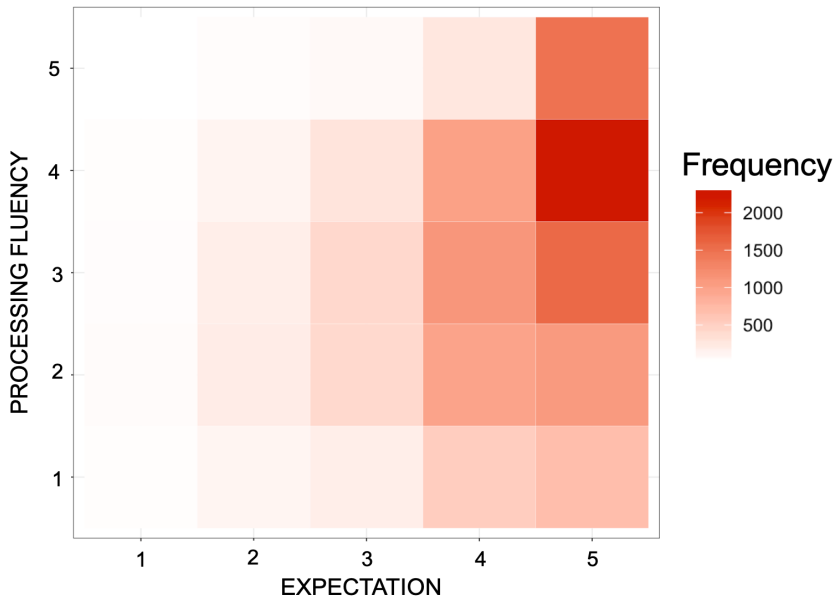

Figure 4.7. *Relation between the ratings attributed to the expectation and processing fluency scales. The heatmap shows the frequency of the observation of each interaction.*

4.3.6 Voice attributes

Friendliness. By means of linear mixed model analysis, the ratings obtained at the perceived friendliness scale were analyzed in function of the Stereotype factor (congruent, incongruent, neutral), including as random effect both the subjects and the sentence-stimuli.

As visible in figure 4.8, the analysis (R^2 = 0.35) revealed a main effect of stereotype (F (2, 183) = 19.71, p < .001), indicating that the voices in the neutral condition (neutral = 3.50, SE= 0.09) received higher friendliness ratings compared to those in the congruent (t(183) = 6.28, pBonferroni<.001) and incongruent conditions (t(183) = 3.17, pBonferroni =.005). Moreover, the voices that pronounced sentences violating the racial stereotype (incongruent = 3.32, SE = 0.07) were friendlier (t(183) = 3.11, pBonferroni =.006) than the ones confirming the stereotypes (congruent = 3.14, SE = 0.07).

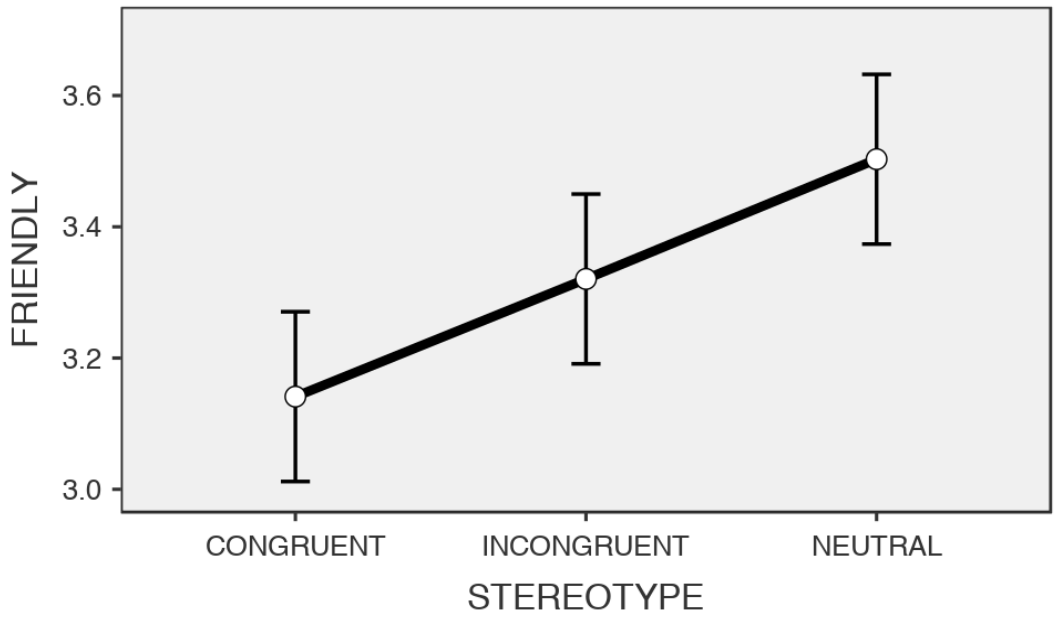

Figure 4.8. *The figure shows the average scores of perceived friendliness (1= not very friendly, 5=very friendly) attributed to voices that pronounced stereotype -congruent, -incongruent or -neutral sentences.*

An additional mixed model analysis examined how the ratings of perceived friendliness varied as a function of speakers' foreign accent (African, Arabic, Chinese, Eastern European, Indian, Latin) and the sentence congruency to racial stereotypes (congruent and incongruent), including as random effect the subjects.

The analysis (R^2 = .26) revealed a main effect of stereotype (F (1, 8599) = 86.98, p <.001), indicating that speakers of sentences with a stereotype-incongruent content (friendliness = 3.31, SE = .06) received higher scores of perceived friendliness (t(8599) = 0.33, pBonferroni<.001) compared to speakers of sentences with stereotype-congruent content (friendliness = 3.14, SE = .06).

Moreover, the analysis revealed a significant effect of accent (F (5, 8599) = 21.05, p < .001), indicating that voices with African (friendliness = 3.31, SE = .06), East European (friendliness = 3.11, SE = .06), Indian (friendliness = 3.26, SE = .06) and Latin accents (friendliness = 3.26, SE = .06) were perceived more friendly than voices with Arabic (friendliness = 3.09, SE = .06) and Chinese accents (friendliness = 3.11, SE = .06) (see table 4.7 for post hoc comparisons).

Comparison							
ACCENT		ACCENT	Estimate	SE	test	df	$p_{bonferroni}$
CHINESE	-	EAST_EUROPEAN	-0.20625	0.0340	-6.074	8599	< .001
CHINESE	-	INDIAN	-0.15293	0.0351	-4.351	8599	< .001
CHINESE	-	LATIN	-0.15293	0.0301	-5.081	8599	< .001
AFRICAN	-	CHINESE	0.20232	0.0297	6.805	8599	< .001
AFRICAN	-	ARABIC	0.21929	0.0277	7.910	8599	< .001
AFRICAN	-	EAST_EUROPEAN	-0.00393	0.0297	-0.132	8599	1.000
AFRICAN	-	INDIAN	0.04939	0.0311	1.589	8599	1.000
AFRICAN	-	LATIN	0.04939	0.0252	1.957	8599	0.755
ARABIC	-	CHINESE	-0.01696	0.0322	-0.527	8599	1.000
ARABIC	-	EAST_EUROPEAN	-0.22321	0.0322	-6.929	8599	< .001
ARABIC	-	INDIAN	-0.16990	0.0335	-5.077	8599	< .001
ARABIC	-	LATIN	-0.16990	0.0281	-6.043	8599	< .001
EAST_EUROPEAN	-	INDIAN	0.05332	0.0351	1.517	8599	1.000
EAST_EUROPEAN	-	LATIN	0.05332	0.0301	1.771	8599	1.000
INDIAN	-	LATIN	1.83e-15	0.0314	5.831	8599	1.000

Table 4.7. *Post Hoc comparisons for the accent factor at the friendliness scale. SE = standard error; df = degrees of freedom.*

The interaction between stereotype congruency and accent (F (5, 8599) = 17.68, p <.001) revealed that voices with Arabic, Eastern European and Latin accents were perceived as more friendly when pronounced stereotype-incongruent sentences than stereotype-congruent sentences. Such difference wasn't encountered considering voices with Chinese, African and Indian accents (see figure 4.9 and table 4.8 and 4.9).

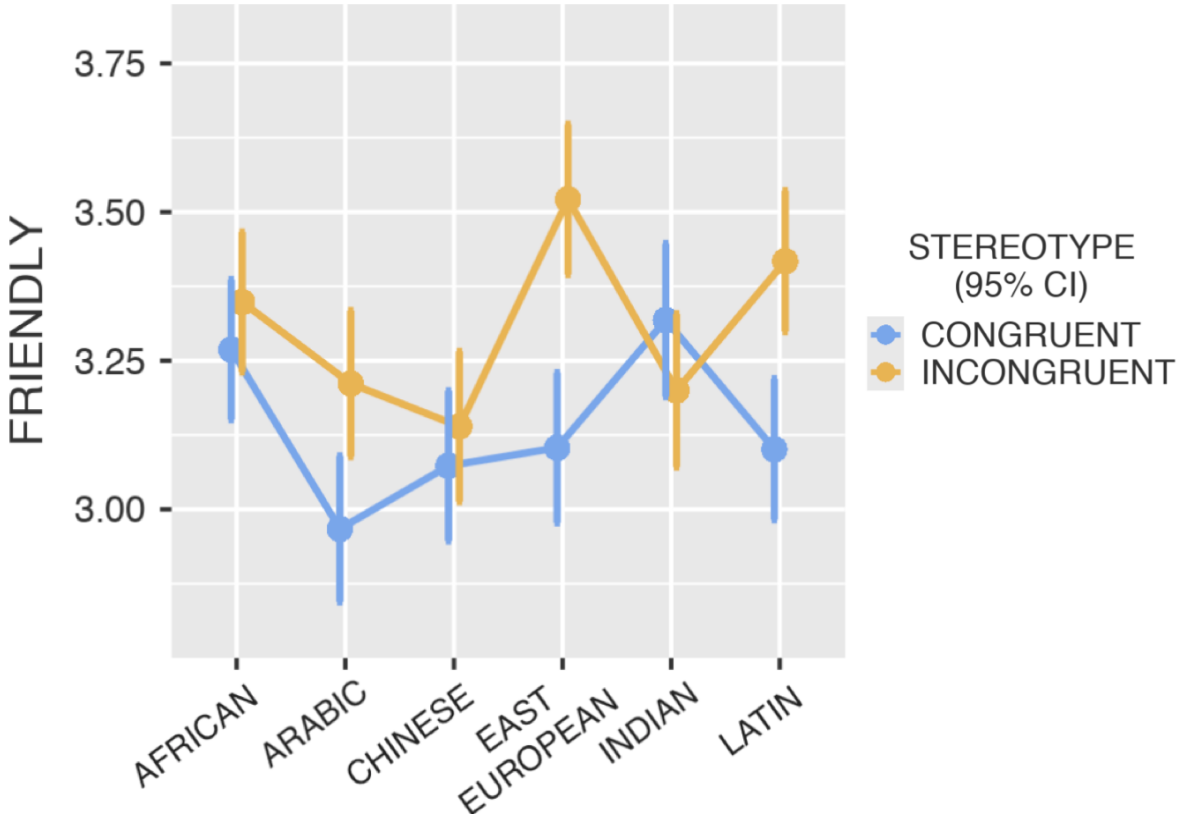

Figure 4.9. *The figure shows the average scores of perceived friendliness (1= not very friendly, 5=very friendly) attributed to voices according to the accent of pronunciation of sentences that were congruent or incongruent to stereotypes.*

Comparison							
Stereotype ACCENT		Stereotype ACCENT	Estimate	SE	test	df	$p_{bonferroni}$
Congruent CHINESE	-	Incongruent CHINESE	-0.06607	0.0480	-13.759	8599	1.000
Congruent AFRICAN	-	Incongruent AFRICAN	-0.08000	0.0351	-22.813	8599	1.000
Congruent ARABIC	-	Incongruent ARABIC	-0.24429	0.0429	-56.877	8599	< .001
Congruent E. EUROPEAN	-	Incongruent E. EUROPEAN	-0.41786	0.0480	-87.019	8599	< .001
Congruent INDIAN	-	Incongruent INDIAN	0.11837	0.0513	23.058	8599	1.000
Congruent LATIN	-	Incongruent LATIN	-0.31633	0.0363	-87.145	8599	< .001

Table 4.8. *Post Hoc comparisons for the interaction between stereotype congruency and accent at the friendliness scale. SE = standard error; df = degrees of freedom.*

				95% Confidence Interval	
ACCENT	STEREOTYPE	Mean	SE	Lower	Upper
African	Congruent	3.27	0.06	3.15	3.39
Arabic	Congruent	2.97	0.06	2.84	3.09
Chinese	Congruent	3.07	0.06	2.95	3.20
East European	Congruent	3.10	0.06	2.98	3.23
Indian	Congruent	3.32	0.07	3.19	3.45
Latin	Congruent	3.10	0.06	2.98	3.22
African	Incongruent	3.35	0.06	3.23	3.47
Arabic	Incongruent	3.21	0.06	3.09	3.33
Chinese	Incongruent	3.14	0.06	3.01	3.27
East European	Incongruent	3.52	0.06	3.40	3.65
Indian	Incongruent	3.20	0.07	3.07	3.33
Latin	Incongruent	3.42	0.06	3.30	3.54

Table 4.9. *Marginal means of perceived friendliness of voices pronouncing congruent and incongruent sentences sorted by accent of pronunciation. SE = standard error.*

Pleasantness. By means of linear mixed model analysis, the ratings obtained at the pleasantness scale were analyzed in function of the Stereotype factor (congruent, incongruent, neutral), including as random effect both the subjects and the sentence-stimuli.

As visible in figure 4.10, the analysis (R^2 = 0.36) revealed a main effect of stereotype ($F(2, 183) = 50.55$, $p < .001$), indicating that the voices in the neutral condition (neutral = 3.54, SE= 0.06) received higher ratings of pleasantness compared to those in the congruent ($t(183) = 9.89$, pBonferroni<.001) and incongruent conditions ($t(183) = 6.52$, pBonferroni<.001). Moreover, the voices that pronounced counter-stereotypical sentences (incongruent = 3.17, SE = 0.06) were more pleasant ($t(183) = 3.37$, pBonferroni=.002) than the ones confirming the stereotypes (congruent = 2.97, SE = 0.06).

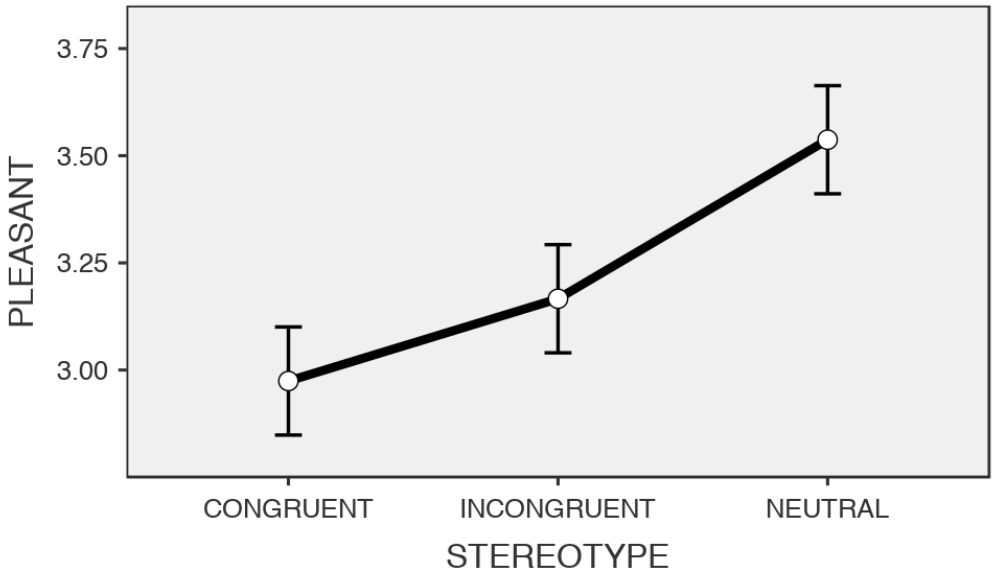

Figure 4.10. *The figure shows the average scores of pleasantness (1= not very pleasant, 5=very pleasant) attributed to voices that pronounced stereotype -congruent, -incongruent or -neutral sentences.*

An additional linear mixed model analysis was performed on the evaluation of perceived pleasantness of the voices of non-native Italian speakers, including as fixed factors the stereotype congruency of the sentence (congruent, incongruent) and the accent of the speaker (African, Arabic, Chinese, Eastern European, Indian, Latin), and as random effect the subject. The analysis (R^2 = .28) revealed a significant effect of stereotype (F (1, 8599) = 94.92, p <.001), indicating that in sentences with a stereotype-incongruent content voices (pleasantness = 3.14, SE = .06) received higher scores of perceived friendliness (t(8599) = 9.74, pBonferroni<.001) compared to sentences with stereotype-congruent content (pleasantness = 2.96, SE = .06).

Moreover, the analysis revealed a significant effect of accent (F (5, 8599) = 53.69, p < .001), indicating that voices with East European (pleasantness = 3.23, SE = .06) and Latin accents (pleasantness = 3.24, SE = .06) were perceived more pleasant than voices with Arabic (pleasantness = 2.95, SE = .06), Chinese (pleasantness = 2.92, SE = .06), Indian (pleasantness = 2.87, SE = .06) and African accents (pleasantness = 3.08, SE = .06). The latter, however, received higher ratings of pleasantness compared to the previous ones (see table 4.10 for post hoc comparisons).

Comparison			Estimate	SE	test	df	$p_{bonferroni}$
ACCENT		ACCENT					
CHINESE	-	EAST_EUROPEAN	-0.31161	0.0337	-9.246	8599	< .001
CHINESE	-	INDIAN	0.04809	0.0349	1.378	8599	1.000
CHINESE	-	LATIN	-0.31824	0.0299	-10.652	8599	< .001
AFRICAN	-	CHINESE	0.16232	0.0295	5.500	8599	< .001
AFRICAN	-	ARABIC	0.13786	0.0275	5.010	8599	< .001
AFRICAN	-	EAST_EUROPEAN	-0.14929	0.0295	-5.059	8599	< .001
AFRICAN	-	INDIAN	0.21041	0.0309	6.819	8599	< .001
AFRICAN	-	LATIN	-0.15592	0.0250	-6.224	8599	< .001
ARABIC	-	CHINESE	0.02446	0.0320	0.765	8599	1.000
ARABIC	-	EAST_EUROPEAN	-0.28714	0.0320	-8.981	8599	< .001
ARABIC	-	INDIAN	0.07255	0.0332	2.184	8599	0.434
ARABIC	-	LATIN	-0.29378	0.0279	-10.526	8599	< .001
EAST_EUROPEAN	-	INDIAN	0.35969	0.0349	10.310	8599	< .001
EAST_EUROPEAN	-	LATIN	-0.00663	0.0299	-0.222	8599	1.000
INDIAN	-	LATIN	-0.36633	0.0312	-11.740	8599	< .001

Table 4.10. *Post Hoc comparisons for the accent factor at the pleasantness scale. SE = standard error; df = degrees of freedom.*

The interaction between stereotype congruency and accent (F (5, 8599) = 16.88, p <.001) revealed that voices with Arabic, Eastern European and Latin accents were perceived as more pleasant when pronounced stereotype-incongruent sentences than stereotype-congruent sentences. Such difference wasn't encountered considering voices with Chinese, African and Indian accents (see figure 4.11 and table 4.11 and 4.12).

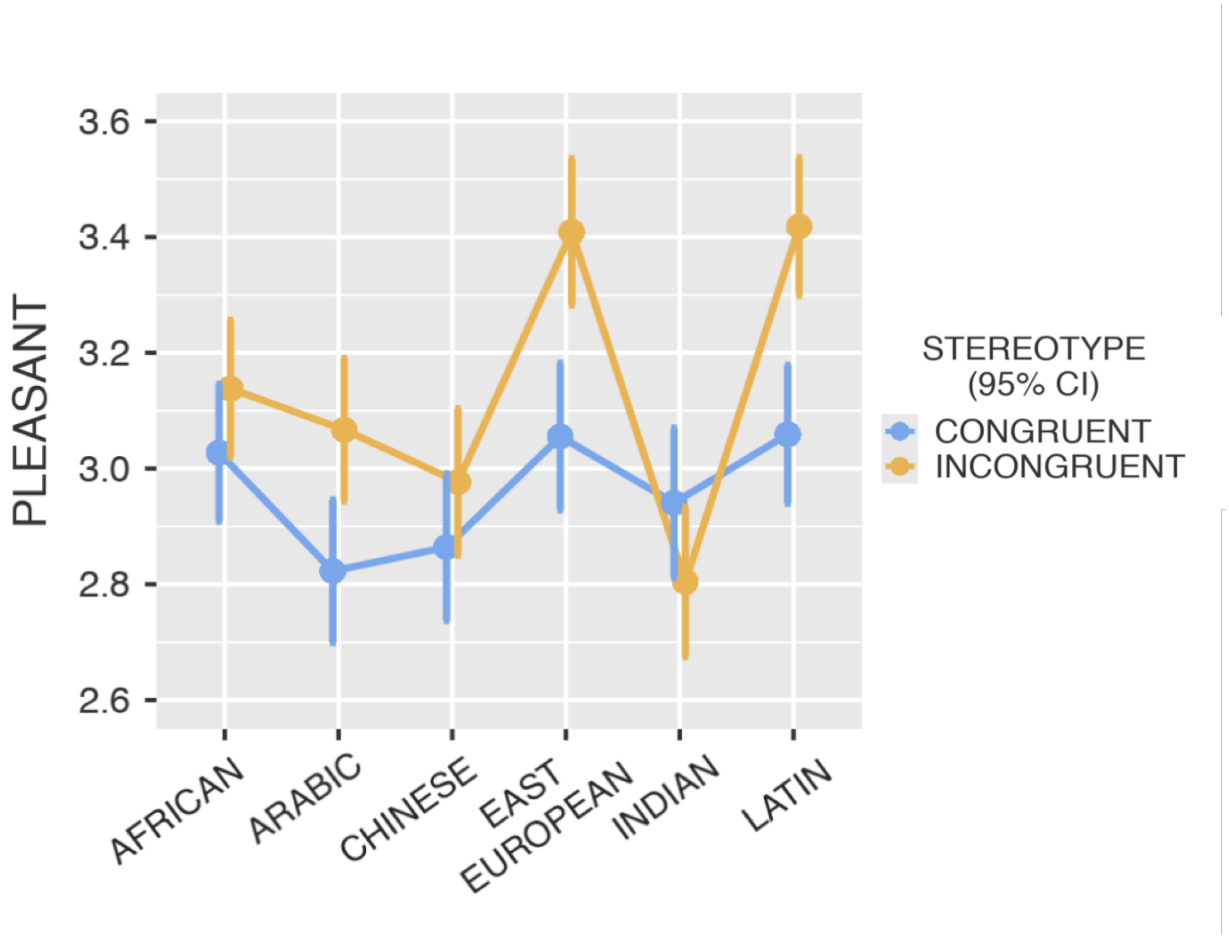

Figure 4.11. *The figure shows the average scores of perceived pleasantness (1= not very pleasant, 5=very pleasant) attributed to voices according to the accent of pronunciation of sentences that were congruent or incongruent to stereotypes.*

Comparison							
Stereotype ACCENT		Stereotype ACCENT	Estimate	SE	test	df	$p_{bonferroni}$
Congruent CHINESE	-	Incongruent CHINESE	-0.11250	0.0477	-23.603	8599	1.000
Congruent AFRICAN	-	Incongruent AFRICAN	-0.11048	0.0348	-31.738	8599	0.099
Congruent ARABIC	-	Incongruent ARABIC	-0.24429	0.0426	-57.301	8599	< .001
Congruent E. EUROPEAN	-	Incongruent E. EUROPEAN	-0.35357	0.0477	-74.180	8599	< .001
Congruent INDIAN	-	Incongruent INDIAN	0.13673	0.0510	26.835	8599	0.481
Congruent LATIN	-	Incongruent LATIN	-0.35918	0.0360	-99.689	8599	< .001

Table 4.11. *Post Hoc comparisons for the interaction between stereotype congruency and accent at the pleasantness scale. SE = standard error; df = degrees of freedom.*

				95% Confidence Interval	
ACCENT	STEREOTYPE	Mean	SE	Lower	Upper
African	Congruent	3.03	0.06	2.91	3.15
Arabic	Congruent	2.82	0.06	2.70	2.95
Chinese	Congruent	2.86	0.06	2.74	2.99
East European	Congruent	3.06	0.06	2.93	3.18
Indian	Congruent	2.94	0.07	2.81	3.07
Latin	Congruent	3.06	0.06	2.94	3.18
African	Incongruent	3.14	0.06	3.02	3.26
Arabic	Incongruent	3.07	0.06	2.94	3.19
Chinese	Incongruent	2.98	0.06	2.85	3.10
East European	Incongruent	3.41	0.06	3.28	3.54
Indian	Incongruent	2.80	0.07	2.67	2.93
Latin	Incongruent	3.42	0.06	3.30	3.54

Table 4.12. *Marginal means of perceived pleasantness of voices pronouncing congruent and incongruent sentences sorted by accent of pronunciation. SE = standard error.*

Competence. By means of linear mixed model analysis, the ratings obtained at the competence scale were analyzed in function of the Stereotype factor (congruent, incongruent, neutral), including as random effect both the subjects and the sentence-stimuli.

As visible in figure 4.12, the analysis revealed (R^2 = 0.40) a main effect of stereotype ($F(2, 183) = 115.28$, $p < .001$), indicating that the voices in the neutral condition (neutral = 3.72, SE= 0.06) received higher ratings of competence compared to those in the congruent ($t(183) = 15.16$, pBonferroni<.001) and incongruent conditions ($t(183) = 8.30$, pBonferroni<.001). Moreover, the voices that pronounced counter-stereotypical sentences (incongruent = 3.30, SE = 0.06) were more competent ($t(183) = 6.86$, pBonferroni <.001) than the ones confirming the stereotypes (congruent = 2.96, SE = 0.06).

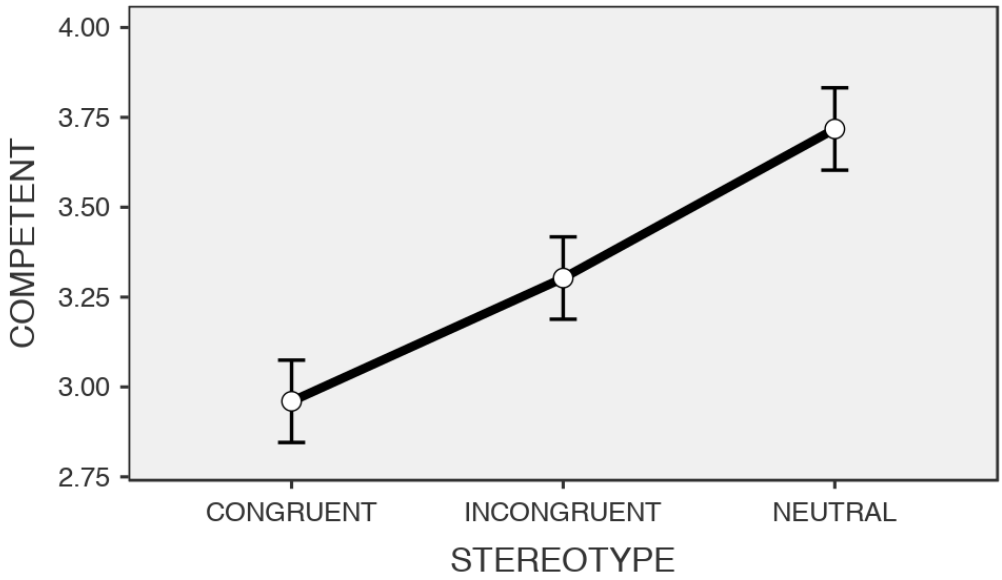

Figure 4.12. *The figure shows the average scores of competence (1= not very competent, 5=very competent) attributed to voices that pronounced stereotype -congruent, -incongruent or -neutral sentences.*

A linear mixed model analysis was performed on the evaluation of perceived competence of the voices of non-native Italian speakers, including as fixed factors the stereotype congruency of the sentence (congruent, incongruent) and the accent of the speaker (African, Arabic, Chinese, Eastern European, Indian, Latin), and as random effect the subject. The analysis (R^2 = .28) revealed a significant effect of stereotype (F (1, 8599) = 373.41, p <.001), indicating that in sentences with a stereotype-incongruent content the voices (competence = 3.29, SE = .05) received higher scores of perceived competence (t(8599) = 19.3, pBonferroni<.001) compared to sentences with stereotype-congruent content (competence = 2.98, SE = .05).

Moreover, the analysis revealed a significant effect of accent (F (5, 8599) = 16.94, p < .001), indicating that voices with East European accents (competence = 3.27, SE = .06) were perceived more competent than voices with Indian (competence = 3.07, SE = .06), African (competence = 3.12, SE = .06), Arabic (competence = 3.02, SE = .06) and Latin accents (competence = 3.15, SE = .05). Voices with Chinese accents (competence = 3.19, SE = .06), similarly to Eastern European accents, were rated as more competent than voices with Indian and Arabic accents, but didn't differ

statistically from voices with Latin and African accents. The latter were, in turn, both rated as more competent than Arabic accents, but not than Indian accents (see table 4.13 for post hoc comparisons).

Comparison			Estimate	SE	test	df	$p_{bonferroni}$
ACCENT		ACCENT					
CHINESE	-	EAST_EUROPEAN	-0.0750	0.0312	-2.40	8599	0.244
CHINESE	-	INDIAN	0.1177	0.0323	3.64	8599	0.004
CHINESE	-	LATIN	0.0417	0.0277	1.51	8599	1.000
AFRICAN	-	CHINESE	-0.0740	0.0273	-2.71	8599	0.102
AFRICAN	-	ARABIC	0.0976	0.0255	3.83	8599	0.002
AFRICAN	-	EAST_EUROPEAN	-0.1490	0.0273	-5.45	8599	< .001
AFRICAN	-	INDIAN	0.0437	0.0286	1.53	8599	1.000
AFRICAN	-	LATIN	-0.0323	0.0232	-1.39	8599	1.000
ARABIC	-	CHINESE	-0.1716	0.0296	-5.80	8599	< .001
ARABIC	-	EAST_EUROPEAN	-0.2466	0.0296	-8.33	8599	< .001
ARABIC	-	INDIAN	-0.0539	0.0308	-1.75	8599	1.000
ARABIC	-	LATIN	-0.1299	0.0258	-5.03	8599	< .001
EAST_EUROPEAN	-	INDIAN	0.1927	0.0323	5.97	8599	< .001
EAST_EUROPEAN	-	LATIN	0.1167	0.0277	4.22	8599	< .001
INDIAN	-	LATIN	-0.0760	0.0289	-2.63	8599	0.128

Table 4.13. *Post Hoc comparisons for the accent factor at the competence scale. SE = standard error; df = degrees of freedom.*

The interaction between stereotype congruency and accent (F (5, 8599) = 10.09, p <.001) revealed that all non-native Italian accent were perceived as more competent when pronounced stereotype-incongruent sentences than when speaking stereotype-congruent sentences (see figure 4.13 and table 4.14 an 4.15).

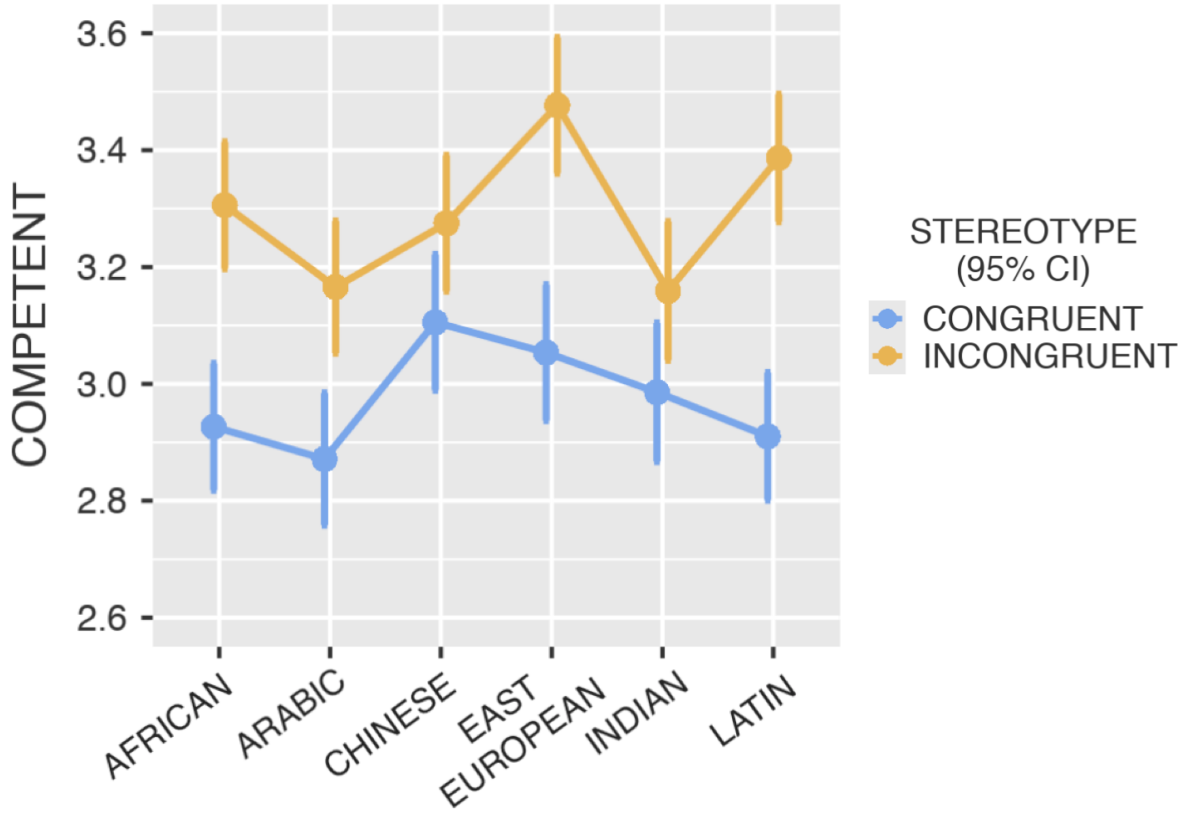

Figure 4.13. *The figure shows the average scores of perceived competence (1= not very competent, 5=very competent) attributed to voices according to the accent of pronunciation of sentences that were congruent or incongruent to stereotypes.*

Comparison							
Stereotype ACCENT		Stereotype ACCENT	Estimate	SE	test	df	$p_{bonferroni}$
Congruent CHINESE	-	Incongruent CHINESE	-0.16964	0.0441	-3.844	8599	0.008
Congruent AFRICAN	-	Incongruent AFRICAN	-0.37905	0.0322	-11.760	8599	< .001
Congruent ARABIC	-	Incongruent ARABIC	-0.29429	0.0395	-7.455	8599	< .001
Congruent E. EUROPEAN	-	Incongruent E. EUROPEAN	-0.42321	0.0441	-9.589	8599	< .001
Congruent INDIAN	-	Incongruent INDIAN	-0.17347	0.0472	-3.676	8599	0.016
Congruent LATIN	-	Incongruent LATIN	-0.47653	0.0334	-14.283	8599	< .001

Table 4.14. *Post Hoc comparisons for the interaction between stereotype congruency and accent at the competence scale. SE = standard error; df = degrees of freedom.*

ACCENT	STEREOTYPE	Mean	SE	95% Confidence Interval	
				Lower	Upper
African	Congruent	2.93	0.06	2.82	3.04
Arabic	Congruent	2.87	0.06	2.76	2.98
Chinese	Congruent	3.11	0.06	2.99	3.22
East European	Congruent	3.05	0.06	2.94	3.17
Indian	Congruent	2.99	0.06	2.87	3.10
Latin	Congruent	2.91	0.06	2.80	3.02
African	Incongruent	3.31	0.06	3.20	3.41
Arabic	Incongruent	3.17	0.06	3.05	3.28
Chinese	Incongruent	3.28	0.06	3.16	3.39
East European	Incongruent	3.48	0.06	3.36	3.59
Indian	Incongruent	3.16	0.06	3.04	3.28
Latin	Incongruent	3.39	0.06	3.28	3.50

Table 4.15. *Marginal means of perceived competence of voices pronouncing congruent and incongruent sentences sorted by accent of pronunciation. SE = standard error.*

Intelligence. By means of linear mixed model analysis, the ratings obtained at the intelligence scale were analysed in function of the Stereotype factor (congruent, incongruent, neutral), including as random effect both the subjects and the sentence-stimuli.

As visible in figure 4.14, the analysis revealed ($R^2 = 0.43$) a significant effect of stereotype ($F(2, 183) = 110.48$, $p < .001$), indicating that the voices in the neutral condition (neutral = 3.69, SE= 0.06) received higher ratings of intelligence compared to those in the congruent ($t(183) = 14.82$, pBonferroni<.001) and incongruent conditions ($t(183) = 8.41$, pBonferroni<.001). Moreover, the voices that pronounced counter-stereotypical sentences (incongruent = 3.33, SE = 0.06) were more intelligent ($t(183) = 6.41$, pBonferroni<.001) than the ones confirming the stereotypes (congruent = 3.06, SE = 0.06).

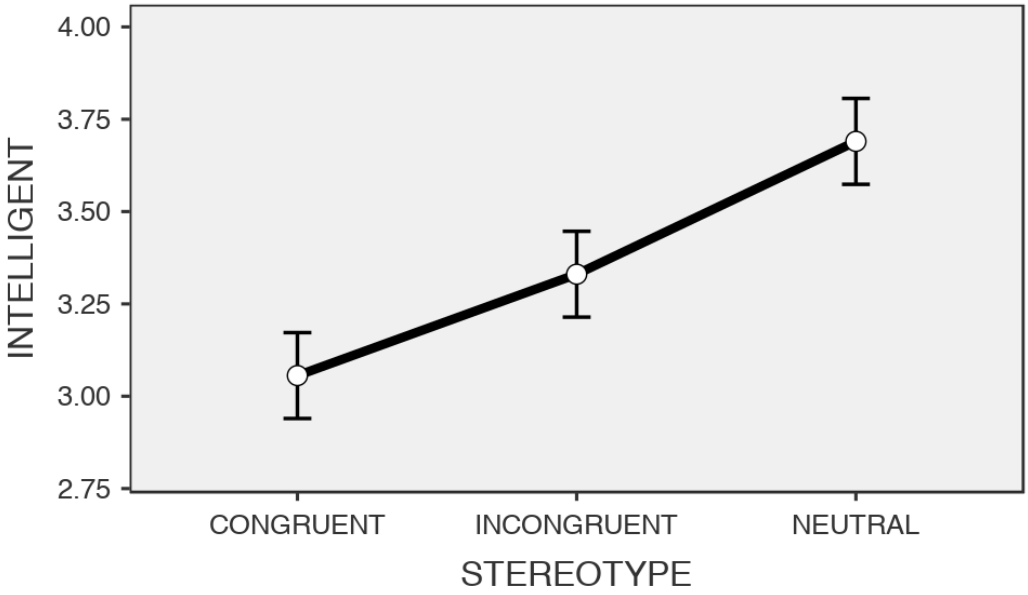

Figure 4.14. *The figure shows the average scores of intelligence (1= not very intelligent, 5=very intelligent) attributed to voices that pronounced stereotype -congruent, -incongruent or -neutral sentences.*

An additional mixed model analysis examined how the ratings of perceived intelligence varied as a function of speakers' foreign accent (African, Arabic, Chinese, Eastern European, Indian, Latin) and the sentence congruency to racial stereotypes (congruent and incongruent), including as random effect the subject. The analysis (R^2 = .33) revealed a significant effect of stereotype (F (1, 8599) = 323.67, p <.001), indicating that in sentences with a stereotype-incongruent content the voices (intelligence = 3.33, SE = .05) received higher scores of perceived intelligence (t(8599) = 18.0, pBonferroni<.001) compared to sentences with stereotype-congruent content (intelligence = 3.06, SE = .05).

Moreover, the analysis revealed a main effect of accent (F (5, 8599) = 16.58, p < .001), indicating that voices with East European accents (intelligence = 3.33, SE = .06) were perceived more intelligent than all the other non-native Italian accents. Subsequently, Latin accented voices (intelligence = 3.22, SE = .06) were rated as more intelligent than voices with Indian (intelligence = 3.10, SE = .06) and Arabic accents (intelligence = 3.13, SE = .06). Finally, voices with an African accent (intelligence = 3.18, SE = .06) were perceived as more intelligent than Indian accents

(intelligence = 3.15, SE = .05), but not different than Chinese (intelligence = 3.18, SE = .06) and Arabic ones (see table 4.16 for post hoc comparisons).

Comparison			Estimate	SE	test	df	$p_{bonferroni}$
ACCENT		ACCENT					
CHINESE	-	EAST_EUROPEAN	-0.14732	0.0284	-5.195	8599	< .001
CHINESE	-	INDIAN	0.08533	0.0294	2.907	8599	0.055
CHINESE	-	LATIN	-0.04375	0.0251	-1.740	8599	1.000
AFRICAN	-	CHINESE	0.00256	0.0248	0.103	8599	1.000
AFRICAN	-	ARABIC	0.05167	0.0232	2.231	8599	0.385
AFRICAN	-	EAST_EUROPEAN	-0.14476	0.0248	-5.830	8599	< .001
AFRICAN	-	INDIAN	0.08789	0.0260	3.385	8599	0.011
AFRICAN	-	LATIN	-0.04119	0.0211	-1.954	8599	0.760
ARABIC	-	CHINESE	-0.04911	0.0269	-1.825	8599	1.000
ARABIC	-	EAST_EUROPEAN	-0.19643	0.0269	-7.301	8599	< .001
ARABIC	-	INDIAN	0.03622	0.0280	1.296	8599	1.000
ARABIC	-	LATIN	-0.09286	0.0235	-3.954	8599	0.001
EAST_EUROPEAN	-	INDIAN	0.23265	0.0294	7.925	8599	< .001
EAST_EUROPEAN	-	LATIN	0.10357	0.0251	4.120	8599	< .001
INDIAN	-	LATIN	-0.12908	0.0263	-4.916	8599	< .001

Table 4.16. *Post Hoc comparisons for the accent factor at the intelligence scale. SE = standard error; df = degrees of freedom.*

The interaction between stereotype congruency and accent (F (5, 8599) = 6.83, p <.001) revealed that all non-native Italian accent were perceived as more intelligent (p <.005) when pronounced stereotype-incongruent sentences than when speaking stereotype-congruent sentences (see figure 4.15 and table 4.17 and 4.18).

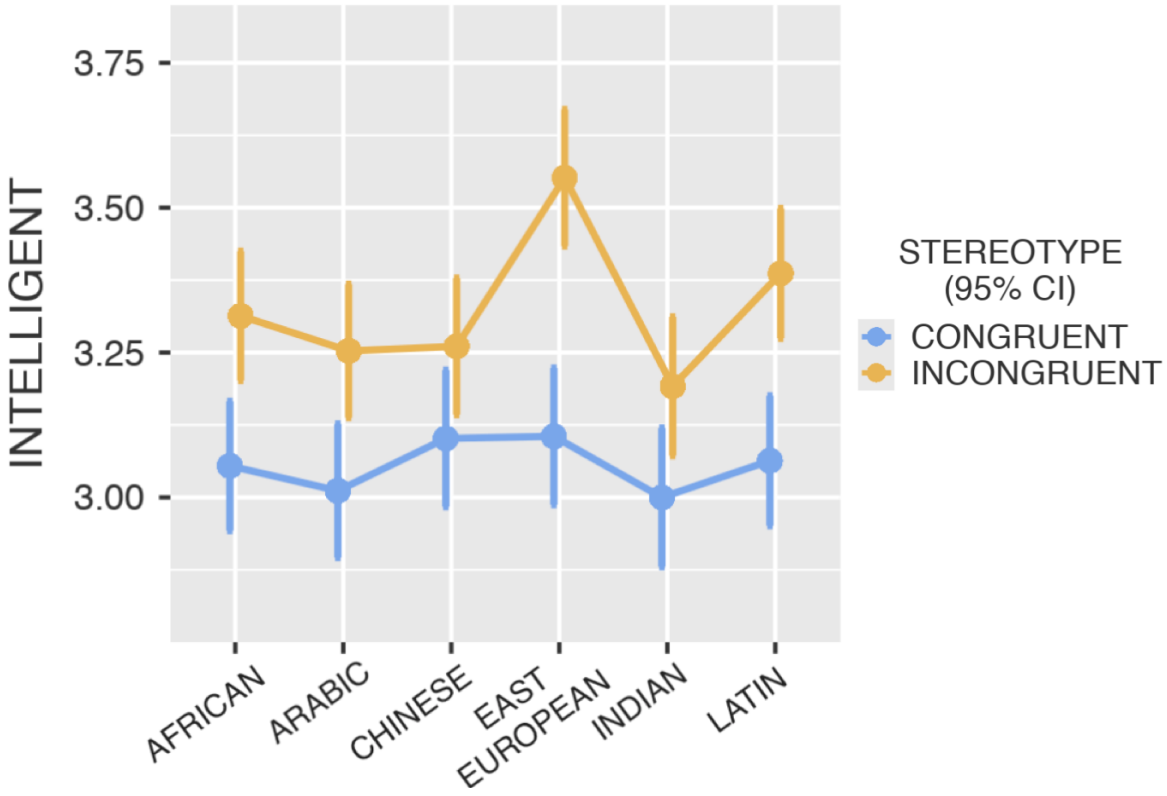

Figure 4.15. *The figure shows the average scores of perceived intelligence (1= not very intelligent, 5=very intelligent) attributed to voices according to the accent of pronunciation of sentences that were congruent or incongruent to stereotypes*.

Comparison							
Stereotype ACCENT		Stereotype ACCENT	Estimate	SE	test	df	$p_{bonferroni}$
Congruent CHINESE	-	Incongruent CHINESE	-0.15893	0.0401	-39.625	8599	0.005
Congruent AFRICAN	-	Incongruent AFRICAN	-0.25905	0.0293	-88.441	8599	< .001
Congruent ARABIC	-	Incongruent ARABIC	-0.24143	0.0359	-67.300	8599	< .001
Congruent E. EUROPEAN	-	Incongruent E. EUROPEAN	-0.44643	0.0401	-111.307	8599	< .001
Congruent INDIAN	-	Incongruent INDIAN	-0.19184	0.0429	-44.741	8599	< .001
Congruent LATIN	-	Incongruent LATIN	-0.32347	0.0303	-106.690	8599	< .001

Table 4.17. *Post Hoc comparisons for the interaction between stereotype congruency and accent at the intelligence scale. SE = standard error; df = degrees of freedom.*

				95% Confidence Interval	
ACCENT	STEREOTYPE	Mean	SE	Lower	Upper
African	Congruent	3.05	0.06	2.94	3.17
Arabic	Congruent	3.01	0.06	2.90	3.13
Chinese	Congruent	3.10	0.06	2.98	3.22
East European	Congruent	3.11	0.06	2.99	3.22
Indian	Congruent	3.00	0.06	2.88	3.12
Latin	Congruent	3.06	0.06	2.95	3.18
African	Incongruent	3.31	0.06	3.20	3.42
Arabic	Incongruent	3.25	0.06	3.14	3.37
Chinese	Incongruent	3.26	0.06	3.14	3.38
East European	Incongruent	3.55	0.06	3.43	3.67
Indian	Incongruent	3.19	0.06	3.07	3.31
Latin	Incongruent	3.39	0.06	3.27	3.50

Table 4.18. *Marginal means of perceived intelligence of voices pronouncing congruent and incongruent sentences sorted by accent of pronunciation. SE = standard error.*

Relation between voice attributes. As visible in figure 4.16, a summary repeated measure ANOVA was performed including as factor within subjects the stereotype congruency of the sentence (congruent, incongruent, neutral) and the voice attribute (friendly, pleasant, competent, intelligent). The analysis showed a significant effect of stereotype congruency ($F(2,138) = 107.91$, $p < .001$, $p\eta^2 = .61$) confirming that, considering all vocal attributes together, voices in the neutral condition (3.61, SE = .05) received higher scores compared to voices in the congruent ($t(138) = 14.64$, pBonferroni<.001; M = 3.03, SE = .05) and incongruent condition ($t(138) = 8.40$, pBonferroni<.001; M = 3.28, SE = .05). Moreover, voices in the incongruent condition received higher scores ($t(138) = 6.24$, pBonferroni<.001) compared to voices in the congruent condition. The analysis revealed a significant effect of attribute ($F(3,207) = 6.26$, $p < .001$, $p\eta^2 = .08$), indicating that, regardless of the stereotype congruency of the sentence, the ratings at the pleasantness scale (pleasantness = 3.23, SE = .05) were overall lower than all the other ratings (friendliness = 3.32, SE = .05, $t(207) = 2.95$, pBonferroni =.021; competence = 3.33, SE = .05, $t(207) = 3.12$, pBonferroni = .013; intelligence = 3.36, SE = .05, $t(207) = 4.10$, pBonferroni<.001).

Moreover, the analysis revealed a significant interaction between the different vocal attributes and the stereotype congruency of the sentence (F (6,414) = 19.84, p <.001, $p\eta^2$ = .22) indicating that, within the stereotype-congruent sentences, voices received higher ratings of friendliness (3.14, SE = .06) than competence (2.96, SE = .06) and pleasantness (2.97, SE = .06); within the stereotype-incongruent sentences, the pleasantness attribute (3.17, SE = .06) received lower ratings than all the other attributes (friendliness = 3.32, SE = .06; competence = 3.30, SE = .06; intelligence = 3.33, SE = .06); within the stereotype-neutral sentences, voices were rated as more intelligent (3.69, SE = .06) and competent (3.72, SE = .06) than friendly (3.50, SE = .06) and pleasant (3.54, SE = .06).

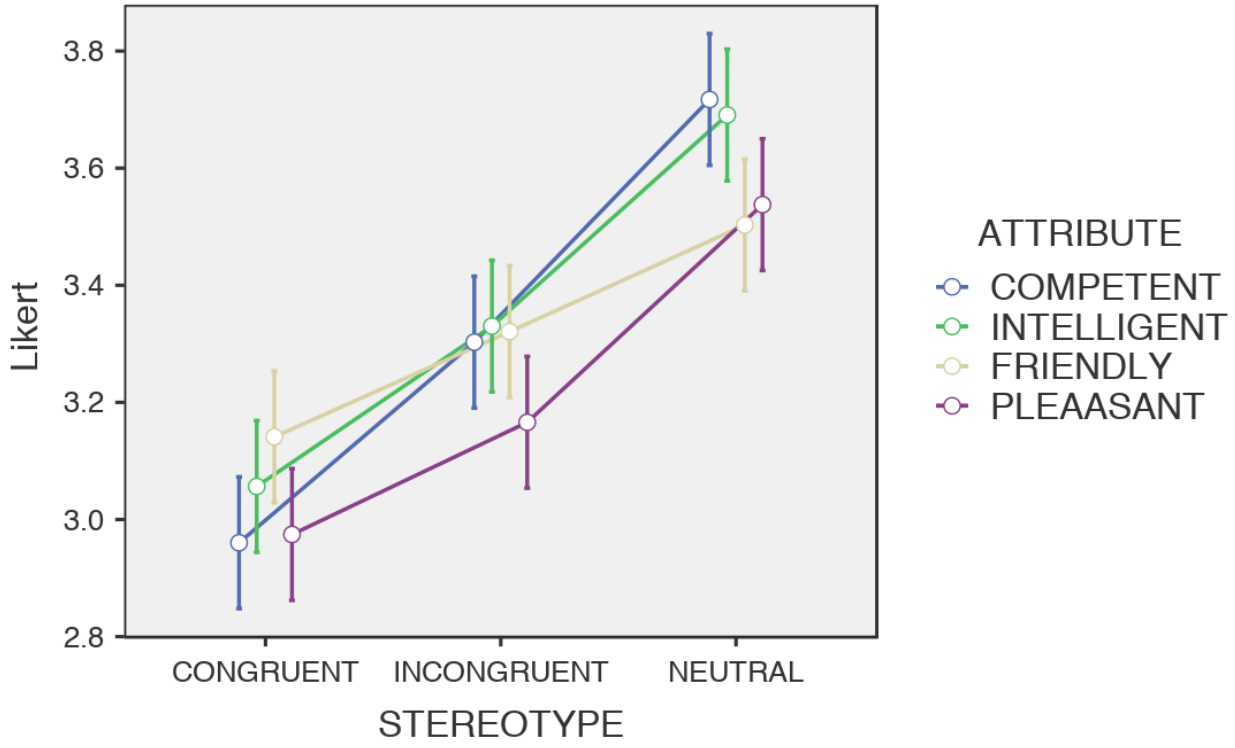

Figure 4.16. *Average scores assigned to speakers' voices at the vocal attributes scales according to the stereotype-congruency of the sentence pronounced.*

The Spearman correlation analyses showed that ratings assigned within the social attractiveness scales (friendliness and pleasantness) presented a strong positive correlation (rho = .71, p <.001). Similarly, ratings assigned within the perceived status scales (competence and intelligence) presented a strong positive correlation (rho = .72, p <.001).

Moreover, as visible in table 4.19, the ratings of the perceived social attractiveness scales showed a moderate linear correlation (p <.001) with the ratings of the perceived status scales.

		PLEASANT	FRIENDLY	COMPETENT	INTELLIGENT
PLEASANT	Spearman's rho	-	0.71***	0.55***	0.54***
	p-value	-	<.001	<.001	<.001
FRIENDLY	Spearman's rho		-	0.49***	0.44***
	p-value		-	<.001	<.001
COMPETENT	Spearman's rho			-	0.72***
	p-value			-	<.001
INTELLIGENT	Spearman's rho				-
	p-value				-

Table 4.19. *Spearman correlation matrix across the ratings assigned at the voice attributes scales, regardless of the experimental condition (congruent, incongruent, neutral).*

4.4 Discussion

The present study aimed to explore whether idiosyncratic ethnic information conveyed by the speaker's voice would evoke stereotypical mental representations in the listener, influencing their way of interpreting the conversation. More specifically, the study investigated whether voice accents would provide the listener with an intergroup frame evoking the stereotypical traits associated with that voices for interpreting the sentences (see Tajfel and Turner, 1986; Giles and Powesland, 1975). The study used voices with standard accents (Italian) and non-standard accents (e.g. African, Chinese, Indian, Latin, Arabic, Eastern European) while they spoke sentences that could match, violate or be neutral to a racial stereotype.

Overall, the results showed that neutral sentences spoken by Italian native speakers were less surprising, therefore more expected or familiar, than stereotype-congruent and -incongruent sentences spoken by non-native Italian speakers. Moreover, as hypothesized, the results revealed that listeners perceived sentences that violated a stereotype more surprising than sentences that confirmed a stereotypical representation. The effect was visible for all accents except Arabic. This

result suggested that stereotype-based inferences were evoked by the speaker's accent and were used to interpret the sentence, making counter-stereotypical sentences less expected, as they violated social expectations.

Indeed, according to our premises, the surprise effect of a sentence ending that violated stereotypical social knowledge, compared to a sentence reinforcing that biased social representation, would indicate that the speaker's voice was able to rapidly activate a chain of world-knowledge representations, including stereotypical traits and assumptions, that were used to make sense of the utterances.

This finding is in line with the literature confirming that language comprehension takes rapid account of the narrative social context, including world-knowledge. Several studies have demonstrated that vocal cues can guide personal attributions about the speaker (Dragojevic and Goatley-Soan, 2020; Campanella and Belin, 2007; Mullennix et al., 1995; Scherer, 1995, 1986; Ellis et al., 1989), inducing the listeners to adapt speech comprehension to the characteristics of the speaker (e.g., Trueswell et al., 2005; Hanna et al., 2004; for a review see Barr & Keysar, 2006). Indeed, people's voice appear to represent a powerful marker to socially classify others, often making stereotype-dependent inferences (e.g., Giles and Billings, 2004; Ko et al., 2009; Krauss et al., 2002; Lambert et al., 1960; Van Berkum et al., 2008). Accent variations represent cues to the speakers' social identities (Lippi-Green 2012) and are used to infer their social group, often activating stereotypes associated with the salient social category (Kinzler et al., 2010).

Interestingly, the surprise effect was recorded despite the overt self-report questionnaire format, suggesting that it was able, to a certain degree, to overcome social desirability issues.

Future developments of the present study will lead towards a more implicit investigation, by means of EEG/ERP technique, of the neural processes (time course and neural substrates) involved in the automatic representation of ethnic stereotypes activated by inferences based on the speaker's voice. This would allow us to further explore how ethnic stereotypical representations are activated by accent-based inferences and how/when they are integrated at a neural level with sentence meaning during language comprehension.

Indeed, in the studies presented in the previous chapters and in a series of electrophysiological studies by our research group (Brusa et al., 2021a; Proverbio et al., 2017; 2018), the temporal course of the implicit activation of automatic stereotypical representations related to gender and ethnicity were investigated (see also Hehman et al., 2014; Wang et al., 2011; White et al., 2009). Studies have focused consistently on the N400 response and demonstrated that written sentences ending with a word that violated gender (Proverbio et al., 2017, 2018) or ethnic bias (see chaper 2, Brusa et al., 2021a) elicited (after about 400 ms) a more negative anterior ERP component (N400) than sentences in which a stereotype was present instead.

Unlike these previous studies, in which the stimuli were written sentences and the ethnicity and nationality of the characters were explicitly conveyed entirely by written words (e.g. “The Ethiopian girl”), the present investigation used spoken sentences instead. Only the speaker’s accent was used to convey a social intergroup context and it evoked stereotypical representation associated to that context that were used to make sense of the incoming information.

The surprise effect that was found for sentences that violated stereotypical social knowledge indicated that the speaker’s voice rapidly activated a chain of world-knowledge stereotypical representations used to make sense of the utterances and could be interpreted as a behavioural counterpart of the N400 effect found in electrophysiological studies.

Indeed, as evidenced by the literature, vocal inferences about the speaker are immediately used in the interpretation of the utterance, in the same way as lexical semantic information (Van Berkum et al., 2008; van den Brink et al., 2012). Similarly, Van Berkum and colleagues (2008) presented spoken sentences whose content sometimes violated social stereotypes associated to the speaker’s voice in terms of sex, social status and age attributed. Their study demonstrated that participants could detect very rapidly the semantic and contextual incongruities, showing a greater N400 negativity in response to such anomalies. To our knowledge there is yet no evidence of such effect related to incongruities of social stereotypes associated to the contextual information conveyed by speaker’s voice in terms of nationality and ethnicity.

Moreover, the present study examined listeners’ evaluations and attitudes toward standard and non-standard accents. Speakers of different accents elicited different evaluations at the questionnaire

scales. To our knowledge, this is one of the only investigation of Italians' attitudes toward foreign accents.

Standard accented speakers were predominantly categorized as Italian, whereas non-standard accented speakers were predominantly categorized as foreign. Nonetheless, native Italian accents were recognized as Italian more easily than how non-native Italian accents were classified as foreign; mainly explained by the fact that speakers with Arabic and East Europeans accents were more often mistaken as Italian than speakers with other non-standard accents.

This finding is consistent with studies on the US population, showing that listeners were very reliable at distinguishing between native- and foreign- accented speakers (Kinzler et al., 2010; Dragojevic et al., 2020).

In addition, the present study showed that listeners experienced more difficulty processing foreign-accented speech, regardless of the experimental condition, than native-Italian speech (see Dragojevic et al. 2020). Across all non-standard accents, sentences spoken by East European accented speakers were the more easy to process, whereas Indian, Chinese and Arabic speech was harder to process. Therefore, East European speech was not only processed more fluently but also more often mistaken as native-Italian.

Moreover, the easier the speech processing, the less surprising the sentence ending was, suggesting that the degree of expectation of a certain conclusion of the sentence was facilitated by the ease of speech processing. This finding may be indicative of the reason why the neutral endings of sentences spoken by standard Italian accents were overall less surprising than endings of sentences spoken by non-standard accented speakers. Whereas, the different surprise effect found between stereotype-congruent and –incongruent sentences was more probably due to the sentence meaning, since speakers received similar evaluations of processing fluency. Indeed, message content has been shown to influence speaker evaluations (e.g. Heaton and Nygaard, 2011).

Interestingly, the literature has suggested that listeners' stereotypes about different foreign groups may contain information about how comprehensible members of those groups are (see Dragojevic et al., 2020). For instance, Dragojevic and colleagues (2020) suggested that Americans may stereotypically associate non-stigmatized foreign groups with higher comprehensibility than

stigmatized foreign groups, and that they may be more inclined to categorize a speaker as belonging to a stigmatized foreign group when they have trouble understanding a foreign-accented speaker.

Consistently with previous literature (Dragojevic et al., 2020; Fiske et al., 2002; Fuertes et al., 2012), the study revealed that all foreign-accented speakers were rated less favorably than native Italian speakers at the social attractiveness and perceived status scales. Nonetheless, foreign-accented speakers were rated more positively when they spoke sentences that violated ethnic stereotypes compared to when they spoke racially biased sentences. This finding might indicate that the sentence meaning influenced the way the speaker was perceived. When a foreign-accented speaker pronounced sentences that to some extent surprised the listener with counter-stereotypical information, the listener tended to evaluate that speaker more favorably.

Evaluations of foreign-accented speakers were not homogenous, rather presented a sort of pattern. For instance, considering the social attractiveness scales, East European and Latin speakers were consistently rated more friendly and pleasant than Arabic and Chinese speakers, whereas considering the perceived status scales, East European, Chinese and Latin speakers were consistently rated more competent and intelligent than Arabic and Indian speakers. Voices with an African accent emerged for being evaluated on average one of the most friendly.

This finding might suggest that stereotypes and attitudes toward different national outgroups are not homogenous, rather some are associated with more negative stereotypes, whereas others with less negative stereotypes. Evaluative hierarchies emerge quite often, with speakers of some varieties faring better than others (Garrett, 2010). Similar effects have been found in the American population considering non-native English speakers, showing that foreign-accented English speakers tended to be downgraded relative to standard-accented speakers in the US and that non-native English speakers were judged according to an evaluative hierarchy (Lippi-Green 2012; Fuertes et al. 2012; Dragojevic et al., 2020).

Non-native accents are, moreover, salient social characteristics that identify and potentially stigmatize people (Derwing & Munro, 2009) providing intergroup information related to own vs. other race discrimination processes (Gluszek and Dovidio, 2010). Thus, foreign accents intrinsically elicit an emotional value that might possibly influence the perceived surprise/familiarity and

friendliness/pleasantness of the voice.

Furthermore, the present findings seem to suggest that variations in listeners' attitudes toward foreign-accented speakers were associated with variation in listeners' processing fluency. Indeed, the foreign accent varieties that were easier to understand (i.e. East European, Latin) were rated more favorably than the ones considered harder to process (i.e. Arabic, Indian). It is yet to be determined whether differences in processing fluency were due to the phonological features of the accents or to the listeners' familiarity with those accents; nonetheless, this finding provides support for the theoretical claim that language attitudes are, at least in part, a function of listeners' processing fluency (Dovidio and Gluszek 2012; Dragojevic et al. 2017, 2020).

4.4.1 Conclusions

The results indicated that speaker information inferred from accent variations significantly activated stereotypical mental representations in the listener, evoking an automatic cognitive response containing an ethnic bias. These results showed that information about the speaker inferred from the voice was able to activate a stereotyped representation towards members of a different nationality (non-Italian) from that of the participants (Italian). Moreover, the study revealed that all foreign-accented speakers were rated less favorably than native Italian speakers at the social attractiveness and perceived status scales. Such ratings were not homogeneous for all foreign-accented speakers and followed, at least in part, an evaluative pattern and the degree of processing fluency.

These findings have important implications showing how attitudes towards specific language variations can have a significant influence at many levels. In English-speaking countries, accents have already been shown to stimulate stereotypes and instigate discriminatory behavior against accented speakers (Gluszek and Dovidio, 2010). Moreover, results may reinforce literature suggesting that increasing the ease of processing non-standard accents may represent an efficient way to attenuate such negative attitudes (see Dragojevic et al., 2020).

Future studies should further explore, using a more implicit paradigm, the neural processes underlying the integration of sentence meaning and pragmatic contextual information during

language comprehension. Moreover, research should expand the study of attitudes toward a wider range of foreign varieties, both of Western and non-Western nationalities.

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Chapter 5

5. General Discussion

5.1 Discussion

This thesis presented an investigation on the neural processes and mechanisms underlying ethnicity-based implicit bias processes during language comprehension. The use of event-related potentials (ERPs), and more specifically of the N400 response, enabled us to effectively investigate and detect the activation and temporal course of ethnic bias implicitly and directly in the active brain, and to bypass social desirability issues (Hewstone et al., 2002). Thus, this work showed and confirmed the ability of the ERP technique to study and reveal the nature of early implicit processes, before control processes could intervene (Batholow, 2010).

As sociologists have long claimed, the effects of stereotype-based assumptions and inferences often act implicitly, out of a person's awareness, and are grounded in social structures. The evidence of this work sheds light on the actual neural underpinnings of the implicit racial bias.

The studies presented showed how rapidly stereotype-based associations were evoked and taken into account during language comprehension. It was demonstrated at brain level that certain sentences, words or even accent variations could elicit and convey a stereotyped mental representation in the beholder, influencing their sentence processing. Indeed, as early as after 300-400 ms, the brain activity revealed the detection of a violation of social expectancies.

Simple cues referring to a person's ethnicity and nationality were able to immediately elicit a chain of world knowledge associations that was implemented in the reader/listener mind to form impressions about others and create biased expectancies on the upcoming information. According to our results, further investigation on the neural processes underlying the role of voice-based racial stereotypes in the implicit integration of sentence meaning and pragmatic contextual information during language comprehension seems promising.

The results supported the claim that stereotyped and biased associations are implicit and grounded in our semantic memory. Indeed, stereotyping represents a type of semantic memory, related to

social world knowledge. It involves the encoding and storage of certain social concept and the ability to select and activate those concepts into working memory to interpret upcoming information (Fiske 1998; Amodio and Cikara, 2021). The results of the present work suggested and confirmed that stereotyping involves brain structures that support more general forms of semantic memory and areas related to social knowledge, such as the temporal lobes, the inferior frontal gyrus, the anterior temporal lobe and regions involved in impression formation, such as the medial prefrontal cortex (Amodio and Frith 2006; Martin, 2007; Olson et al. 2013, Zahn et al. 2007). As Amodio and Cikara (2021) suggested, stereotypes, as social forms of semantic processing, are indeed associated with activity in these regions of social semantic memory.

Results seem to suggest that stereotype-based expectancies can affect, implicitly, how we first tend to interpret what we read/listen, making certain developments more complex to process and more unexpected (e.g., Sherman et al., 2000; Duffy and Keir, 2004; Cacciari and Padovani, 2007). Nonetheless, many individuals actively oppose to bias, such as racial bias, and express equalitarian beliefs (Allport, 1954). Interestingly on this regard, our findings were, indeed, based on a rather young and educated population of University students of psychology of the quite international city of Milan, that expressed low levels of prejudice at overt self-report scales. This reflection opens and deserves a discussion on the role of stereotype control mechanisms that intervene to regulate behavior. Indeed, several studies and theories have addressed the matter of prejudice control processes. Among multiple accredited theories, interestingly, the model by Botvinick and colleagues (2001) suggests that the regulation of prejudice involves a monitoring process that detects the activation of bias (supported by dACC) and a regulatory process that produces an intended response (supported by lateral PFC). This model proposed that the detection of a conflict between a stereotype-based response and a more intended one plays a crucial role in prejudice control (Amodio and Cikara, 2021). Future studies might investigate whether the early detection of stereotype violations related to violations of one's own expectancies is involved in such control processes.

Moreover, the present research documented at neural level the efficacy of counter-stereotypic training and the exposure to scenes that defy stereotypes in modulating stereotype-based expectancies. It was investigated whether these deeply grounded mental associations in the form of

stereotypes could be modulated, as indexed by the neural marker that is the ERP N400 response. Given the abundant behavioural literature on the impact of media on group stereotypes (Brown, 1995; Dill and Thill, 2007; Dixon et al., 2000; Ramasubramanian et al., 2007; Soble et al., 2011), the present work showed how exposure to media that defied stereotypes could positively shape attitudes towards ethnic minorities, attenuating social bias, using the N400 response as a neural marker of this modulation. It was hypothesized that watching the experimental documentary possibly updated participants' mental representations modulating their expectations.

In a review of neuroimaging studies on racial prejudice, Chekroud and colleagues (2014) highlighted the amygdala as a recurrent brain region of interest (e.g. Hart et al., 2000; Phelps et al., 2000) and argued that the observed pattern of amygdala activity in studies involving racial stereotype could be explained by negative culturally-learned associations between certain racial groups and potential threat. Following to their theory, it might be conceivable that our manipulation (exposure to counter-stereotypical reassuring information) acted on the prefrontal cortex - amygdala circuit remodelling the association between foreign ethnic groups and perceived threat. Future studies should further investigate the neural underpinnings of this modulatory effect, enquiring also the effectiveness of other methods for reducing implicit bias, and verify their duration in the long-term memory.

Overall, the results presented in this work represent promising contributions in the field of social neuroscience to understand how racial implicit bias work at the individual brain level and how it can be studied effectively. The research moreover opens for future investigations on how implicit bias can successfully be reduced, dismantling stereotype-based semantic associations grounded in our world knowledge.

5.2 Limits and future developments

When tackling the issue of racial stereotypes and prejudices, it is important to mention and expand a reflection on the so-called WEIRD science. Indeed, Henrich and colleagues (2010) have evidenced and brought to the scientific attention the issue related to the poor generalizability of results in psychological and behavioral studies. The authors claimed that scientists publish results about

human psychology and behavior based on samples drawn entirely from Western, Educated, Industrialized, Rich, and Democratic (WEIRD). The authors reviewed the literature on cognitive processes (including visual perception, fairness, cooperation, spatial reasoning, categorization and inferential induction, moral reasoning, reasoning styles, self-concepts and related motivations, and the heritability of IQ) among different human cultures. Their findings suggested that members of WEIRD societies were not representative of the entire population and concluded that results were not always extendible. Legare and Harris (2016) argued that focusing on such a narrow population, research has presented a distorted view of the human mind. Moreover, according to a study by Roberts and colleagues (2020), when considering cognitive, developmental, and social psychology journals, publications that highlight race are rare, and when it is discussed, it is authored mostly and edited almost entirely by white scholars.

Moreover, Ceci et al., (2010) highlighted the role of contexts in modulating results even in the presence of sample diversification and concluded that it is important not only to diversify the sample population of studies, but also to broaden the range of contexts in which data are gathered.

These issues are relevant when considering and approaching the matter of race in society, acknowledging how pervasive the bias has become and how research, although unintentionally, might play a role in perpetuating racial disparities.

In light of these considerations, the studies presented are well aware of focusing on a very specific set of participants, Italian University students of psychology of the Milanese metropolitan area, and in a specific historical time. Moreover, the studies presented in this work tackle the issue of racial stereotypes towards only certain non-Western ethnicities. If on one hand the present work contributes to the field on the social neuroscience of stereotypes, expanding the investigation to the Italian population, on the other hand still involves a WEIRD society in the study of prejudice towards non-Western populations. This raises the issue of questioning whether the premises of such research reinforce a prejudicial and discriminatory attitude. Additional research is needed to explore to what extent results can be generalized. Future studies should not only expand the participants' population to different social and racial backgrounds, but also consider stereotypes towards a more

wide range of national outgroups. Moreover, follow-up studies will have to monitor the trend of results over time, alongside social and geopolitical developments.

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Appendix

A - List of Sentences*

*English translation follows below

Incongruent condition

1. Ha conosciuto un nigeriano che fa il pilota
2. Il ragazzo senegalese stava andando all'università
3. La signora etiope vive in un attico
4. Alcuni marocchini hanno organizzato una sfilata
5. Uscita di casa, la nigeriana prese il Mercedes
6. I ragazzi algerini lasciarono una grossa mancia
7. Il congolese lavora in banca
8. Tanisha deve alzarsi presto per tenere la lezione
9. Il tunisino cominciò ad allestire la mostra
10. La tunisina comprò una casa sfarzosa
11. La ragazza senegalese veste sempre di nero
12. La signora etiope ha indossato un top
13. Il marocchino gettò la carta nel cestino
14. In Italia arrivano solo immigrati onesti
15. I nigeriani abitano in un appartamento costoso
16. Ha servito una deliziosa coppia algerina in gioielleria
17. Il chirurgo che l'ha operata si chiama Aziz
18. Jala ha creato un nuovo medicinale
19. Prima di salire sul treno, il tunisino fece l'abbonamento
20. Un africano parlava al telefono pacatamente
21. Il nostro amico egiziano è troppo meticoloso
22. I ragazzi africani giocano a scacchi
23. In classe Malik è il più intelligente
24. I ragazzi algerini hanno fatto beneficienza
25. Oggi ho visto il progetto dell'ingegnere congolese
26. Il mio amico senegalese era un campione di nuoto
27. Una coppia cinese gestisce la boutique

28. I soldati cinesi sono indisciplinati
29. Vide la ragazza cinese leggere la Bibbia
30. Le ragazzine cinesi indossavano gonne lunghe
31. All'idea di avere una figlia, Xi fu entusiasta
32. Il manager cinese disse agli operai di riposarsi
33. La squadra di Xu ha vinto il torneo di basket
34. La nonna di Liang ha cucinato la caponata
35. Qiang ha svolto egregiamente il compito di latino
36. Cheng desiderava tanto una figlia
37. La commessa cinese ci accolse con un sorriso
38. L'orologio cinese che ho comprato funziona perfettamente
39. Le mie colleghe cinesi sono abbastanza pigre
40. Del negozio cinese adoro il clima accogliente
41. Contattarono la famiglia del ragazzo rom per lodarlo
42. Il ragazzo rom si fratturò una gamba ballando
43. La ragazzina rom finse un pianto per lo spettacolo
44. Una peculiarità della ragazza gitana è l'onestà
45. La gitana aveva un aspetto signorile
46. La famiglia sinta vive in una casa lussuosa
47. La gitana, nel parcheggio, chiedeva indicazioni
48. Le famiglie rom insegnano ai bambini a leggere
49. Inciampò e lo zingaro lo soccorse
50. La signora gitana si avvicinò per aiutarmi
51. Ho visto una famiglia sinta dal pediatra
52. Il gruppo di ragazzi sinta si preparò per l'esame
53. La coppia rom entrò in gioielleria per comprare
54. Le cadde la borsa e il rom gliela porse
55. Ho visto una famiglia sinta al cinema
56. La signora rom è una madre premurosa
57. La zingara appare sempre molto composta
58. La gitana trovò lavoro come segretaria
59. La ragazza bielorussa sposò un uomo squattrinato
60. Per l'incarico in questura fu scelta l'impiegata slava
61. Ekaterina fa la commercialista

62. La mia amica russa beve solo tè
63. La signora moldava lavora come notaio
64. La bielorussa sposò l'anziano perché innamorata
65. Quel gruppo di lituani si è riunito per un coro
66. Zvenislava non indossa mai la minigonna
67. Lucia fu assunta da un'imprenditrice polacca
68. L'indiana preparò la carbonara
69. La cingalese si svegliò presto per eseguire l'intervento
70. Il ragazzo bengalese è stato assunto come infermiere
71. Al semaforo vide un ragazzo singalese che attraversava
72. Accanto al ragazzo singalese sentì un odore delicato
73. L'attore intrigante del film è bengalese
74. La carne era troppo speziata per Jaldhar
75. Il mio amico indiano non mangia la cipolla
76. Ho venduto una villa ad una famiglia filippina
77. Nella casa dei cingalesi c'era odore di lavanda
78. In palestra, il più allenato è Sing
79. Questa domenica la famiglia cingalese va in chiesa
80. Quel pakistano veste sempre in modo raffinato
81. Jalaja è stata scelta per lavorare come manager
82. La singalese gli fece una multa
83. La casa dei bengalesi è moderna
84. Ha discusso della tesi con l'amica cingalese
85. Il colombiano scese in strada per arrestarli
86. La tecnologia è stata sviluppata dallo scienziato cubano
87. Le ragazzine cubane erano vestite in modo fine
88. La boliviana ha cucinato una buonissima amatriciana
89. Il colombiano sotto casa vende mobili
90. Il ragazzo cubano la sera è sempre sobrio
91. La coppia argentina vinse il festival di hip-hop
92. Il nostro amico jamaicano ascolta solo musica classica
93. Il cubano era a favore della dittatura
94. La nostra amica cubana non fa altro che lavorare
95. L'argentina si allenava per la gara di valzer

96. I vicini messicani ci chiesero di fare silenzio
97. La ragazza brasiliana ha una pelle candida
98. La mia amica cubana mi offrì un bicchiere di grappa
99. La banda di messicani andò in piazza per suonare
100. Le ragazzine brasiliane sono molto timide
101. Ali sta disattivando un ordigno
102. Abdul si pronunciò a favore del femminismo
103. La signora araba indossa dei tacchi
104. L'attentato fu sventato da Ahmad
105. Mustafa fa parte di un gruppo di alpinisti
106. Nadir incoraggia la moglie a studiare
107. Raamiz sostiene delle idee progressiste
108. In compagnia Hassan beve spesso vino
109. Aisha è una ragazza esuberante
110. Stasera Mamadou cena nel resort

Congruent condition

1. Ha incontrato un ragazzo africano che fa il corriere
2. La ragazza tunisina è andata a lavorare in piazza
3. La ragazza nigeriana abita in una baracca
4. Alcuni tunisini hanno progettato un furto
5. Questa mattina la ragazza etiope è uscita in bicicletta
6. I ragazzi eritrei spesero tutti i soldi in alcool
7. Oggi gli africani hanno lavorato nelle serre
8. Il ragazzo nigeriano sta andando nel campo
9. Un tunisino le ha venduto un braccialetto
10. L'africana abitava in una casa molto piccola
11. La signora africana indossa un abito colorato
12. Ha incontrato una somala che portava della frutta
13. Un africano ha gettato dei rifiuti dal finestrino
14. In Italia ci sono molti immigrati delinquenti
15. Quegli africani abitano in un appartamento sporco
16. Ho incontrato una graziosa famiglia somala in mensa
17. Il benzinaio che mi aiuta di solito si chiama Amir

18. In spiaggia l'africana faceva una collana
19. Kayin salì sul tram senza il biglietto
20. La donna nigeriana discuteva al telefono animatamente
21. La tua amica marocchina è un pò aggressiva
22. I ragazzi somali stanno giocando a calcio
23. A scuola Mugambi è molto disattento
24. I ragazzi senegalesi si sono ubriacati
25. Stamattina ho saputo di un delitto di un immigrato
26. Il ragazzo sudafricano era bravo nella corsa
27. Alcuni cinesi hanno aperto un ristorante
28. L'esercito cinese è molto obbediente
29. Alla mia amica cinese piace leggere i manga
30. Vide le adolescenti cinesi con abiti succinti
31. Avendo avuto una figlia, la coppia cinese fu delusa
32. L'ingegner Sakatani ordinò agli impiegati di sbrigarsi
33. Chang ha vinto la gara di karate
34. La mamma di Mei cucina degli ottimi involtini
35. A scuola, Lian non era brava in italiano
36. Il negozio dei cinesi è pieno di cianfrusaglie
37. La borsa che ho comprato dai cinesi era un'imitazione
38. Il caricatore preso al negozio cinese è già rotto
39. I dipendenti cinesi sono instancabili
40. Le commesse del negozio cinese sono scontrose
41. La scuola chiamò la madre di Andrei per rimproverarlo
42. Lo zingaro si ruppe la caviglia scappando
43. La gitana simulò un gran pianto per truffarci
44. Lo zingaro si rivolse a lui con grande insolenza
45. Quel ragazzo rom sembra molto malandato
46. La dimora della zingara è molto trascurata
47. I sinti, nel parcheggio, chiedevano l'elemosina
48. I sinti addestrano i bambini a rubare
49. La ragazzina gitana lo sedusse per fregarlo
50. Un gruppo di bambini gitani tentò di imbrogliarci
51. Hanno visto un ragazzo rom scrivere sui citofoni

52. Oggi la ragazza rom ha tentato una rapina
53. Alcuni rom si procurarono del rame per rivenderlo
54. Dimenticò il portafogli e lo zingaro lo prese
55. C'era una zingara al semaforo
56. Il viso della gitana è molto duro
57. Nel parcheggio la zingara fu molto insistente
58. La bambina rom fa la cartomante
59. Kharitina vuole sposare un uomo facoltoso
60. La donna del call center aveva un accento rumeno
61. La signora polacca lavora come badante
62. Svetlana tracannò un bicchiere di vodka
63. La ragazza polacca fa la modella
64. La polacca si sposò per soldi
65. Alcuni ragazzi senegalesi hanno provocato una rissa
66. Magdalina indossa spesso altissimi stivali
67. Ieri abbiamo assunto una badante bulgara
68. La bengalese mangiò una salsa con moltissimo aglio
69. La singalese preparò la bancarella
70. Anisha è stata assunta in cucina
71. Per strada videro il ragazzo bengalese mentre lavorava
72. Nella casa dei bengalesi c'è sempre un odore cattivo
73. In quel minimarket lavora un pakistano
74. La singalese sta preparando le lenticchie
75. Jamal ha cucinato il pollo al curry
76. Abbiamo incontrato un incantatore di serpenti indiano
77. Il bengalese voleva venderle una rosa
78. La cingalese non è brava nello sport
79. La moglie del pakistano era sottomessa
80. Il cingalese appare spesso trasandato
81. Il ragazzo indiano lavora come lavapiatti
82. Mentre controllava i biglietti, il bengalese fuggì
83. Nella casa degli indiani c'è spesso molto disordine
84. Questo piatto piccante è asiatico
85. Il messicano, vedendo i criminali, prese la pistola

86. La polizia indagò per narcotraffico il peruviano
87. Le colombiane indossano abiti seducenti
88. Gli argentini prepararono della buona carne
89. Il peruviano per strada vende stupefacenti
90. Il ragazzo messicano mi sembra un alcolista
91. La cubana stava ballando la salsa
92. I vicini jamaicani stanno ascoltando musica reggae
93. I cubani celebrano Che Guevara
94. I ragazzi messicani non fanno altro che festeggiare
95. La coppia argentina ballò il tango
96. I cubani del mio palazzo fanno sempre chiasso
97. La brasiliana andò dal chirurgo per rifarsi il seno
98. I cubani festeggiarono con una bottiglia di rum
99. I colombiani che incontrammo possedevano un'arma
100. Dopo cena, i cubani fumarono un sigaro
101. Yasir sta costruendo un esplosivo
102. Discusse con Aamir per le sue idee estremiste
103. La signora araba indossa un velo
104. La polizia postale ha arrestato Saamir
105. Naadir è a capo di un gruppo di ribelli
106. La signora araba fu minacciata dal marito
107. Fareed è molto tradizionalista
108. I miei amici arabi non bevono alcool
109. Le donne arabe del quartiere sono molto dimesse
110. Gli arabi si rifugiarono a dormire nel sottopassaggio

Neutral condition

1. Leonardo lavora come cuoco
2. Simone e Laura sono andati al museo
3. Bruno stava andando in ufficio
4. Il signor Villa ha pianificato una riunione
5. Antonio sta prendendo la metropolitana
6. I signori Esposito hanno comprato una barca
7. Edoardo sta lavorando in garage

8. La signora Gallo lavora in un negozio di casalinghi
9. Alcuni amici siciliani ci hanno fatto un regalo
10. L'appartamento degli abruzzesi è spazioso
11. Luisa mi ha prestato la sua gonna blu
12. Ludovica le regalò una bella camicia
13. Il signor De Santis sta portando le macerie in discarica
14. I miei amici molisani sono sempre garbati
15. I signori Monti hanno comprato un terreno molto ampio
16. La famiglia Longo stasera va in pizzeria
17. Il medico che l'ha visitato si chiama Brambilla
18. L'impiegata ligure deve consegnare il progetto
19. Giovanni sta facendo la fila per comprare il carnet
20. Quando Ivo e Lea si videro, si abbracciarono calorosamente
21. Gaia è una ragazza molto empatica
22. La squadra abruzzese vinse la competizione
23. Fra i compagni Matteo è il più creativo
24. Domani i milanesi vogliono andare al mare
25. E' stata accompagnata a casa da Enrico
26. Marco adorava il ciclismo
27. Mio cugino gestisce una pescheria
28. I piloti delle frecce tricolori sono molto abili
29. La mia amica toscana ama leggere i gialli
30. Alessandro ha comprato delle scarpe nuove
31. Quando nacque Giulia, mia sorella fu felice
32. L'architetto Carrera mi chiese di continuare a disegnare
33. Andrea ha vinto la partita di tennis
34. Carmela ha servito la parmigiana
35. Matteo fu il migliore nell'interrogazione di scienze
36. Claudia non si sentiva pronta per diventare mamma
37. Per il matrimonio Maria ha scelto un abito sartoriale
38. La lavatrice nuova di Emilia è molto efficiente
39. Il mio collega abruzzese è molto preparato
40. Il dottor Ferrari è stato molto gentile
41. La mia amica mi ha chiamato per confidarsi

42. Il ragazzo molisano si è slogato un polso giocando
43. Daniela si sta esercitando per la recita
44. L'autista sardo guidò tutta la notte con prudenza
45. La ragazza abruzzese è molto intrigante
46. La ragazza calabrese cerca una casa luminosa
47. Per raggiungere l'aeroporto ho seguito i suoi suggerimenti
48. Maria guardava amorevolmente il figlio mangiare
49. Francesca e Giulio si sono appena sposati
50. Dei ragazzi liguri si sono offerti di accompagnarci
51. La signora calabrese sta scrivendo un libro
52. Serena mi ha aiutato a preparare la presentazione
53. La signora Rossetti ha iniziato a dipingere
54. Alessandra preparò la borsa e partì
55. La signora Ferri accompagnò i figli a scuola
56. La famiglia pugliese è sempre disponibile
57. Oggi il signor Giuliani era molto stanco
58. Dario sta studiando per diventare sceneggiatore
59. Il marito della signora Costa è un medico rinomato
60. L'attrice della commedia aveva un accento sardo
61. La signora Mariani fa la parrucchiera
62. Stamattina Stefania ha già bevuto due caffè
63. Claudia fa la pasticciera
64. Chiara si è sposata con un collega
65. Il signor De Luca ha organizzato un'escursione
66. La signora Russo ha un bellissimo cappotto
67. Andremo in vacanza con alcuni amici marchigiani
68. Quel calabrese mi ha venduto una cassetta di arance
69. Lo studente veneto sta studiando per il concorso
70. Il signor De Santis è stato assunto per un nuovo incarico
71. Dopo il duro lavoro, Marco andò a dormire
72. Il pesto di Elena aveva un profumo delizioso
73. Siamo andati al concerto con i toscani
74. I nostri amici pugliesi hanno cucinato il pesce
75. Pietro, al ristorante, ordinò il risotto

76. Il corteo è guidato dalla signora romana
77. Massimo è andato a comprare il pane
78. Leonardo si sta allenando per un'importante partita
79. I ragazzi trentini sono andati in baita
80. Letizia indossava un abito molto elegante
81. Carlo sta studiando per il concorso da ricercatore
82. Luigi gli ha regalato i biglietti del concerto
83. Il ragazzo friulano ha preso casa in montagna
84. La villa in campagna è di alcuni amici umbri
85. La signora Orlando festeggia la promozione
86. Ieri siamo usciti con degli amici emiliani
87. Francesca ha comprato dei guanti morbidi
88. La mia vicina stava preparando il pranzo
89. Quest'anno Tommaso ha avviato una startup
90. Tamara mi è sembrata triste
91. Elisa frequenta un corso di pilates
92. Gaetano ha comprato un disco funky
93. Riccardo ha una mentalità molto aperta
94. Il mese prossimo Caterina si laurea
95. Carolina si è iscritta ad un corso di danza
96. La signora Lombardi è stata molto d'aiuto
97. Valentina ha delle gambe bellissime
98. I sardi ci hanno regalato del mirto
99. Maurizio mi ha prestato un martello
100. Roberta è una ragazza molto simpatica
101. La coppia sarda sta ridipingendo le pareti
102. I ragazzi campani hanno difeso la loro amica
103. Elisa ha comprato una giacca
104. La più veloce in campo è Sara
105. Mirco frequenta un gruppo di attori
106. Maurizio ha accompagnato i figli dagli zii
107. Cristina è sempre molto socievole
108. Mio fratello è un esperto di birra
109. Le mie amiche di Napoli sono sempre ospitali

110. Per il compleanno, Luca ha prenotato un tavolo al pub

English translation

Incongruent condition

1. She met a Nigerian who is a pilot.
2. The Senegalese boy was going to university
3. The Ethiopian lady lives in a penthouse apartment
4. Some Moroccans organised a parade
5. The Nigerian woman left the house and took the Mercedes.
6. The Algerian boys left a big tip
7. The Congolese man works in a bank
8. Tanisha has to get up early to teach the class
9. The Tunisian started to set up the exhibition
10. The Tunisian bought a fancy house
11. The Senegalese girl always wears black
12. The Ethiopian lady wore a top
13. The Moroccan man threw the paper in the bin
14. Only honest immigrants arrive in Italy
15. Nigerians live in an expensive flat
16. He served a lovely Algerian couple in the jewellery shop
17. The surgeon who operated on her is called Aziz
18. Jala created a new medicine
19. Before boarding the train, the Tunisian man took his season ticket.
20. An African man spoke quietly on the phone
21. Our Egyptian friend is too meticulous
22. African boys play chess
23. Malik is the smartest kid in class.
24. The Algerian boys did charity work.
25. Today I saw the Congolese engineer's project.
26. My Senegalese friend was a swimming champion
27. A Chinese couple runs the boutique
28. Chinese soldiers are undisciplined
29. He saw the Chinese girl reading the Bible

30. Chinese girls wore long skirts
31. Xi was excited about having a daughter.
32. The Chinese manager told the workers to rest.
33. Xu's team won the basketball tournament.
34. Liang's grandmother cooked caponata.
35. Qiang did very well in his Latin test.
36. Cheng longed for a daughter
37. The Chinese shop assistant greeted us with a smile.
38. The Chinese watch I bought works perfectly
39. My Chinese colleagues are quite lazy.
40. I love the cosy atmosphere of the Chinese shop
41. They contacted the Roma boy's family to praise him
42. The Roma boy broke his leg while dancing.
43. The little Roma girl faked crying for the show
44. A peculiarity of the gypsy girl is honesty
45. The gypsy girl had a stately appearance
46. The Sinti family lives in a luxurious house
47. The gypsy woman was asking for directions in the car park.
48. Roma families teach children to read
49. He stumbled and the gypsy rescued him
50. The gypsy lady approached to help me
51. I saw a Sinti family at the pediatrician
52. The group of Sinti boys prepared for the exam
53. The Roma couple went into the jewellery shop to buy
54. She dropped her purse and the Roma handed it to her.
55. I saw a Sinti family at the cinema
56. The Roma lady is a caring mother
57. The gypsy woman always looks very composed
58. The gypsy woman found a job as a secretary
59. The Belarusian girl married a penniless man
60. The Slavic employee was chosen for the job at police headquarters
61. Ekaterina is an accountant
62. My Russian friend only drinks tea.
63. The Moldovan lady works as a notary

64. The Belarusian woman married the old man because she was in love with him.
65. That group of Lithuanians got together for a choir
66. Zvenislava never wears a miniskirt
67. Lucia was hired by a Polish businesswoman
68. The Indian prepared carbonara
69. The Sinhalese woman woke up early to perform the operation
70. The Bengali boy was hired as a nurse
71. At the traffic lights he saw a Sinhalese boy crossing
72. Next to the Sinhalese boy he smelled a delicate odour
73. The intriguing actor in the film is Bengali
74. The meat was too spicy for Jaldhar
75. My Indian friend doesn't eat onion
76. I sold a villa to a Filipino family.
77. It smelled like lavender in the Sinhalese's house.
78. In the gym, the one who works out the most is Sing
79. This Sunday the Sinhalese family goes to church
80. That Pakistani guy always dresses fancy
81. Jalaja has been chosen to work as a manager.
82. The Sinhalese woman gave him a fine
83. The Bengali's house is modern
84. He discussed his thesis with his Sinhalese friend
85. The Colombian took to the streets to arrest them
86. The technology was developed by the Cuban scientist
87. Cuban girls were dressed in fine clothing
88. The Bolivian woman cooked a delicious amatriciana.
89. The Colombian below the house sells furniture
90. The Cuban boy is always sober in the evening
91. The Argentinean couple won the hip-hop festival
92. Our Jamaican friend only listens to classical music
93. The Cuban was pro-dictatorship
94. Our Cuban friend does nothing but work
95. The Argentinean was training for the waltz competition
96. The Mexican neighbours asked us to be quiet
97. The Brazilian girl has snow-white skin

98. My Cuban friend offered me a glass of grappa
99. The band of Mexicans went to the square to play
100. Brazilian girls are very shy
101. Ali is deactivating a bomb
102. Abdul spoke out in favour of feminism
103. Arab lady wearing
104. Postal police arrested Saamir
105. Naadir is the leader of a rebel group.
106. Arab lady was threatened by her husband
107. Fareed is very traditionalist
108. My Arab friends don't drink alcohol
109. The Arab women in the neighborhood are very quiet
110. The Arabs took refuge to sleep in the subway

Congruent condition

1. He met an African boy who is a courier.
2. The Tunisian girl went to work in the square
3. The Nigerian girl lives in a shack
4. Some Tunisians planned a robbery
5. This morning the Ethiopian girl went out on a bicycle
6. The Eritrean boys spent all the money on alcohol
7. Today the Africans worked in the greenhouses
8. The Nigerian boy is going to the camp
9. A Tunisian man sold her a bracelet.
10. The African woman lived in a very small house
11. The African lady is wearing a colourful dress
12. She met a Somali woman carrying fruit.
13. An African man threw rubbish out of the window.
14. There are many criminal immigrants in Italy.
15. Those Africans live in a dirty flat.
16. I met a nice Somali family in the cafeteria.
17. The gas station attendant who helps me is usually named Amir.
18. On the beach, the African woman made a necklace.
19. Kayin got on the tram without a ticket

20. The Nigerian woman was having a heated argument on the phone.
21. Your Moroccan friend is a little aggressive.
22. The Somali boys are playing football.
23. Mugambi is very careless at school.
24. The Senegalese boys got drunk
25. This morning I heard about a crime committed by an immigrant.
26. The South African boy was good at running.
27. Some Chinese people opened a restaurant.
28. The Chinese army is very obedient.
29. My Chinese friend likes to read manga.
30. He saw Chinese teenage girls wearing skimpy clothes
31. Having had a daughter, the Chinese couple was disappointed
32. Engineer Sakatani ordered the employees to hurry up.
33. Chang won the karate competition
34. Mei's mum cooks delicious rolls.
35. At school, Lian was not good at Italian.
36. The Chinese shop is full of junk.
37. The bag I bought from the Chinese was an imitation.
38. The charger I bought at the Chinese shop is already broken.
39. Chinese employees are tireless
40. The salesgirls at the Chinese shop are grumpy
41. The school called Andrei's mother to scold him.
42. The gypsy broke his ankle running away.
43. The gypsy woman faked a big cry to trick us
44. The gypsy addressed him with great insolence
45. That Roma boy looks very shabby
46. The gypsy girl's home is very neglected
47. The Sinti were begging in the car park
48. Sinti train children to steal
49. The gypsy girl seduced him in order to fool him
50. A group of gypsy children tried to cheat us
51. They saw a Roma boy writing on the intercoms
52. Today the Roma girl attempted a robbery
53. Some Roma got hold of some copper to resell it

54. He forgot his wallet and the gypsy took it.
55. There was a gypsy woman at the traffic light
56. The gypsy's face is very hard
57. In the car park the gypsy was very insistent
58. The Roma girl is a fortune teller
59. Kharitina wants to marry a wealthy man
60. The woman in the call centre had a Romanian accent
61. The Polish lady is working as a caregiver
62. Svetlana swigged a glass of vodka
63. The Polish girl is a model
64. Polish girl married for money
65. Some Senegalese boys provoked a fight
66. Magdalina often wears very high boots
67. Yesterday we hired a Bulgarian caregiver
68. The Bengali woman ate a sauce with lots of garlic
69. The Sinhalese woman prepared the stall
70. Anisha was hired in the kitchen
71. On the street they saw the Bengali boy working
72. There is always a bad smell in the Bengali house
73. A Pakistani man works in that convenience store
74. The Sinhalese woman is preparing lentils
75. Jamal cooked chicken curry.
76. We met an Indian snake charmer.
77. The Bengali man wanted to sell her a rose.
78. The Sinhalese woman is not good at sports
79. The Pakistani's wife was submissive
80. The Sinhalese woman often looks unkempt
81. The Indian boy works as a dishwasher
82. While checking tickets, the Bengali boy ran away.
83. The Indian house is often very messy.
84. This spicy dish is Asian
85. The Mexican, seeing the criminals, picked up the gun
86. The police investigated the Peruvian for drug trafficking.
87. Colombian women wear seductive clothes

88. Argentines prepared good meat
89. The Peruvian on the street sells narcotics
90. The Mexican boy looks like an alcoholic to me
91. The Cuban woman was dancing salsa
92. The Jamaican neighbours are listening to reggae music.
93. Cubans are celebrating Che Guevara
94. The Mexican kids are celebrating all the time.
95. The Argentinean couple danced the tango
96. The Cubans in my building are always noisy
97. The Brazilian woman went to the surgeon to have her breasts done.
98. The Cubans celebrated with a bottle of rum
99. The Colombians we met owned a gun
100. After dinner, the Cubans smoked a cigar
101. Yasir is building an explosive
102. He argued with Aamir about his extremist views
103. Arab lady is wearing a veil
104. Postal police arrested Saamir
105. Naadir is the leader of a rebel group.
106. Arab lady was threatened by her husband
107. Fareed is very traditionalist
108. My Arab friends don't drink alcohol
109. The Arab women in the neighborhood are very quiet
110. The Arabs took refuge to sleep in the subway
104. Postal police arrested

Neutral condition

1. Leonardo works as a cook
2. Simone and Laura went to the museum
3. Bruno was going to the office
4. Mr Villa planned a meeting
5. Antonio is taking the underground
6. Mr and Mrs Esposito bought a boat
7. Edoardo is working in the garage
8. Mrs. Gallo is working in a housewares shop

9. Some Sicilian friends gave us a present.
10. The Abruzzi's flat is spacious.
11. Luisa lent me her blue skirt.
12. Ludovica gave her a beautiful shirt
13. Mr. De Santis is taking the rubble to the dump
14. My Molise friends are always polite
15. Mr and Mrs Monti have bought a very large piece of land
16. The Longo family is going to a pizzeria tonight
17. The doctor who examined him is named Brambilla.
18. The Ligurian employee has to deliver the project.
19. John is standing in line to buy the booklet.
20. When Ivo and Lea saw each other, they warmly embraced.
21. Gaia is a very empathetic girl
22. The team from Abruzzo won the competition
23. Matteo is the most creative among his teammates
24. Tomorrow the Milanese want to go to the beach
25. She was accompanied home by Enrico.
26. Marco loved cycling
27. My cousin runs a fish market.
28. The pilots of the tricolour arrows are very skilled.
29. My Tuscan friend likes to read thrillers.
30. Alexander bought new shoes.
31. When Julia was born, my sister was happy.
32. The architect Carrera asked me to continue designing.
33. Andrea won the tennis match
34. Carmela served parmesan cheese
35. Matthew was the best in the science test.
36. Claudia did not feel ready to become a mother
37. Maria chose a tailored dress for her wedding
38. Emilia's new washing machine is very efficient
39. My colleague from Abruzzo is very knowledgeable.
40. Dr Ferrari was very kind
41. My friend called me to confide in me
42. The boy from Molise sprained his wrist while playing

43. Daniela is practicing for the play
44. The Sardinian driver drove all night carefully
45. The girl from Abruzzo is very intriguing
46. The girl from Calabria is looking for a bright house
47. I followed her suggestions to get to the airport
48. Mary lovingly watched her son eat
49. Francesca and Giulio just got married.
50. Some boys from Liguria offered to accompany us
51. The lady from Calabria is writing a book
52. Serena helped me prepare the presentation
53. Mrs. Rossetti started painting
54. Alessandra packed her bag and left
55. Mrs. Ferri accompanied her children to school
56. The Apulian family is always helpful
57. Mr. Giuliani was very tired today
58. Dario is studying to become a screenwriter
59. Mrs. Costa's husband is a renowned doctor
60. The actress in the play had a Sardinian accent
61. Mrs. Mariani is a hairdresser
62. Stefania has already had two cups of coffee this morning.
63. Claudia is a pastry chef
64. Chiara got married to a colleague.
65. Mr De Luca has organised an excursion
66. Mrs Russo has a beautiful coat
67. We are going on holiday with some friends from the Marche region
68. That Calabrese sold me a box of oranges
69. The student from Veneto is studying for the competition
70. Mr. De Santis has been hired for a new job
71. After hard work, Marco went to sleep
72. Elena's pesto smelled delicious
73. We went to the concert with the Tuscans
74. Our friends from Puglia cooked the fish
75. Pietro ordered risotto in the restaurant.
76. The procession is led by the Roman lady

77. Massimo went to buy bread
78. Leonardo is training for an important game.
79. The kids from Trentino went to the cabin
80. Letizia was wearing a very elegant dress
81. Carlo is studying for the researcher competition.
82. Luigi gave him concert tickets as a present.
83. The boy from Friuli has taken a house in the mountains.
84. The villa in the country belongs to some Umbrian friends
85. Mrs Orlando is celebrating her promotion
86. Yesterday we went out with friends from Emilia.
87. Francesca bought some soft gloves
88. My neighbor was preparing lunch.
89. Tommaso started a startup this year.
90. Tamara seemed sad to me.
91. Elisa is attending a Pilates class
92. Gaetano bought a funky record
93. Riccardo has a very open mind
94. Catherine is graduating from college next month.
95. Carolina has enrolled in a dance class.
96. Mrs. Lombardi has been very helpful.
97. Valentina has beautiful legs
98. The Sardinians gave us myrtle as a gift
99. Maurizio lent me a hammer
100. Roberta is a very nice girl
101. The Sardinian couple is repainting the walls.
102. The boys from Campania defended their friend.
103. Elisa bought a jacket
104. Sara is the fastest on the court
105. Mirco hangs out with a group of actors
106. Maurizio took his children to his aunt and uncle's
107. Cristina is always very sociable
108. My brother is a beer expert
109. My friends in Naples are always hospitable
110. Luca booked a table at the pub for his birthday.