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THE EFFECT OF MOTOR COMPATIBILITY WITH THE GESTURES OF NODDING AND SHAKING THE HEAD: A UNIVERSAL OR CULTURAL EMBODIMENT?

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Abstract

The gestures of nodding and shaking the head are important bodily expressions of agreement and disagreement and are considered among the first nonverbal behaviors acquired by children (Darwin, 1872; Guidetti,2005). However, different cultures may express agreement and disagreement in different ways. For example, while in Western culture nodding generally means "yes" and shaking the head "no," in Bulgaria the same gestures can mean the opposite (McClave, Kim, Tamer, & Mileff, 2007). According to embodiment theory, cognition and sensorimotor mechanisms are strongly interrelated (Barsalou, 2003) and this relationship is generally manifested through a facilitating or interfering effect in cognitive processing based on the presence or absence of compatibility between cognitive and bodily states. Andonova and Taylor (2012) showed that these motor compatibility effects are not universal but culture-specific. In their cross-cultural study involving American and Bulgarian participants, the two authors found that the induction of nodding and head-shaking movements generated positive or negative evaluations towards an object only in the American sample, without replicating the effect with Bulgarians.

This and other studies of head gestures (e.g., Wells and Petty, 1980;Förster, 2004), however, have exclusively investigated the conditions under which an

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induced action subsequently produces an effect on stimulus processing. A recent study (Moretti and Greco, 2018a; 2018b) investigated for the first time the effect that occurs, conversely, when processing a stimulus (partially) reactivates a compatible action. The participants (Italians) were asked to evaluate a series of sentences as true or false, moving them with the head vertically and horizontally, thanks to a software that detects the movements of the head and converts them into the movement of the pointer on the screen. The authors found that response times were shorter when true sentences were evaluated with a vertical head movement and false sentences with a horizontal movement.

The aim of the present study was to replicate this experiment with Bulgarian participants to test whether the compatibility effect manifests itself in the same directions as in Western culture or in the manner of the Bulgarians, i.e., in the reverse directions. The results clarify to what degree embodiment effects may be innate or learned, contributing to the theoretical debate on the relationship between body and cognition.

1. Introduction

The gestures of nodding and shaking the head have an important communicative and social function because they are commonly used in interactions with others, not only as conversational feedback but also to express attitudes, intentions, and emotions (Jakobson, 1972; Ekman, 1979; Morris, 1979; Poggi, D'Errico, and Vincze, 2010; Wagner, Malisz, and Kopp, 2014). While not necessarily accompanying a verbal message, in fact, these two gestures are able to convey significant information such as acceptance and agreement or rejection and disagreement, and for this reason they have been studied by Embodied Social Cognition, a branch of Social Psychology interested in the role of the body in the formation of attitudes. In this type of study, generally, nodding and shaking the head are generally studied by inducing the two gestures in participants and then observing the effects at the behavioral, cognitive, and affective level (Wells and Petty, 1980; Tom et al., 1991; Förster and Strack, 1996; Briñol and Petty, 2003). Recently, however, an experimental study conducted at the University of Genoa (Moretti and Greco 2018a; 2018b), tested the automatic activation of the two head movements in conjunction with the cognitive and affective processing of verbal stimuli. The authors showed that the processing of true expressions or expressions with which we agree is able to activate a mental simulation, and therefore partial, of the vertical movement of the head, which is the direction of the movement that we do to nod. Similarly happens for the horizontal movement of the head, that is typically performed in shaking the head, while processing false

expressions or expressions with which we do not agree.

The explanation for this phenomenon, as well as for other motor-compatibility effects found with other parts of the body (Chen and Bargh,1999; Glenberg and Kaschak, 2002), would lie in the foundation of cognitive processing on sensorimotor mechanisms that allow for mental (partial) simulations of previous sensory, motor, or affective experiences (Stein, 1994; Barsalou, 2003; Niedenthal et al., 2005; Gibbs,2005). Due to these mechanisms, when a motor experience is strongly associated with a content so that they co-occur, then, in the presence of that content that specific experience will be reactivated more easily (in terms of less cognitive resources use) than experiences that are generally not associated or do not occur in conjunction with that content (Förster and Strack, 1997; Zwaan et al., 2004; Gallese and Lakoff, 2005; Gibbs, 2006;Borghi and Cimatti, 2009; Shalev, 2015). According to this hypothesis, the vertical head gesture, precisely because it is typically performed to give or accompany positive responses, is able to reactivate more easily in the presence of information that is accepted or with which one agrees. Similarly, the horizontal gesture of the head, performed with negative responses, is reactivated with information that is rejected or with which one disagrees.

These associations, on which the effects of motor compatibility are based, are so common that one may be tempted to consider them universal; however, there are body movements that may take on different meanings depending on the culture of reference (Abercrombie,1954; Morris, 1979). With regard to the movements of nodding and shaking the head, for example, Bulgarian culture is the most paradigmatic case because the two gestures can be performed to communicate the exact opposite of what Westerners intend: Bulgarians use a vertical movement of the head to say 'no' and turn it to the side to say 'yes' (McClave et al., 2007). A study conducted with American and Bulgarian participants (Andonova and Taylor, 2012) shed light on the cultural specificity of embodiment, showing that the two head movements had different effects depending on the sample analyzed. Although the authors' result is important from a theoretical point of view, however, this study, as well as almost all studies conducted with head movements, investigated exclusively the effect of the induction of the two movements on the subsequent evaluation of stimuli. In order to overcome this shortcoming, the aim of the present investigation was to contribute to the debate on the relativity of embodiment effects, through a cross-cultural study that investigated the automatic reactivation of the experience of nodding and shaking the head during the processing of the truth value of verbal expressions.

The structure of the article is as follows: initially, the main empirical

research involving head movements will be presented, with particular reference to the study on the automatic activation of the two head movements (Moretti and Greco 2018a; 2018b) and the one conducted with American and Bulgarian samples (Andonova and Taylor, 2012). Next, we will explain the design and experimental procedure of the present investigation, which is a replication of the first experiment of Moretti and Greco's (2018a) study with Bulgarian participants. In conclusion, the results of the research in relation to the main assumptions of the theories of embodiment and Embodied Social Cognition will be discussed.

1.1 Head Gesture Compatibility Effects

Non-verbal communication has always attracted the attention of researchers interested in the study of attitudes, emotions, and behavior in general. Among the various body expressions, the gestures of nodding and shaking the head assume particular importance for this type of study because they are among the first nonverbal behaviors acquired by infants (together with the hand gesture used to say "hello") (Bates et al., 1975; Darwin, 1872), and for children up to 16 months of age they are the only means of expressing acceptance and rejection (Guidetti, 2005). Given their early acquisition and their habitual use in interpersonal communication, these two conventional gestures have become increasingly important for social psychology, and in particular for Embodied Social Cognition. This field of investigation is, in fact, interested in the relationship between higher-order cognitive processes - such as evaluation and judgment - and habitual body movements, and, specifically, how these embedded habits can influence the processing of stimuli with social or affective value.

One of the earliest and most famous studies on this topic (Wells and Petty,1980) demonstrated how the two head gestures can be involved in the generation of attitudes. The experiment involved a cover story that presented the study as a market research study to test the quality of a brand of earphones. Participants were divided into two groups: the first group was asked to move their head up and down vertically while listening to a radio message on several students' comments about the amount of tuition, while the second group was asked to move their head horizontally, shaking it, while listening. Both groups then, in a second moment, evaluated their degree of agreement with the radio message they had just heard. The authors found that the judgments were influenced by the different movements of the head: the group that expressed more

agreement with the contents of the radio message was the one that had been asked to nod while listening, while the group that had been asked to shake the head disagreed more. This compatibility effect occurred both in the condition in which the comments heard were positive and in the condition in which they were negative. The authors also found that during the initial task, the frequency of head movements increased vertically for messages with which the participants agreed and horizontally for messages with which they disagreed.

A replication of this experiment conducted about ten years later (Tom et al., 1991), reconfirmed the influence of the two gestures on the participants' judgments, this time with regard to a neutral object: one group had to move their head vertically and the other group horizontally while they observed a pen placed on the table where they were sitting. Next, participants were offered a new pen and asked if they would prefer it to their old pen.The group that was asked to nod chose to keep the old pen, i.e. the one observed during the head movement, while the group that was asked to shake the head preferred the new pen. Also in this case, therefore, the attitudes were determined by the motor behaviors previously performed.

Förster and Strack (1996), using the same paradigm as Wells and Petty, found a similar effect at another level of processing. The participants' task was still to move their heads vertically and horizontally, but this time they had to learn a list of words with positive and negative valence. The authors found that the positive words learned while nodding were remembered more than the negative words, which, in contrast, were remembered more when asked to shake the head. The authors interpreted these data as a consequence of a "conceptual-motor compatibility mechanism", whereby vertical head movements are compatible with positive conceptual contents and facilitate the generation of favorable thoughts, while the opposite situation occurs with horizontal movements. In the same study, a dual-task paradigm was also used and it was found that the incompatibility between the motor action performed and the conceptual meaning of the stimulus required more cognitive resources. From these results, the authors concluded that when a behavior is strongly associated with a certain type of thoughts or feelings, such that they usually occur together, this behavior requires less cognitive effort to be performed than behaviors that are not normally associated with these contents (Förster and Strack, 1997).

Another study in which head movements were manipulated confirmed that the degree of persuasion of a message can increase or decrease consistent with the head movement performed while perceiving that

message (Briñol and Petty, 2003). The paradigm was always the same: nodding and shaking the head while listening to a message. In this experiment, the information contained in the message could be strong or weak: for example, if the message was about the need for university students to have an ID card, the reason given to justify this rule could be related either to student safety issues (strong argument) or to the benefits that security guards would enjoy under the new system (weak argument). The authors found that the group that was asked to nod generated more favorable opinions toward the proposal, compared to the group that was asked to shake their heads. However, when the argument was weak, the group that was asked to nod reported less favorable comments. This difference between the effects of the two types of argument was justified as a consequence of the fact that the two movements of the head had assumed the function of feedback reinforcing or weakening their perceptions. If the argument was interpreted as strong, nodding confirmed this interpretation, increasing its influence; similarly, if the argument was considered weak, nodding led to a confirmation of this perception, weakening its influence. On the other hand, shaking the head had the opposite effect in both conditions. This increase or decrease of confidence in the message therefore depended on the fact that the two head gestures served as proprioceptive signals of the goodness of one's thoughts.

This interpretation, however, as Förster (2004) later pointed out, could only apply to cases of persuasive communication, i.e., where no strong opinion or attitude had previously been established for the object in question. For this reason, the author decided to replicate the experiment and to test the influence of the two gestures on judgments regarding well-known objects (food products) and towards which a strong opinion had already been built up. The experiment consisted of the participants following with their heads the movement of some stimuli on a computer screen, both vertically and horizontally. As a result of the manipulation it was obtained that the induction of the nodding movement led to more positive evaluations of objects towards which they already had a favorable attitude (candy), but in no way improved the evaluation of objects considered unpleasant (beef lung). Similarly, the action of shaking the head had increased the perception of unpleasantness of objects with negative valence, but had not influenced the judgments of objects considered pleasant. The motor compatibility effect found in this type of experiment shows how body expressions can influence higher order cognitive processes such as evaluation and judgment, not only for neutral or unfamiliar objects but also for objects towards which a certain opinion has been established. Moreover, it is important to specify how the effect

of these motor behaviors is automatic and implicit, and, consequently, difficult to control, precisely because in no case were the participants of the experiments just described aware of the meaning of the movements they were performing, since they were given a cover story.

A recent study (Osugi and Kawahara, 2017) showed that vertical and horizontal head movements can compatibly generate impressions and attitudes even when observed to be performed by another agent and not only when performed personally. In this experiment, participants watched videos of 3D models of female figures who could nod or shake their heads. In the next phase, they were asked to rate on a scale the degree of attractiveness, approachability and pleasantness of the figures. The results showed that when the model nodded, the perception of its attractiveness and willingness increased considerably, compared to the condition in which it was observed shaking its head. The authors concluded that the cause of this effect lies in the ability of the two head gestures to activate a cognitive schema containing social information about the possibility for the observer to avoid or approach the interlocutor. In fact, as the two gestures are social signals commonly used in everyday interactions and that serve as important conversational feedback in interpersonal communication, it is plausible to expect that those movements are associated with a series of information concerning, in fact, the mode of interaction with others. According to the authors, therefore, the two gestures should be considered as approach and avoidance behaviors.

This interpretation is not new: a first physiological explanation of the two gestures of nodding and shaking the head was already contained in Darwin's book on the expression of emotions in man and animals (1872). According to this theory, their origin would date back to the very first infantile actions of acceptance and maintenance of food in the mouth (vertical movement) and to that of refusal of the breast or bottle, or a spoon of food (horizontal movement). This hypothesis about the natural acquisition of the two gestures of the head would be based, therefore, on the assumption of the universality of certain human physical experiences. However, as we mentioned in the introduction, although nodding to express acceptance, and shaking the head to express rejection, are a widespread practice especially in Europe and the United States, this practice can not be said to be universal.

A cross-cultural study involving a Bulgarian and an American sample was conducted precisely with the aim of testing differences in motor compatibility effects in Bulgarian participants, who typically move their heads vertically to disagree and horizontally to communicate assent (Andonova and Taylor, 2012). Participants in both samples were asked to

follow with their heads the movement of colored dots projected on the computer screen, in the two directions, vertical and horizontal, and with two speeds, slow and fast. When the dot stopped moving, participants were asked to rate its color on three scales: pleasantness, aroused mood, and brightness. As hypothesized by the authors, the data showed no interaction between culture and judgments of brightness (control condition), while differences in ratings of pleasantness and mood showed that the two movements of the head did not affect responses in the same way. The Americans, in fact, reported an improvement in mood following the execution of vertical movements, while the Bulgarians did not. However, no improvement in mood was found in Bulgarians following the execution of horizontal movements.The authors interpreted this finding as due to a greater exposure by Bulgarians to the Western convention of head movement (e.g., through the media), whereas Americans are less familiar with cultures that express agreement with different movements. The overall results of this study have been interpreted as evidence that embodiment effects can be influenced by the habitual coupling of action and meaning, which appears to be grounded in cultural practices.

Andonova and Taylor's study is a unique case of cross-cultural investigation within the embodiment perspective, since this type of research, when concerned with the relativity of motor compatibility effects, focuses more on differences related to body specificity (Casasanto, 2009). Consequently, in order to confirm the actual cultural specificity of embodiment, we believe that further investigation is needed. Moreover, as introduced at the beginning of this article, most of the research conducted on head gestures has investigated exclusively the effect of the induction of the two movements on the subsequent cognitive or emotional processing of stimuli, whereas the inverse effect of stimulus processing on the activation of sensorimotor mechanisms, as far as we know, has been investigated only in recent studies (Moretti and Greco, 2018a; 2018b).

The first of two experimental studies investigated the relationship between head movement and the evaluation of the truth value of sentences that are objectively true ("The cat meows") or false ("The snail runs"). The second investigated the evaluation of the truth value of sentences that can be evaluated subjectively ("I love chocolate", "I despise coffee"). In both studies, participants were asked to control the movement of sentences on the screen with the movement of their heads, thanks to a program that uses a webcam to detect movements and transform them into the action of the pointer. In one condition, the response bars (towards which the participant

had to drag the sentences) with the word "true" were positioned on the upper and lower sides of the screen, while those with the word "false" were positioned on the right and left sides. This was the compatible condition because one had to make a vertical head movement to evaluate a sentence as true and a horizontal head movement to evaluate it as false. In the incompatible condition the order of the bars was reversed. The data collected from both studies showed that response times were faster in the compatible condition than in the incompatible condition, both for sentences that were objectively true or false and for those that could be evaluated on the basis of personal preferences.
In light of these data, the experimental research presented in the next section was designed with the aim of replicating the first experiment (Moretti and Greco, 2018a) with a Bulgarian sample and to bring, therefore, new evidence to the literature on embodiment effects, in order to prove the actual relativity of the phenomenon. The expectation, in line with the hypothesis of cultural specificity (Andonova and Taylor, 2012), was to find a different effect of motor compatibility in the Bulgarian sample than in the Italian one. In particular, on the basis of the data obtained by the two authors in their cross-cultural study, we expected not to find a strong difference between the compatible and the incompatible condition because Bulgarians, while expressing assent and dissent with reversed directions of head movements, are exposed to Western culture and, consequently, they know the way of nodding and shaking the head.

2. Overview of the Experimental Survey

2.1. Method

Participants

A total of 94 students from New Bulgarian University (including 23 men, mean age 21.71, ds 4.82) participated in the experiment for course credits. All participants had normal color perception and normal or corrected visual acuity. Informed consent was obtained at the beginning of the experiment.

Stimuli and apparatus

To analyze the Bulgarian sample's exposure to foreign cultures, an implicit and an explicit questionnaire were designed and added to the original experimental design (Moretti and Greco, 2018a). The implicit questionnaire was constructed with 10 simple questions formulated orally

and whose answer could be exclusively either positive (yes) or negative (no) (e.g., "Have you participated in this study before?; "Are you participating in the study for credit?"). The purpose of the implicit questionnaire was to observe how much and how well participants nodded and shook their heads in an interpersonal communication situation. The explicit questionnaire (paper and pencil), on the other hand, was designed with 15 questions to collect information about the participants' awareness of their way of expressing agreement and disagreement with their heads, their knowledge of foreign languages, and the level of influence of Western culture. Regarding the main task, all instructions and 120 original sentences (60 of which were objectively true and 60 objectively false) were translated into Bulgarian. Due to some grammatical differences with the Bulgarian language, some sentences have been entirely replaced or transformed to the plural respecting the overall balance of the sentences.

The monitor used for the main task (HP1955 LCD monitor 19-inch color flat screen) was placed approximately 60 cm away from where the participants were seated. The procedure was controlled using a custom program written in Visual Basic 6. In order to make possible the control of the mouse pointer with the head, we used the free software 'Enable Viacamv.1.7.2' (CREA software, released under GNU, General Public License, www.crea-si.com), which using a common webcam, mounted in the middle of the upper side of the monitor, is able to capture the head movements and convert them into the pointer movement. Response times were recorded from the moment the black box was clicked and the sentence appeared, to the moment the box began to be moved with the head movement. Motion recording occurred when the cursor had reached a distance of 20 pixels from its starting point, both vertically and horizontally. This measure was set to maximize sensitivity to actual responses and minimize the influence of small random movements.

Procedure

The experiment took place in a separate, quiet room. Prior to the main task, the experimenter completed the implicit questionnaire with the participants' responses, also recording all movements that the participants made with their heads while responding. The experimenter had previously been instructed to avoid during the conversation any movements with the head that might influence the participants' motor responses. Next, the main task began. Participants first performed a warmup session in which they were instructed to move their heads and experience the commands they could make the pointer perform (point, click, and drag) by moving a

central black box (size 11x13 cm), on a gray background, to each of the four sides of the screen (top, bottom, right, left). Then the instructions explained to the participants that inside the black box placed in the center of the screen they would see some sentences that could be true or false, and asked them to evaluate them.

Then the instructions explained to the participants that inside the black box in the center of the screen they would see sentences that could be true or false, and asked them to evaluate the truth value by moving (always using the head) the box towards one of the four bars on the sides of the screen. The bars were of two types: two were green with the words "True" and two were red with the words "False" (in Bulgarian). In one condition, the green bars were placed at the top and bottom sides of the screen, thus requiring vertical movement (up or down) for the "true" judgment, while the red bars were placed at the left and right, requiring horizontal movement (right or left) for the "false" judgment. This condition was considered incompatible, as it was incongruent with the direction of head movements used in Bulgarian culture for assent and rejection (Andonova and Taylor, 2012). In the compatible condition, the position of the green and red bars was reversed (vertical for refusal and horizontal for assent). The task was divided into two blocks (compatible and incompatible) whose order was counterbalanced among the participants, who were randomly divided into two groups: Group A had the incompatible condition in block 1 and the compatible one in block 2, Group B had the compatible condition in block 1 and the compatible one in block 2. At the end of the task, participants were debriefed in order to identify the difficulties encountered during the experimental procedure and to check if they had discovered the experimental hypothesis.

2.2. Results

As a first step, the data of the main task were cleaned: the first 8 answers for each block were considered as further practice and were removed (13%) together with the wrong answers (47%) and the answers in which the direction of the first movement performed did not coincide with the position of the box on which the subject dragged the sentence (6%). Subsequently, all response times less than 300 milliseconds (0.4%) and more than 3000 milliseconds (4%) were considered invalid times and removed. As a result, 6 participants were eliminated from the analyses: 3 participants for a high number of errors and 3 for an insufficient number of trials following data cleaning. The reaction times of the remaining 88

participants (Group A = 41; Group B = 47) were subjected to logarithmic transformation and analyzed using the Linear Mixed Modeling technique (LMM, Baayen, Davidson, Bates, 2008); degrees of freedom were estimated using the Satterthwaite approximation. In the LMM model, response times (RTs) were introduced as the dependent variable, Group x Block interaction as the independent variable along with Truth Value and Grammatical Construction. Participants and Item were entered as random factors, with random intercepts for both of these variables. No interaction between Block and Group emerged from the analysis ([F(1,7916)= 0.33, p = .6), thus no difference between compatible and incompatible conditions. On the other hand, there was a significant difference between Block 1 (M = 1613.28 ms) and Block 2 (M = 1515.80 ms) (F(1,115) = 8.52, p < .005) irrespective of Group, with shorter response times in the second block. Also significant were the difference between Group A (M = 1623.82 ms) and Group B (M = 1511.64 ms) (F(1,86) =3.96, p < .05), with Group B being faster, and the difference between true (M = 1499.50 ms) and false sentences (M = 1629.37 ms) (F(1,115) = 15.54, p = .0001), with false sentences being evaluated more slowly.

As expected, these results highlight how easily Bulgarians were able to adapt to both conditions. In fact, the speeding up of response times in the second block, also found in the group that had the incompatible condition in the second block, shows that there was no real difficulty on the part of the Bulgarians in performing the task with the opposite directions to their way of expressing assent and dissent. Consequently, the effect of the practice found in the second block, that is, having performed the task already in a first block, speeded up the responses of both groups, regardless of condition. This finding confirms what was found in the previous study with Bulgarians (Andonova and Taylor, 2012) and can be explained in light of the analysis of the questionnaires. According to the implicit questionnaire, in fact, not all participants nodded and shook their heads in the same way: 54 participants moved their heads both as Bulgarians generally do and as Westerners do, 28 in Western style and only 6 in Bulgarian style. The explicit questionnaire confirmed this ambivalence. In fact, only one participant stated that he was not studying any foreign language and did not know how Westerners use head movements to express assent and disapproval, while 68 participants stated that they used the Western style, 13 the Bulgarian style and 6 both styles.

Therefore, according to the data collected from both questionnaires, it emerges that Bulgarians do not use only one system of nodding and shaking but can activate both the Western and the Bulgarian styles. Consequently, during the task of moving sentences with the head, the

participants were able to easily adapt to both types of setting without manifesting a real difficulty in the incompatible condition, as is the case with Westerners (Moretti and Greco, 2018a; 2018b).

However, the group that started the task with the incompatible condition (for the Bulgarians) had slower response times than the group that in the first block had the compatible condition. For this reason, we decided to perform a further analysis of RTs excluding the second block in which the effect of practice, combined with the ability of the Bulgarians to activate both ways of moving the head, had decreased response times regardless of condition. In the second LMM model we included only Block 1 and Truth Value as independent variables, and Participants and Item as random factors, with intercepts for both. This analysis revealed a statistically significant difference between the compatible block ($M = 1560.62$ ms) and the incompatible block ($M = 1673.24$ ms) ($F(1,86) = 3.98, p < .05$) and confirmed the evidence that false sentences require more processing time than true ones ($F(1,56) = 7.98$, $p = .006$). A second model was then run with the same variables and with the truth value factor as a random slope. Also in this case the difference between compatible and incompatible condition remains significant ($F(1,86)= 4.00$, $p < .05$).

3. General discussion

The results of the present study revealed a cross-cultural difference in the ways in which the two head movements can be triggered in a compatible way by processing true and false stimuli. For Westerners, evaluating a sentence as true activates the simulation of vertical head movement whereas evaluating false sentences activates the horizontal direction of movement. For Bulgarians, on the other hand, the two movements can easily activate in the evaluation of both true and false sentences, although it is more automatic for them to perform the Bulgarian pattern (true-horizontal/false-vertical). While for Westerners the compatibility effect is strong and stable (Moretti and Greco 2018a; 2018b), in the sense that the difference between compatible and incompatible condition is significant and replicable, for Bulgarians, given their exposure to Western culture (through the media) and their knowledge of conventional ways of expressing agreement and disagreement, this difference is less detectable. In fact, in the Bulgarian sample the interaction between head movement and truth value of sentences, i.e. the difference between compatible and incompatible condition, was found only in the first block, while in the second block the effect of practice hid

the effect of condition.

This result is in line with what emerged from the two questionnaires (implicit and explicit): almost all the participants (all university students) stated that they were exposed to foreign cultures and languages (mainly Western). However, the subjects who in the first block were asked to perform movements compatible with the Bulgarian way of disagreeing and disagreeing (Group B), were facilitated in the execution of the task, taking less time overall than the group that started with the incompatible condition (Group A). Thus, in the first block, i.e., when the participants were facing the task for the first time, the habitual pattern performed by the Bulgarians seems to have emerged, which in the case of Group A was incompatible with respect to the direction of the movement required by the condition, while in Group B it was compatible. When the movement to be performed to evaluate a sentence as true was horizontal and a false sentence vertical, the response times of the Bulgarians were much faster, compared to the condition with the opposite directions. However, this effect is easily cancelled out by practice, precisely because the Bulgarians have experience with both ways of assenting and disagreeing with their heads.

According to the data obtained with this and the previous study on Bulgarians, therefore, the cultural specificity hypothesis (Andonova and Taylor,2012) would seem to be confirmed for both sides of the double relationship that embodiment theories assume to exist between sensorimotor mechanisms and cognitive processing, namely both in the case where it is the body that influences cognition, and in the reverse case where cognition affects the body (Barsalou, 2010).

However, there are only a few studies in the literature that address the issue of differences in embodiment effects between individuals and cultures. An important exception, regarding the difference between individuals, is the studies conducted by Casasanto on the theory of body specificity (Casasanto, 2009; Casasanto and Hennetz, 2012). In a series of studies on the association of meanings with body parts, the author has found that right-handed and left-handed people associate positive or negative emotional meanings to the right or left-handed space according to the dominant hand, i.e. the hand with which they interact more easily with objects in everyday life. These results are in line with research investigating the effects of motor compatibility with arm movements, both in the processing of verbal stimuli and in the virtual manipulation of objects, including objects with affordances (e.g., Stanfield and Zwaan, 2001).

Another example of the investigation of body specificity is language

studies interested in how different cultures assign social, metaphorical, and symbolic meanings to different body parts. In a research on the Turkish language, for example, it was found that Turkish people have mapped the conceptualization of social stratification in the body: the head is used as a metaphor for positive cultural values or high social status, while the foot is used for negative values and low social status (Aksan, 2011). In a study on the differences between German and Indonesian cultures, it was found, however, that the concept of "head" is used by Germans figuratively to refer to thinking and thoughts, while for Indonesians the same part of the body is used to refer to leadership roles in their social and institutional system (Siahaan, 2011). These studies are in line with Lakoff and Johnson's (1999) theory of spatial metaphors as the core of our conceptual system. These metaphors are considered to be closely related to the structure of the body, i.e., how the various parts of the body are organized.

In addition to the specificities of the body, which can affect the way we act in and interact with the environment, another important source of variability is cultural differences in the way we use the body for interpersonal communication. A paradigmatic example is gestural communication: a series of body movements that have no practical function of manipulating objects but serve only to convey (or reinforce) information and emotions (McNeill, 1992; Krauss, Chen and Chawla, 1996; Krauss, 1998; Kita, 2009). This communicative function is embedded within social conventions that are learned and modified by culture and then become customary use. Beyond the iconic gestures that have a form of analogical correspondence with the physical properties of the referents, symbolic gestures are highly arbitrary in the way they map meanings, just as the mapping with sound, in language, is mostly arbitrary. For example, in interpersonal communication, gestures are routinely used to convey abstract information such as agreement or disagreement with an interlocutor or a statement, and this function is purely symbolic. In fact, since there is no referent for "yes" or for "no", and, therefore, no kind of isomorphism or iconicity, their association with specific head movements can be easily seen as arbitrary. Indeed, as we have seen, much of Western culture has incorporated acceptance and agreement into the vertical head movement and disagreement and rejection into the horizontal one, whereas in the Bulgarian tradition, association with opposite directions is the most common convention (McClave et al., 2007).

Accepting the hypothesis of cultural specificity, i.e. admitting the existence of an arbitrary association between meaning and body movements that can lead to generate variable compatibility effects, does

not mean, however, to reject the thesis of embodiment. This perspective, in fact, has been interested from the beginning in gestures and has tried to explain the compatibility effects found experimentally between these actions of the body and the content of linguistic acts through a theory that sees gestures and language processed by the same sensorimotor system (Glenberge Kashak, 2003). However, this hypothesis has been tested primarily with representational gestures, and only recently have scholars in the field begun to consider symbolic gestures as well (Alibali et al., 2014; Zwaan, 2014; Dijkstra and Post, 2015;). The reason for this new interest is justified by the fact that although the association between meanings and gestures is relative because it can vary, e.g., by culture, a particular association becomes, over time, a physical and mental habit for the agents of that particular culture. As a consequence, the meanings conveyed by particular gestures become based on the habitual use of body parts, and, therefore, their abstract meaning becomes embedded in motor experience.

The compatibility effect found in this research, as well as those found in previous studies of Moretti and Greco (2018a; 2018b), can be explained as a consequence of the reactivation of experiential traces associated with content with which one agrees or disagrees both from a cognitive and affective point of view. In the presence of a stimulus considered true or pleasant, the simulation of head movements typically performed during the processing of information that is accepted or towards which one has a favorable attitude will be activated, and, similarly, in the presence of a stimulus considered false or unpleasant, those head movements that are generally performed during the processing of information that is rejected or towards which one has an adverse attitude will be activated. According to this hypothesis, then, regardless of the surface difference in the specific ways of embodying meanings, the mechanism underlying embodiment phenomena works by reactivating the behaviors most associated with that particular meaning, i.e., with previously established patterns (Förster and Strack, 1997; Zwaan et al., 2004; Shalev, 2015).

However, it is clear that an associationist explanation was inadequate 60 years ago as it still is now. In fact, a crucial aspect of the association advocated by embodiment theories between body and cognition is that it is a well-founded inter-relationship, in which the two parts not only co-occur but also influence each other. We have seen in the first paragraph how studies on persuasion and attitude generation have shown a causal role of bodily responses on high level cognitive processing. New studies are needed to deepen this and other aspects of embodiment theory that are still somewhat controversial, but not yet sufficiently explored. Similarly,

the conclusions we reached in our study, on the cultural specificity of embodiment effects, should be interpreted taking into account the fact that the literature on the phenomenon is still very lacking. In order to be able to generalize our conclusions, further investigations are needed to clarify the border between cultural and natural aspects and what is their weight in the determination of specific motor patterns in spite of others.

Moreover, in our study, the Bulgarian sample consisted of university students and therefore of a young generation of Bulgarians that has inevitably been influenced by the westernization brought by globalization. Consequently, it would be interesting, but not less complicated, to be able to test the same paradigm with a sample of "pure" Bulgarians, i.e., those older generations in which tradition has not been too contaminated by Western forms of communication and lifestyles. Another interesting future investigation on the cultural relativity of embodiment could test, again on a Bulgarian sample, the activation of the two head gestures in the condition in which the instructions and verbal stimuli of the experimental design are not in Bulgarian but in a Western language. Observing any new differences could lead to an interesting new finding about the possibility of activating a specific motor pattern based on the constraints imposed by the verbal representation. This result would be in line with those studies that have shown that the associations between stimulus and motor response vary not only according to experience but also to the contingencies of the moment, as for example happens with a set of different instructions or with the induction of aversive conditioning (Markman and Brendl, 2005; Lavender and Hommel, 2007). In this case, embodiment effects would be relative not only because they vary according to the culture in which they are established, but also and mainly because they are due to mechanisms that are more adaptive than active (Niedenthal et al., 2005). From this perspective, the Bulgarian culture lends itself particularly well to this type of investigation, not only because it has incorporated assent and dissent in the opposite directions to the more widespread system but also because it can easily adapt to this system.

Equally interesting would be to investigate the activation of body movements in the absence of instructions that could somehow influence or drive responses. In the specific case of our study, for example, participants could be asked to move true and false sentences, or sentences with pleasant and unpleasant contents, towards one of the four sides of the screen without, however, asking them to evaluate their truth value. In this case, in the absence of the intention of evaluation, and therefore with an implicit task, it is likely that an even more "primitive" compatibility effect emerges, precisely because it is based on a spontaneous and automatic

elaboration, therefore not very controlled, of stimuli.

A curious consequence of this type of manipulation could be to find that in the condition in which the task of moving stimuli is implicit, Bulgarians perform the same motor pattern as Westerners. This result would be curious but not surprising since, as mentioned earlier in the article, a first physiological explanation of the two gestures (Darwin) and a recent study conducted on the generation of attitudes (Osugi and Kawahara, 2017) consider them as movements of approach, of a concrete or social stimulus, towards one's body, and of avoidance of a stimulus and, therefore, its removal from one's body. In the event that the opposite configuration actually occurs, one would be encouraged to find the common matrix of all the different specific effects found in the literature, while the opposite result would still be undoubtedly relevant because it would be further evidence in favor of the thesis of cultural specificity of embodiment effects.

These and other future investigations are interesting precisely because this study is part of a broader line of research, which is placed within the perspective of Embodied Social Cognition, and has among its main objectives to develop an implicit test able to exploit the automaticity of the activation of the movement of nodding and shaking the head to detect an attitude of favor or disfavor towards situations, objects or social groups. In order for this instrument to be able to predict approach or avoidance behavior on the basis of head movements, it is necessary to investigate how the meanings of "approachable" and "avoidable" have been "incorporated" in the various cultures, but also, and above all, to investigate the possibility of finding a common matrix, universal and culture-independent, which allows the instrument to operate in a precise way by detecting precisely those activations that are more spontaneous and less subject to conscious control.

In conclusion, the results of this experimental research have shown that the actions that people perform (both physical and simulated) can affect cognition but, equally, cognitive and affective aspects can affect actions, both at the time of their acquisition and during their processing (Barsalou, 2010; Glenberg et al., 2013; Kaschak et al., 2014; Körner et al., 2015). Moreover, it has been shown that, beyond cultural differences, gestures and body expressions in general are to be considered as a special form of action that derives from sensorimotor simulations and, for this reason, it is interesting and necessary to investigate more and more the ways in which this type of actions can interact with cognition.

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