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Where to place social targets? Stereotyping and Spatial Agency Bias

Direttore della Scuola: Ch.mo Prof. Luciano Stegagno

Supervisore: Ch.ma Prof.ssa Anne Maass

Dottoranda: Caterina Suitner

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Contents

Brief Summary

Our experience as human beings is embedded in space, is lived through our bodies moving along spatial coordinates and it is often expressed in visually aided communications where space is conventionally used to simplify the interpretation of a message. Space is therefore an overwhelming aspect of our existence and we take advantage of this spatial foundation to envisage abstract concepts whose mental representation and communication would be almost impossible otherwise. Be this conscious or not, the role spatial schemas in knowledge organization is extensive. We *envisage* power *along* the vertical dimension, we *point out* moral issues that are not physically observable, we wait for a *long* time and we have *high* expectations. The spatial schemas in concept representations go beyond their use in metaphorical expressions and affect cognitive processes in various ways. Goal of this research project was to investigate the role of horizontal spatial schemas in social cognition. Although horizontal spatial biases have been studied in various fields, from art history to attention orientation, from neurological and from a cultural perspectives, to our knowledge this is the first time that they are investigated from a social psychological point of view.

The general idea underlying all studies reported here is that agentic targets (i.e. performing an action) are systematically associated with a left position, with recipient targets to their right. The resulting direction of the action is rightward. This idea, initially proposed by Chatterjee (2002) is here applied from a social psychological perspective, with agency interpreted a fundamental characteristic of stereotype contents (Abele, Uchronski, Suitner, & Wojciszke, 2008; Spence, Helmreich, & Stapp, 1974). The association between the rightward spatial vector and agency is linked to the direction of writing/reading that is in fact rightward in western cultures. Cultural factors were therefore taken into account as possible moderators of the bias; specifically writing/reading directions were tested comparing left-to-right and right-to-left readers (Study 1c and 5).

After reviewing the relevant literature on spatial bias in the Introduction, in the first Chapter the specific spatial representations of concepts related to stereotype content are analyzed in the horizontal and vertical spatial domains. The most important results for the goal of this project are that Agency (Study 1a) and dynamism (Study 1b and c) were horizontally represented with a rightward vector. This effect is in line with the hypothesized role of agency proposed by Chatterjee (2002) in horizontal spatial bias (i.e. the Spatial Agency Bias). This bias was absent among right-to-left readers (Arabic participants, Study 1c), confirming the role of writing direction in spatial bias. In Chapter 2 the application of the SAB to gender stereotypes was investigated in 4 studies. The first two consisted in archival researches of Web-Images representing famous couples. The male of the couple tended to be represented to the left of the female (Study 2a), but only when he was perceived as more agentic than her (Study 2b). The relation of SAB and gender stereotypes was further analyzed in the evaluation of left- or right-ward directed single targets in Study 2c, where participants displayed an association between the rightward direction and male targets. These three studies confirmed the use of specific spatial representations to envisage gender differences. The subsequent study (i.e., Study 2d) analyzed the effect of such association showing that the biased decoding of spatial information is associated with congruent attributions of stereotypic characteristics to males and females in general and with ambiguous attitudes toward males and female. Specifically, the more female participants associated male targets with

the rightward direction, the more they attributed power to males and communion to females and the more they endorsed an ambiguous attitude toward males and females. This result is particularly relevant as it represents, to our knowledge, the first evidence of the consequences of the bias. Study 2d also investigates the stability of the bias, showing the key role of exposure to direct stimuli. The number of rightward (vs. leftward) male (vs. female) portraits to be categorized had an effect on the bias. When participants were exposed to a large number of rightward male and leftward female profiles, they displayed a standard SAB; when participants were exposed to a large number of leftward male and rightward female profiles, they displayed an opposite bias, namely associating the leftward (vs. rightward) profile to male (vs. female) targets. The role of exposure is further shown in Study 4, where a writing exercise toward right or toward left was respectively strengthening or weakening the SAB and its relation with gender stereotype endorsement. This finding suggests that cultural habits do not exert an inalterable as not chronic influence, but rather that spatial bias is susceptible to behavioural experiences, namely the momentary experience with the "opposite" writing direction. This embodied character of the bias is further analyzed in Chapter 3 focusing on the role of motion by comparing events that were either static (not involving motion) or dynamic (involving motion). Although the direction of the bias was not always in line with predictions, the bias was generally found to be specifically related to moving targets, in line with the simulation processes indicated as responsible of embodied cognition (Barsalou, 2008a; Lakoff, 1992).

The implications of spatial schemas are investigated in Study 5, where the preferences for advertisement layouts were investigated in a cross-cultural study, showing the relevance of cultural background in the selection of a specific layout.

The bias was finally investigated in relation to politics and political stereotypes, showing an association between rightward direction and rightwing political partisanship of single targets (Study 6b and c). However, at the group level, spatial bias was mainly driven by in-group favouritism, namely participants indicated the rightward group as the political group matching their own political affiliation. The in-group bias was intensified by the attribution of competence, providing additional evidence for the key role of agency in the SAB.

Altogether the present research project provides evidence for a subtle but persistent SAB with a wide range of consequences and applications in the field of social cognition and mass communication.

Sommario

La nostra esperienza fisica è radicata nello spazio che ci circonda, i nostri vissuti passano attraverso la fisicità dei nostri corpi che si muovono lungo coordinate spaziali. Spesso le nostre esperienze sono espresse attraverso comunicazioni in cui il supporto visivo fa uso dello spazio in modo convenzionale per semplificare il contenuto di un messaggio. Lo spazio è dunque un aspetto pervasivo della nostra esistenza, non solo dal punto di vista fisico ma anche da quello cognitivo, dal momento che viene utilizzato nella rappresentazione di concetti astratti attraverso schemi mentali in cui le conoscenze vengono organizzate in connessione con esperienze fisiche. Consapevole o meno, l'estensione di questo processo è tale da coinvolgere gran parte della elaborazione delle informazioni. Per esempio, il potere è rappresentato in riferimento alla dimensione *verticale* (e.g., essere subordinato a..), così come utilizziamo metafore spaziali quando *indichiamo* delle questioni morali, o *sveliamo* segreti, o aspettiamo a *lungo* e ancora quando abbiamo *alte* aspettative. Queste rappresentazioni spaziali vanno ben oltre la loro espressione metaforica e influenzano i processi cognitivi a vari livelli. L'obiettivo di questo progetto di ricerca è esaminare il ruolo degli schemi spaziali legati alla dimensione orizzontale in relazione ai processi di cognizione sociale. Sebbene tali schemi siano stati oggetto di studio in vari campi, dalla storia dell'arte agli studi sull'orientamento dell'attenzione, dalla psicologia cross-culturale alla neurologia, questo progetto rappresenta uno dei primi tentativi di affrontare il tema da una prospettiva psico-sociale.

L'idea su cui si basano tutti gli studi riportati nel presente lavoro prevede che un target responsabile di un'azione, venga rappresentato nel campo visivo alla destra del target che subisce quell' azione. La traiettoria implicita dell'azione è, di conseguenza, da sinistra verso destra. Questa proposta, inizialmente avanzata da Chatterjee (2002), è qui rivisitata da un punto di vista psico-sociale, in cui la potenzialità d'azione del target (agency) è considerata una caratteristica fondamentale degli stereotipi sociali (Abele, Uchronski, Suitner, & Wojciszke, 2008; Spence, Helmreich, & Stapp, 1974). Il legame tra il vettore spaziale sinistra-destra e il costrutto agency è associato alla direzione di scrittura/lettura, almeno nelle culture occidentali. I fattori culturali sono dunque analizzati come possibili moderatori del bias spaziale attraverso il confronto di partecipanti la cui direzione di scrittura/lettura è sinistra-destra o destra-sinistra (Studio 1c e 5). Dopo una rassegna della principale letteratura sul bias spaziale nell'introduzione, il primo capitolo indaga le specifiche rappresentazioni spaziali di concetti legati al contenuto degli stereotipi, focalizzandosi sui vettori verticale e orizzontale. Il risultato più importante, per gli obiettivi del presente progetto, è la rappresentazione di agency (Studio 1a) e dinamismo (Studio 1b e c) lungo il vettore sinistra-destra da parte dei partecipanti italiani. Questo risultato è coerente con il ruolo di agency ipotizzato da Chatterjee (2002) nel bias spaziale orizzontale, che per semplicità definiremo SAB (Spatial Agency Bias). A conferma del ruolo della direzionalità della scrittura nel bias, i partecipanti di origini arabe non hanno confermato il pattern mostrato dai partecipanti italiani. Oggetto del secondo capitolo è l'applicazione del SAB agli stereotipi di genere. Nei primi due studi questa applicazione è stata analizzata attraverso ricerche d'archivio su immagini web di coppie famose. In generale, il maschio della coppia è rappresentato alla sinistra della donna (Studio 2a), ma soltanto quando è percepito come più agentic di lei (Studio 2b). La relazione tra il SAB e gli

stereotipi di genere è stata ulteriormente indagata nelle valutazioni di immagini di uomini e donne il cui volto è rivolto verso destra oppure verso sinistra. Nello Studio 2c i partecipanti hanno mostrato una preferenza nell'associare il profilo maschile alla direzione verso destra e quello femminile verso sinistra, con un bias che si può definire stereotipico. Nell'insieme, questi ultimi tre studi sostengono l'ipotesi in base alla quale le differenze di genere possano essere definite, nelle rappresentazioni visive, attraverso specifiche informazioni spaziali. Ad ulteriore conferma dell'importanza di caratteristiche spaziali nello schema mentale di uomini e donne, lo Studio 2d mostra che questa associazione non solo è presente anche ad un livello di decodifica, cioè nella categorizzazione di volti maschili e femminili, ma è legata anche ad attribuzioni di caratteristiche stereotipiche nei confronti di uomini e donne e ad atteggiamenti ambivalenti rispetto alle categorie sociali in questione. In particolare, tanto più gli uomini (vs. le donne) sono associati alla direzione sinistra-destra (vs. destra-sinistra), tanto più è alta l'attribuzione di potere agli uomini e calore alle donne e ambiguo l'atteggiamento verso entrambi. Questo dato è di particolare rilevanza, perché rappresenta (a nostra conoscenza) il primo risultato inerente le conseguenze sociali di questi bias. Un secondo aspetto dello Studio 2d, riguarda l'analisi dell'esposizione a stimoli visivi sociali la cui direzione è variata sistematicamente. La proporzione del numero di volti maschili verso destra e di quelli femminili verso sinistra ha un effetto nel bias che emerge dalla loro categorizzazione. L'esposizione ad un numero molto elevato di volti maschili e femminili, rispettivamente orientati verso destra e verso sinistra, era associato ad un bias congruente (quello che abbiamo definito stereotipico). Quando l'orientamento dei volti veniva invertito, i partecipanti mostravano un bias opposto, ovvero contro-stereotipico, categorizzando più facilmente volti maschili orientati verso sinistra e volti femminili orientati verso destra. Il ruolo dell'esposizione a specifiche direzioni è stato ulteriormente indagato nello Studio 4 in cui la direzione (questa volta non di uno stimolo visivo, bensì di un' azione) veniva promossa attraverso un esercizio di simulazione di scrittura verso destra o verso sinistra, che rispettivamente rafforzava o indeboliva il SAB e il suo legame con le credenze stereotipiche. Questo risultato suggerisce che l'effetto di variabili culturali nella promozione di una direzione non è cronico, piuttosto è suscettibile a condizioni contestuali come le esperienze corporee legate ad azioni contingenti. L'aspetto motorio come fondamento del bias spaziale è oggetto d'indagine nel Capitolo 3, in cui il ruolo dell'azione è valutato comparando il giudizio di eventi rappresentati in modo statico oppure dinamico. Sebbene la direzione del bias non segua sempre le ipotesi, l'andamento generico dei risultati suggerisce che tale bias è specificamente legato a target in movimento, sostenendo la prospettiva dell'embodiment e il processo di simulazione nella rappresentazione cognitiva (e.g., Barsalou, 2008a; Lakoff, 1992).

Il Capitolo 5 è dedicato all'aspetto più applicativo del bias spaziale, analizzato come possibile fattore da tenere in considerazione nelle comunicazioni di massa, con una particolare attenzione al back-ground culturale delle persone a cui è diretta la comunicazione o pubblicità.

Infine, il Capitolo 6 indaga il legame tra le rappresentazioni spaziali e la politica, mostrando che gli stereotipi legati alla politica giocano un ruolo chiave nell'associazione tra il vettore verso destra (vs. sinistra) e l'orientamento politico di destra (vs. sinistra) di target individuali (Studio 6b e c). Nella valutazione di gruppi, il bias spaziale era caratterizzato soprattutto da un favoritismo verso il gruppo congruente con

l'orientamento politico del partecipante, cui veniva assegnata la rappresentazione verso destra. Questo bias nei confronti dell'ingroup era rafforzato dall'attribuzione di competenza allo stesso (Studio 6a).
Nell' insieme, il presente progetto di ricerca accerta il carattere sottile ma persistente del SAB, mostrando l'ampia varietà di conseguenze e applicazioni nei campi della psicologia sociale, cognitiva e delle comunicazioni di massa.

Introduction

Duality seems to be everywhere. We have two hands, two ears, two eyes. We breathe in and out; our brain has two hemispheres. There are two genders. Electric charge is negative or positive; the earth has two poles (north and south). This overwhelming presence of duality in our body and in the environment around us is affecting the way we envisage abstract concepts and organize information. We split the world in good and bad, politics is divided in leftwing and rightwing, we invented machines working in binary codes. Also our religions are permeated by duality. In Taoism there is a contraposition of *yin* (light, action, and maleness) and *yang* (darkness, passiveness/motionless, and femaleness); in Catholicism God is juxtaposed to the Devil.

Duality simplifies our worldview and it is easily represented visually. Intangible and complicated concepts can be reduced to thinkable entities through their dichotomization. Moreover, dichotomic concepts can be easily envisaged at a visual level with symbolic images involving the use of spatial representations. According to Lakoff (1992) and Casanto and Boroditsky (2008) we use the physical domain to support our thinking of abstract concepts. Given that we experience the world in space, spatial coordinates[1] are often recycled to envisage intangible entities. The vertical and horizontal spatial vectors are therefore useful tools for our cognition. Vertical and horizontal vectors -although equally valuable axes of the Cartesian space- have very different properties.

As underlined by Barbara Tversky in a private communication, the vertical (up-down) axis is a-symmetric, because of gravity. On the contrary the horizontal (left-right) axis is more symmetric and flexible, because it can be easily reversed changing the point of view. Despite the symmetry of the horizontal vector, the representations that are drawn on it are often characterized by a fascinating lack of symmetry, with right and left being anything but interchangeable. For example we spontaneously envisage the past to the left and the future to the right (Santiago, 2007), not vice versa. Although horizontal representations of abstract concepts seem all but random, they still have a high degree of flexibility as illustrated by variations across cultures. For example, we drive on the left side of the street in England, but not in France. Italian is written from left to right, but Hebrew from right to left. Time is envisaged as flowing toward the right for English children, but toward the left for Arabic children (Tversky, Kugelmass, & Winter, 1991).

The asymmetric horizontal representation of duality is intriguing because it has a surprising arbitrariness; therefore it is more susceptible to cultural influences. Aim of this research project was to investigate the relation between abstract concepts related to social psychological processes and the representation of duality in the spatial horizontal domain.

[1] Although spatial coordinates have three mainly dimensions, we focused on the bi-dimensional space that is easier represented in the visual representations. The axis referring to deep, that in an egocentric perspective can be identified with front-back, is therefore omitted in the present research project.

Right and Left in history, mythology and art

The horizontal domain is characterized by a right and a left pole. Since the very origin of the two words, right and left assumed meanings that go beyond the spatial domain. Looking at their etymology, it becomes immediately evident that right is associated with goodness and power, and left with badness and weakness. The word *right,* which in Old English was *riht*, derives from an Indo-European past participle, meaning 'having moved in a straight line'. Many European languages use terms that derive from this common root to indicate right, such as *recht* in Dutch and in German, *Rätt* in Swedish and *Rett* in Norwegian. The Indo-European root is also the source of Greek *ορεκτος* (and the subsequent Latin *rectus* and Italian *retto*), meaning straight, correct. To indicate the right position, many Romance languages (such as Italian) use words linked to the old Latin *dexter* (meaning right, but also propitious and proper) that probably derives from the Ancient greek *δεξιος* (meaning right, propitious, good, smart), which in turn derives from the Sanskrit *daksinah* (again meaning right and skillful). Across different languages the link between right and good therefore appears to be constant. In a similar vein, the word *left* derives from the Anglo-Saxon *lyft*, meaning worthless, weak. The Latin word for left was *sinister,* meaning unlucky, evil, bad and probably derived from the Ancient Greek *αριστεροζ*, meaning "to the left" but also "off track", and "off one's head". Interestingly when used to define arms, *left* meant "defensive", a passive action. Thus, in many Latin languages the word denoting the left side in space derives from *sinister* and generally maintains a negative connotation. For example, in Italian the word *sinistro* means *to the left* but also *grim* (in the adj. form) and *accident* (as a noun). This short review of the historical origins of the words used to express right and left in different western languages suggests a clear relation between the spatial domain and abstract concepts, such that the same words that express spatial information also express abstract concepts such as right and wrong, just and adverse.

Similar links between abstract concepts and space can also be found in ancient philosophies and mythologies. For example, in the Indian Mythology (7^{th}-8^{th} century) the duality between maleness and femaleness that is thought to characterize the polarity of each person is represented with the famous deity of Ardhanari-Ishvara, the unique being made of two halves. In the Hindu tradition the left side is generally female and the right side is male. These two aspects of humanity are associated with two main energetic channels (Nādi) that were later resumed by the Yoga practice that rebalances and unifies the two, acknowledging their laterality in the body. Ida, the female Nādi, channels a negative and passive energy that is represented by the moon (Chandra). It flows in the left side of the body and is linked to functions such as perception, emotion, intuition, generation and conservation. Pingala, the male Nādi, vehicles transmits a positive and active energy that is represented by the sun. It flows in the right side of the body and is linked to functions such as reason, action and destruction (Monsalves, Mioni, & Vale, 2004). In sum, the Indian philosophy

acknowledges the physical duality of the body as the expression of abstract concepts, with the body's right being more active and the left more receptive. Interestingly this iconography has been part of the dispute about the dominance of the feminine vs. masculine nature of Ardhanarishvara[2] and the deity is often represented with the male /powerful part to the right from the observer point of view (rather than in the actual right part of the represented target). This detail stresses the importance of the relativity of the concepts *right* and *left* and their use for communication purposes.

Fig. 1 Representations of Ardhanarisvara, the Indian deity who is half Woman and half Man.

In a similar way, in the Western art tradition, artworks are characterized by spatial information that links rightward with activity and leftward with passivity. An emblematic example is the representation of Day and Night in two drawings of Henri Matisse, where an awake woman

[2] Although originally defined as mainly feminine, the deity was later interpreted as a masculine deity with one feminine half. This interpretation as been challenged in Eastern and Southern India, where first-millennium Shaktas placed the feminine half on the "dominant" right side of their Ardhanari images in order to reaffirm the feminine character of the deity. Although the balance between the two halves is promoted by Indian philosophy, it is clear that the popular view of an association between right and dominance has influenced the iconographic representation of the deity. Therefore we can easily found representation of the deity with the male (vs. female) part to the left or the right according to the importance that is given to the feminine or masculine part (Jain & Daljeet, 2005).

facing toward the right represents the day and an asleep woman facing toward the left represents the night (see Fig. 2).

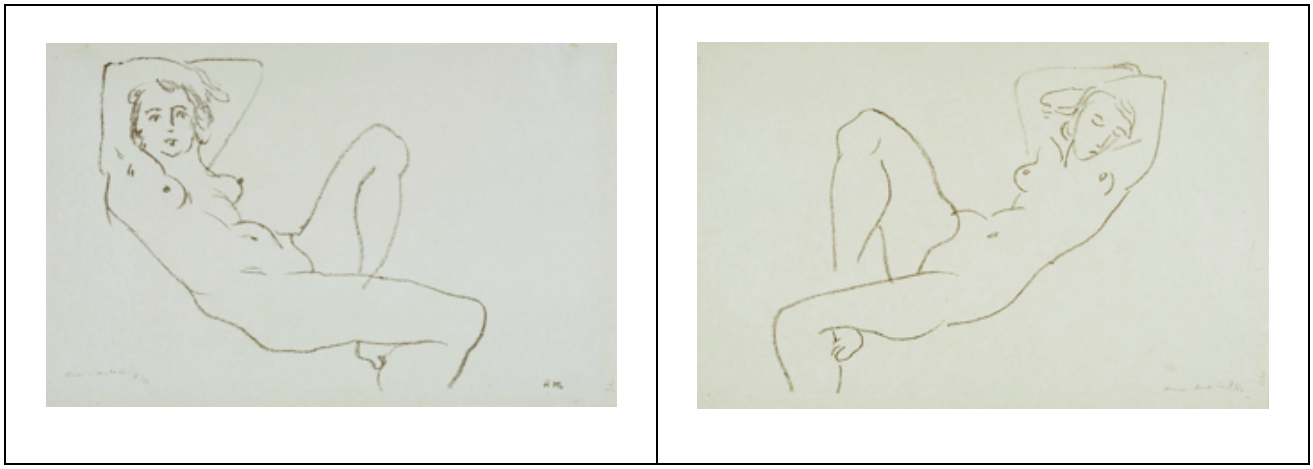


Fig. 2: To the left "Day" and to the right "Night", Henri Matisse. Baltimore Museum of Art, NewYork.

A more systematic analysis of the literature on portrait paintings shows a surprisingly regular use of space to indicate activity. Usually painters depict the target in the half profile pose that confers depth to the figures. They therefore have to choose which of the two half faces of the sitter they want to expose to the observer's gaze. The results of various archive analyses show that painters choices are far from being random, but influenced by the characteristics of sitter, such that the more the sitter is characterized by passivity, the more s/he is represented facing left (from the observer's perspective). This leftward bias (Conesa, Brunold-Conesa, & Miron, 1995; Gordon, 1974; Grüsser, Selke, & Zynca, 1988; McManus & Humphrey, 1973; Suitner & Maass, 2007) has been interpreted as the result of the passive attitude of sitters that are inertly posing for the portrait (Chatterjee, 2002). Moreover leftward presentations are more frequent when the portrayed sitter is a woman (Gordon, 1974; Grüsser et al., 1988; Humphrey & McManus, 1973; Suitner & Maass, 2007; ten Cate, 2002) suggesting that the stereotype content of women-as-passive is expressed through their spatial representations. Consistently with this hypothesis, the effect is stronger among artworks of male artists (Suitner & Maass, 2007) and it has undergone considerable changes over time, with reduced differences between male and female sitters in recent times, presumably due to women's emancipation (Grüsser et al., 1988; Suitner & Maass, 2007). Finally, this bias is opposed to a rightward bias in self-portraits (Humphrey & McManus, 1973; Latto, 1996; Suitner & Maass, 2007) presumably reflecting the activity of the sitter who, in the situation of self-portraits, actually is drawing or painting the picture him/herself.

This type of bias is present also in unsuspected contexts, such as the scientific environment. An archive research on some of the leading APA journals (e.g., Journal of Personality and Social Psychology) over the period 1965-2004 showed that graphs and tables showing gender differences systematically position men to the left of women in the visual representation. This layout was present in 74% of the 282 articles that depicted gender differences (Hegarty & Buechel, 2006).

Together, archival analyses of artwork and of graphic representations in science both reveal a systematic bias in which males are positioned on the left, facing rightward, whereas women are positioned on the right, facing leftward. These two lines of research converge in showing that, in the minds of artists and scientists alike, gender is systematically linked to space. However, it remains unclear whether this subtle spatial bias also affects broader areas of social cognition such as recognition and categorization. Also, I am not aware of any experimental work investigating the presumed link between gender stereotyping and spatial bias in a systematic way. These issues are addressed in Chapter 2.

Empirical evidence for spatial representations of abstract concepts

Some concepts have obvious spatial representations such as notes (in a pentagram), directions (usually represented with arrows), or isohypses (typically representing elevation in a topographic map using parallel lines). These representations are conventional symbols, consciously used and culturally shared. Other concepts are not openly associated with specific visual representations. Although their visual representation is rarely acknowledged, such concepts may still be related to spatial cues that facilitate their cognitive processing. For instance, Richardson and colleagues showed that some verbs are spontaneously envisaged with horizontal image schemas, such as to pull, to push or to offend, whereas other words are envisaged with vertical representations such as to fly, to lift, to hope or to increase (Richardson, Spivey, Edelman, & Naples, 2001). The spatial position of a given verb was shown to facilitate or interfere with the performance in a visual discrimination task, such that a visual stimulus is detected faster when presented in a location (top-bottom vs. right-left) that is congruent with the verb's spatial schema. Similarly, in a visual memory task, participants recognized previously seen pictures easier when the picture was oriented along the same axis of the associated verb (Richardson, Spivey, Barsalou, & McRae, 2003). For instance, the verb *to push* was associated with the horizontal axis and the visual representation was easier recognized when horizontally arranged, whereas *to fly* was vertically envisaged and its visual representation was easier recognized when vertically arranged.

These spatial cues are often captured by language through the meaningful use of metaphors, as in the case of *power*, a concept that is metaphorically –but not conventionally- associated with the vertical spatial axis (e.g. *subordinate*, *upper class*, *higher level* in the hierarchy). In fact, it is not sufficient to point up in order to indicate that a person or group is holding the highest status. Nevertheless the association between the abstract concept of power and the visual representation has been shown to be so pervasive that the presentation of a powerful group at the bottom (rather than at the top) of a computer screen creates a contrast able to slow down the identification of the group (Schubert, 2005). The same holds for other abstract concepts such as valence, with positive words being categorized faster when presented at the top (Meier & Robinson, 2004). Even one of

the most intangible concepts humans can possibly think of is spatially represented: God is up there (Meier, Hauser, Robinson, Kelland Friesen, & Schjeldhal, 2007).

Other concepts are represented on the horizontal axis. For instance, letters, months, and numbers are spatially organized in an ordinate way, with smaller units to the left and larger units to the right (Dehaene, Bossini, & Giraux, 1993). As already mentioned, we map the intangible concept of time onto a spatial frame (Boroditsky, 2000). Moreover this space-time relation is asymmetric, namely we do not use time to represent space. We use space to estimate duration, but we do not strongly rely on time to estimate distance (Casanto & Boroditsky, 2008; Santiago, 2007). It is therefore evident that the physical realm is of use for understanding the concept that is less accessible to our senses, not the contrary. Similarly of what happens in the representations of concepts like power and valence, the relation between time and space is so strong as to affect tasks in which the spatial information is, theoretically, irrelevant. For instance, the categorization of time-related terms (e.g., yesterday or tomorrow) is affected by the position of both the response key and the target words, with words referring to the past categorized easier when presented to the left side of the screen and evaluated with the left key, and words referring to the future being processed easier when presented to the right with the response key to the right (Santiago, 2007). Interestingly the relation between time and the left-right vector hardly finds a correspondence in language use. The linguistic metaphors for time usually make use of the back-front axis. Although this spatial representation of time is also present, with the future being envisaged to the front and the past to the back, the mere introduction of response keys –rather than a verbal response- can make the participant's body salient through the use of the left and right hand in the task and can activate the alternative representation of time involving right and left (Torralbo, Santiago, & Lupiáñez, 2006).

This shift from one spatial frame to another is further evidence for the key role of the physical experience in envisaging abstract concepts. In other words, the selection of spatial representations appears to be strongly related to action. This is consistent with the idea that our cognitive processes are strongly intertwined with action, and that not only the aim of thinking is acting (Glenberg, 2008), but also that action is a means for thinking. Foroni and Semin (in press) have recently shown that the activation of muscles is not only involved in the processing of words, but it is also a key component of the full activation of their meaning. In this study, participants were subliminally exposed to emotional verbs (e.g. *to smile* or *to frown*) that activated the corresponding facial muscles and, as a consequence, affected subsequent judgments (e.g., cartoons were perceived as funnier after exposure to the word *to smile*). When this muscle activity was inhibited (by asking participants to hold a pen in their mouth), participants' judgments about cartoons were no longer affected by the meaning of prime words. The authors concluded that the motor resonance plays a key role in cognitive processes. An interesting question that arises from these findings is whether visuo-motor activity also plays a similar role in the left-right bias that is the object of this Thesis.

This question will be investigated through the presentation of target resembling motion (see Chapter 3) and through a motor exercise (see Chapter 4).

The spatial agency hypothesis

Given that many abstract concepts such as time, valence and divinity, are associated with specific representations, the question then arises whether **social psychological concepts** also have their spatial component. This claim –that is specifically addressed in Chapter 1- derives from Anjan Chatterjee's (2002) Agency Hypothesis that for the first time created a link between spatial representation and social roles. Chatterjee asserts that certain spatial representations are distinctly associated to the perception of agency, such that left positions are more strongly associated with agency rather than right positions. This hypothesis finds its origins in the observation of an aphasic patient who was not able to transfer the grammatical role of subject and object in a sentence into the thematic roles of, respectively, agent and recipient of the described action. The patient developed an interesting strategy, namely the assignment of the agentic role to the target presented at the left side and the recipient role to the target presented at the right side (Maher, Chatterjee, & Rothi, 1995). Consistent with Chatterjee's theory, subsequent research showed that the same spatial schema is present also in the normal population. When participants are asked to draw pairs of interacting persons, the agent tends to be positioned to the left (Chatterjee, Maher, & Heilman, 1995; Maass & Russo, 2003). Similarly, the agent is recognized easier when positioned to the left of the recipient with action going from left toward right (Chatterjee, Southwood, & Basilico, 1999).

Visual field asymmetries and the advantage of the rightward vector

A further consequence of the spatial schema proposed by Chatterjee (2002) regards the direction of the action, in fact being the agent to the left and the patient to the right, it follows that the action evolves from left to right. Consistent with this argument, Chatterjee and colleagues (Chatterjee et al., 1995; Chatterjee et al., 1999) showed that actions are better processed in a thematic role task when evolving from left toward right rather than from right to left. Similarly, Maass and colleagues found that rightward trajectories are evaluated as more beautiful, faster and stronger than leftward ones (Maass, Pagani & Berta, 2007)

The spatial layout of a stimulus is therefore an important feature for the evaluation on dimensions for which space should be irrelevant, such as likeability. For example Leonardo's drawing of faces were judged to be more active and potent when originally rightward depicted by the artist, compared to leftward facing portraits and to mirror images of originally rightward facing portraits (Benjafield & Segalowitz, 1993). This suggests that Leonardo expressed more power and action when he chose the rightward face profiles. This could be a peculiarity of Leonardo's style. However, it is not an isolated case, considering that Rembrandt's portraits of female sitters were

perceived as more likeable when leftward directed, whereas the portraits of male sitters were more likeable when rightward oriented. Again the original orientation was accountable of the different judgments (Schirillo, 2000, 2007). These results underline the ability of the painters in using spatial information as an additional feature to express the characteristics of the target. Naturally not all artists use spatial features the way Leonardo and Rembrandt did. Not surprisingly, in mixed collections of portraits from different painters, the style of the painters is more difficult to recognize and participants rely on the orientation of the portrait observable at the moment, rather than on the original one. In this case, the rightward portraits (either original or mirror version) were generally preferred (McLaughlin & Kimberly, 1994; Zaidel & Fitzgerald, 1994). Nicholls and colleagues also addressed the issue of portrait direction from the sitter's point of view, showing that direction may be the expression of communicative intentions not only of the painters (as shown in the analyses of Leonardo and Rembrandt' portraits), but also of the sitter. Participants were asked to pose either for a family portrait or for the Royal Society, in the first case to express warmth and affection and in the second case to appear impassive and cool-headed. Participants posing for the family portrait were more likely to put forward their left cheek exposing a leftward profile to the observer. Participants posing for the Royal Academy were on the contrary more likely to show a rightward profile (Nicholls, Clode, Wood, & Wood, 1999). Consistently, in a subsequent study of Nicholls and colleagues, females and participants who were more expressive were more likely to show a leftward profile when posing for a photograph (Nicholls, Clode, Lindell, & Wood, 2002). Therefore the spatial schema seems to have two components that work in concert, one related to the position of the actor, the other to the direction in which the action evolves.

To our knowledge, Chatterjee and colleagues (1999) are the only researchers who have addressed this issue before. In a picture-matching task, they asked participants to indicate if the picture was correctly representing a described event. The picture layout was organized with the agent being either to the left or to right of the recipient, and with the action evolving either leftward or rightward (contrasting verbs such as *pull* or *push*). They found two independent and additive effects of direction and position, with representations in which the agent was positioned to the left of the recipient and the action moving rightward being recognized with greater ease.

The asymmetry is interpretable either as an effect of position or of direction, and evidence for the asymmetries of the visual field both in terms of position and direction comes from different areas of investigations. One example related to the position lays in the asymmetric performances in the line-bisection task, one of the classic tasks used to investigate the consequences of brain damages for spatial cognition. This task consists in splitting a horizontal line in two halves and patients with a unilateral brain damage usually bisect the line further on the side of their lesion, namely if they have a right-hemisphere deficit they indicate the half of the line to the right of the geometrical midpoint. Put simply, this error shows that patients underestimate the size of the half-

line in the controlesional visual field, which is in fact neglected (for a review on spatial hemineglect disorders see Vallar, 1998). More interestingly for the present context, also neurologically normal participants show a systematic –although smaller- bias in the line bisection task, splitting the line to the left of its geometrical midpoint (for a meta-analysis and review on pseudoneglect see Jewell & McCourt, 2000). This phenomenon, known as pseudoneglect, has been interpreted has the result of an attention shift following the right hemisphere specialization in space-related functions. According to the activation-orienting hypothesis (Reuter-Lorenz, Kinsbourne, & Moscovitch, 1990), the activation of the right hemisphere is thought to be responsible for a shift of the attention to the left. Along the same line, Holländer and colleagues found a left visual field advantage in attentional blinks during rapid streams of visual stimuli (Holländer, Corballis, & Hamm, 2005). Participants were more accurate in detecting a target stimulus immediately following a previous target stimulus when the two were presented in the left visual field rather than the right. The asymmetry was again interpreted as the result of the right hemisphere specialization for allocating spatial attention.

This rightward bias becomes particularly relevant when applied to methodology. Psychologists in fact often use scales that are spatially arranged to measure attitudes, believes, stereotype endorsement, self-evaluations and so on. Participants are often asked to express their responses using graphical devises, such as Likert scales, where the answer boxes are organized along the horizontal vector using right and left as anchors of the scale (e.g., ***agree*** ☐ ☐ ☐ ☐ ☐ ☐ ***disagree*** vs. ***disagree*** ☐ ☐ ☐ ☐ ☐ ☐ ***agree***). Nicholls and colleagues (Nicholls, Orr, Okubo, & Loftus, 2006) reported a pseudoneglect-like effect in participants responses on Likert scales assessing "satisfaction" such that participants were more likely to agree with the presented items when the "agree" pole was positioned to the left (i.e., the first scale in the previous example).

Additional evidence for the asymmetry, but in terms of direction rather than position, comes from the literature of attention orientation. The tendency to visually explore novel location and to avoid the return to already explored locations, is defined the inhibition of return effect (for a review see Klein, 2000). This effect is functional from an evolutionary point of view because it enhances the probability to find what we are looking for. Taking as an example the activity of picking mushrooms, it is wiser to move to a novel location looking for more mushrooms rather to go back to the already explored areas. Interestingly, the inhibition of return is stronger when the return would imply a leftward gaze, suggesting a left-to-right bias in the movement of attention (Spalek & Hammad, 2004). Such rightward attentional bias also occurs for a phenomenon known as representational momentum. Participants asked to indicate the final position of a stimulus moving horizontally across a computer screen and suddenly disappearing have the tendency to mentally prolong the movement of the target and to indicate the final position further along the implied trajectory (for a recent review see Hubbard, 2005). Again the general effect of representational

momentum is evolutionary useful, as it can be of help when catching a moving target. We mentally figure out the final position along the movement hypothesizing the target will not stop all of a sudden and we adjust our action to this predicted final position. Surprisingly, this effect is stronger when the motion of the target is rightward oriented rather than leftward oriented (Halpern & Kelly, 2003).

We can conclude that the spatial asymmetries are present both at the level of encoding (e.g. in the neglected line bisections) and decoding (e.g. in the interpretations of thematic roles) and that they are characterized by two additive features, namely position and direction, with left position and rightward direction being advantaged over right positions and leftward direction. At least in Western cultures.

Theoretical aspects

This brief review concerning asymmetries in the processing of stimuli embedded in space rises the question of the causes of such biases. From a theoretical point of view the origin of the spatial agency bias can be due to two different processes that do not necessarily exclude each other. One is neuro-scientifically, the other culturally defined. From a neuro-science point of view, the visuo-spatial function of the right hemisphere might play an important role in defining the supremacy of the left visual field for pictorial information. This hemisphere is specialized in face recognition and attentional monitoring (Gazzaniga, 2000). Moreover, the right hemisphere is also involved in the identification of coordinate properties for locating objects (Kosslyn et al., 1989 and 1994) and in the exploration of novel stimuli (see Novelty Routinization Theory, Goldberg, 2001). In contrast, the left hemisphere is mainly implied in linguistic functions, in problem solving, and in the understanding of categorical properties defining a specific object. The different functions of the two hemispheres are therefore supposed to create a mirror asymmetry in the two visual fields; when the target is placed in the counter-lateral visual field (e.g. left visual field) of the hemisphere specialized to elaborate a specific type of targets (e.g. right hemisphere), the process is facilitated. The left visual field is therefore the perfect candidate to start the visual exploration and to locate a stimulus. Subsequently, a shift of attention towards the right visual field enables the perceiver to analyze the characteristics of the object in relation to previously known categories. This possible cognitive/physical path may be responsible for a left-to-right bias suggesting a preference for information starting in the left visual field and evolving toward the right visual field.

Another possibility, taking a cultural perspective, is that the asymmetry is due to an attentional bias that is consistent with the direction in which a given language is written and read. Since many languages are in fact written with a left to right vector, this trajectory may be particularly easy to process because of the greater familiarity. Evidence for the role of reading habits in spatial biases comes from a large corpus of cross-cultural research comparing left-to-right

(e.g. English, Italian or French participants) with right-to-left (e.g. Hebrew, Arabic, or Urdu participants) readers. In fact patterns of spatial bias congruent with the direction of written language are evident in a wide range of tasks, from symbolic representations to attentional shifts, and seem to involve both encoding and decoding processes.

The writing direction appears to affect the way abstract concepts are envisaged in space. As already mentioned, in left-to-right languages numbers and letters are envisaged on a horizontal line with the first letter or smaller number to the left and proceeding toward right (SNARC effect). A Reverse SNARC effect (with numbers envisaged from right to left) has been found among Arabic readers. However, the Reverse SNARC effect was weaker when Arabic participants were able to read a left-to-right language (English or French) and not present at all among illiterate Arabic speakers (Zebian, 2005). The experience with language writing seems therefore to affect the presence, the direction and the strength of the SNARC effect.

Also time is envisaged in a way that is consistent with the dominant writing direction, being thought to proceed from left toward right in Western cultures (Santiago, 2007), but vertically by Chinese speakers whose language direction is top-down (Boroditsky, 2001). Similarly, in the assignment of thematic roles, the agent is envisaged to the left by Italian, but to the right by Arabic speaking participants (Maass & Russo, 2003). Writing direction also affects aesthetic preferences, with rightward readers preferring rightward images and leftward readers preferring leftward images (Chokron & De Agostini, 2000; Israel Nachson, Argaman, & Luria, 1999). Finally, an aggression is perceived as more violent, and an athletic action as more powerful and beautiful when oriented in the same direction of the habitual writing vector (Maass et al., 2007).

Additional evidence shows the effect of language direction in the automatic orientation of attention and in space perception. For example the already mentioned inhibition of return effect has been found to reverse among Arabic readers, who showed a right-to-left bias (Spalek & Hammad, 2005). Again consistently with their reading habits, English reading participants were slower in ignoring letters presented in the left visual field, namely the field where their reflexive attention is biased to, given that they usually start their scanning mechanism at the beginning of a sentence at the left, proceeding to the right. For Arabic participants, the opposite was true, as they found it harder to disregard a stimulus presented in the right visual field, namely the place where they usually orient their attention when starting a reading activity. According to the author, these biases are unlikely to be related to hemispheric specialization (Eviatar, 1995). Vaid, one of the major contributors to cross-cultural evidence for the role of writing habits in spatial biases, compared Hindi and Urdu participants that represent ideal populations to investigate effects of writing direction. In fact, Hindi and Urdu are two north Indian languages that although being very similar from a phonological, semantic and syntactical point of view, and despite their similarity as spoken languages (Urdu and Hind people can roughly understand each other), different on one major

characteristic, namely the direction in which are written. Urdu is written from right to left, whereas Hindi is written from left to right (for the historical reason of this difference see Vaid, 1995). Vaid explored the drawing order finding opposite patterns in Hindi and Urdu participants who respectively started the drawing task on the Top Left vs. the Top Right, and used a left to right vs. a right-to-left drawing sequence. This study also included Arabic participants who performed similarly to Urdu participants, consistently with their common writing direction (Singh and Vaid, 1987, reported in Vaid, 1995). Hindi, Urdu and Arabic speakers were also compared in a chimeric facial affect judgement task (Vaid, 1989). When asked to choose the happier face, Hindi participants preferred the chimeric face in which the smile was in the left hemiface, whereas Urdu and Arabic speaker preferred the chimeric face with the smile in the right hemiface. This study was later replicated with similar results adding an illiterate control group that was characterized by an absence of a spatial bias (Sakhuja, Gupta, Singh, & Vaid, 1996). Vaid further discussed the cultural effects in interaction to biomechanic effects related to handedness (Vaid, Singh, Sakhuja, & Gupta, 2002). In a drawing task, participants drew objects (e.g. an arrow, a pen, a fish) with a direction that was consistent with their writing habits (rightward for Hindu and leftward for Urdu participants). This effect was very similar to the one reported by Nachson (1985), namely Arabic and Hebrew readers drawing stimuli from right to left and English readers from left to right. Vaid reported an additional effect of handedness consisting in a tendency for outward motions, with left-handers drawing more frequently left oriented objects and an opposite pattern for right-handers.

Although the effect of handedness is not the object of this review and the literature is not very consistent, it is important to acknowledge its possible role in spatial bias. For example, De Agostini and Chokron (2002) found inconsistent results within the same study reporting no spatial bias among left-handers when asked to draw a face profile (with right-handers drawing leftward profiles), but they found a tendency to draw leftward lines among left-handed children. This tendency reversed among left-handed adults who drew rightward lines. The authors commented that there are a motor and a scanning habit component in the spatial bias, which may decrease with increasing schooling. Nachson and colleagues (1999) found an effect of handedness such that right-handers participants preferred left positioned images and left-handers right positioned images. It is important to note that handedness has been shown to be related to cultural (Medland, Perelle, De-Monte, & Ehrman, 2004), genetic and hemispheric factors (for a recent review see Perelle & Ehrman, 2005), resulting in a rather complex picture. A final curiosity about handedness is that left-handedness have been found to be twice a frequent among Jewish than non-Jewish students (Rife & Schonfeld, 1944).

Together, the cross-cultural differences reported above suggest that culture cannot be discarded as a key component in spatial biases, allowing members of a given culture to process stimuli more fluently when their real or implied movement corresponds to the dominant scanning

habit. The role of writing direction will be analysed in depth later on. In particular, cross-cultural evidence will be reported in Chapter 1 (Study 1c) and in Chapter 5, whereas the role of visuo-motor activity in sustaining (or reducing) the culturally determined scanning habit will be addressed in Chapter 4.

It is important to note that the cultural and the hemispheric hypotheses are not necessarily in contrast; in fact it is possible that the writing direction is promoted by a hemispheric advantage or vice versa. Actually, it is very unlikely that cultural and brain specialization effects are independent as it would suggest a largely overcome dichotomy between the biological and the cultural aspects of humanity. Assuming therefore an interaction between the two domains, two possibilities arise. First, we can hypothesize neuro-cognitive systems to promote specific spatial asymmetries that mirror their organization. The second possibility is that culture is affecting brain organization. In support of the first hypothesis, we can cite that several studies of patients with unilateral brain damage show that hemi-neglect is more frequent and more severe after damages to the right hemisphere (Bisiac & Vallar, 1988). Speedie and colleagues (2002) examined right-handed patients from Jerusalem's hospitals with unilateral stroke (either to right or left hemisphere) that had learned to read a L-R (English, Russian, German, Rumanian, Hungarian) or a R-L (Hebrew or Arabic) language by the age of six and that did not learn other languages until late adolescence. In their study the higher frequency and the greater severity of neglect after right-hemisphere (vs. left) lesion was independent of reading direction, supporting the hypothesis that neglect is not uniquely dependent from scanning habits and that it may be partially due to inborn hemispheric specialization. However, the authors do recognize the "possibility that the exposure of Semitic readers to European languages was greater than our European readers to Semitic languages and, therefore, overall subjects are more likely to attend rightward than leftward. This overall bias may incorrectly lead us to believe that there are inborn physiological hemispheric asymmetries of attention" (p. 65). Similarly Fagard and Dahmen (2003) found cultural differences in three space-related tasks. In a line bisection task, right-to-left readers (Tunisian children) showed a weaker left bias compared to left-to-right readers (French children). Interestingly, the differences between Tunisian and French children emerged only after some years of writing practice (namely at the age of 9). However the fact that Arabic children did not show a right bias is interpreted by the authors as showing that they have two opposing tendencies, one being neurally (i.e. the left bias), the other culturally (i.e., the right bias) defined. The authors also acknowledge the possibility that by the age of 9 Tunisian children have started to learn French as well and that the two tendencies may be both culturally defined. In the same groups of children were also asked to perform a circle-drawing task. Young children, independent of their culture, generally draw the circles with a clockwise motion. However cultural differences were registered by the age of 7, when French children start to use a counter-clock wise direction. This effect is interpreted as the result of writing exercise of Latin letters that

usually involve counter-clockwise movements (e.g. **a, c, o, e**…etc). The third task consisted in a dot-filling task; consistently with the direction of their language, by the age of 7 French children filled more dots when drawing from left to right and Tunisian children filled more dots when drawing from right to left. Before the age of 7 children have a tendency to fill more dots when their movements imply an outward motion, leftward with the left hand and rightward with the right hand. Overall the results provide evidence for innate asymmetries in pre-literate children. These tendencies are then strengthened or weakened by congruent or incongruent writing habits.

Another issue that sustains the brain functions as a primary reason for spatial asymmetries is the fact that the number of languages written from left to right be much larger than the number of languages written from right to left. Written language history has been recently interpreted as the result of an evolutionary process started around 3500 B.C. in Mesopotamia with the Sumeric scripts, although there were probably other writing systems in other areas such as China at about the same time (Aaron & Malatesha Joshi, 2006). According to these authors, the evolution can be traced along the general pattern that starts with pictograms (such as in simple symbolic drawings), then develops into ideograms and later into rebus writing, such as in the Egyptian Hieroglyphics in which the drawing may represent the name of the object and not only the object it self. The syllabic writing is the major step toward the two modern writing systems, namely the consonantal writing and the alphabetic writing. This progression is accompanied by a parallel development of a consistent writing direction. Until consonant writing systems were developed, direction was not a consistent feature of writing systems. With the consonant writing system, there was a passage from a multi directional style to a consistent leftward direction. The development of an alphabetic vocal system is ascribed to the Greeks who, between 800 and 500 B.C., borrowed the consonantal Phoenician alphabet and added vowels (Watt, 1988). Adding the vowels, the Greeks changed the nature of writing from a context to a sequence based process (de Kerckhove, 1988a). Interestingly, they also changed the writing direction, from the original rightward direction of the Phoenician writing to the rightward direction of Ancient Greek. Why? Rightward and leftward writing systems have been explained as the result of the different type of relations that exist among the individual characters in the rightward and leftward texts (de Kerckhove, 1988b). According to de Kerckhove (1988b), languages written from right to left (e.g. Arabic or Hebrew) are characterized by consonantal alphabets that imply a contextual relationship between the letters. That is, the missing vowels, and hence, the meaning of the work have to be guessed from the context. Rightward languages (like English or Italian), on the contrary, have vocalic alphabets in which letters are sequentially related by contiguity. Taylor (1988) argued that there is a match between hemispheric specialization and writing systems such that the characteristics of writing systems mirror the feature of the hemispheric mainly involved in the processing of the given writing system. De Kerckhove (1988a) concludes that the left hemisphere specialized for sequential and analytic processing

promotes the rightward direction for vocalic alphabets in which the sequence is the key feature and the right hemisphere specialized in holistic processes promotes a leftward direction for consonant alphabets in which the pattern is the key feature.

Naturally, the entire debate can be reversed if we interpret brain asymmetries as the result of cultural processes. According to Vallortigara and Rogers (2005), the asymmetric behaviours in a population can be described as the results of social interactions. In fact, at the individual level there is no evolutionary advantage in a same-side lateralization. Although a lateralization in general has the individual advantages of increasing the neural capacity and unifying the brain response to a stimulus (i.e. the behavioural response is driven by the dominant hemisphere while the other hemisphere is inhibited), the advantages for the alignment in the direction of lateralization can be found only at the population level. Namely, the need of a coordinated behaviour is proposed as a natural selection criterion, with the asymmetric organisms pushed to align with the others in order to act is a socially organized way. The alignment of such asymmetries is therefore thought to be grounded at the social level.

We can conclude with Aristotele that *in medio stat virtus,* namely it is likely that cultural factors and neurological systems are affecting human behaviour in a join action, with culture affecting brain specialization and brain specialization affecting culture. Contextual factors can be addressed as possible factors that time by time define the direction of this relationship.

Regardless their possibly innate underpinnings, scanning habits undoubtedly affect cognition and the relation between space and cognition. They appear to be so pervasive as to intrude the symbolic representation of abstract concepts. This symbolic representation of abstract concepts can be defined with Lakoff as metaphoric (G. Lakoff & Johnson, 1980), namely a *cross-domain mapping* (Lakoff, 1992) that is used in the encoding and decoding processes of the conceptual system. Notably Lakoff's conceptual metaphors are not propositional, rather they are defined as sets of conceptual correspondence that overcome the linguistic definition as a figure of speech and reach the status of thinking modality that affects the cognitive processes in general. In other words, we first find analogies between the concrete (e.g. *war*) and the abstract (e.g. *argument*) domains and then we apply such analogies in systematic ways in order to simplify the conceptualization of abstract concepts. The metaphor in the example, namely *argument is war*, is re-applied to understand, explain and even experience the abstract concept, as shown by expressions like *Your claims are indefensible, I demolished his arguments* or *I've never won an argument with him* (the example is taken from Lakoff & Johnson, 1980). Through metaphors we link different domains and create image-schemas in which spatial information is preserved and transferred from a source domain to a target domain. For example, the passing of time is metaphorically envisaged as a motion and this image confers to the abstract concept of time properties of motion, such as

direction, speed and so on. This process is defined as the Invariance Principle (Lakoff, 1992) and justifies the pervasiveness of spatial characterization of abstract concepts. According to Gallese and Lakoff (2005) any concept (be it concrete or abstract) is embodied in the sensory motor system and conceptual knowledge is structured in our body and brain and is affected by the physical interaction with the environment. This interactionist theory of mind is based on the multimodality of the sensory-motor system that recycles the same neuron circuits to respond to action, perception, and imagination. The process behind a possible common ground of the concrete and abstract domains is simulation. This theory is in line with other embodied approach, such the Embodied or Grounded Cognition framework (Barsalou, 2008a, 2008b; Rohrer, 2006; Semin & Smith, 2008; Wilson, 2002). These theories underline the strong effect of action, perception and bodily states on cognitive processes and abstract representations. From these perspectives, body and mind are interpreted as intertwined parts of human existence

Aims of the present research

The above review shows that abstract concepts are related to spatial representations that affect their processing and their representation. Both, hemispheric specialization and writing direction appear to be involved in shaping these spatial schemas. Different from many other areas of psychology, the cross-cultural literature is well developed providing strong evidence for cultural determinants in all of the above biases. Until now the spatial biases have been studied in the field of art history (specifically in the portrait literature), of symbolic representations (e.g., representation of time, power, valence), of neuro-psychology (e.g., hemineglect, pseudoneglect effects) and in the field of attention orientation (e.g., representational momentum, inhibition of return).

Yet, to our knowledge spatial biases have been rarely investigated from a social psychological point of view. In fact, the present research project represents one of the very first attempts to apply spatial biases to social psychological issues. With the exception of Schubert's (2005) studies on the vertical spatial bias of power in groups perception, there is a surprising lack of research on the potential role of space in social cognition. Assuming that events are processed easier when coinciding with one's written language and that, in LR writing cultures like Italian, action is perceived as evolving from L to R (see Chatterjee's Agency Hypothesis, 2002), one may easily envisage a number of applications in the social realm. First, one may hypothesize a systematic link between stereotyping and spatial arrangements such that stereotypically more agentic groups (such as males or older people) are envisaged to the left of less agentic groups (such as females and younger people) and that this bias should mainly hold for people who endorse these stereotypes. Thus, spatial arrangements may serve as subtle cues to convey stereotypic beliefs. Following the same logic, the spatial orientation of a target should provide information about its category membership. For instance, right-oriented faces should be perceived as more agentic and, in cases of ambiguity, be more easily interpreted as male than left-oriented faces. Hence, we hypothesize a link between stereotyping and space that becomes relevant not only at encoding (for instance when drawing an interaction between a man and a woman), but also at decoding (for instance when trying to quickly categorize targets as either male or female). Previous research has provided some (non-experimental) evidence for the decoding, or production, side, whereas, to our knowledge, nothing is known about the role of spatial information during decoding. The first general aim of this research project is therefore to investigate the link between gender stereotyping and space in a series of controlled experiments, considering both encoding and decoding.

Second, although there is considerable research on cross-cultural differences in spatial bias, little is known about the mechanism by which writing direction promotes spatial bias. From an

embodiment perspective (see Semin & Smith, 2008), two hypotheses may be advanced. On one side, if spatial bias represents a case of embodied cognition related to writing and reading, then it should mainly occur for events that involve motion. The reason for this prediction is that writing (and reading) are, by definition, dynamic and that only dynamic, but not static scenes are likely to activate the sensorimotor experience involved in writing. This sensorimotor resonance elicits the application of schema related to the activated experiences, resulting in a spatial bias.

On the other side, an embodied cognition approach also suggests that the culturally determined trajectory (either LR or RL, depending on writing direction) may be enhanced or overridden by momentary sensorimotor experiences that work as proximal causes in the bias. The hypothesis is that momentary actions can create temporary mental schemas that - although weaker and situationally confined- may have short-term effects able to influence those of the culturally defined habitual trajectory. For instance, Italian participants may display a strong SAB after having written or read a regular Italian text, but they may fail to show the bias after having performed a writing or reading exercise in Arabic or Hebrew language.

Third, from an applied point of view, spatial information should become highly relevant in communication such as films, news reporting, advertisement, or political propaganda. Again, the spatial trajectory with which individuals, objects or complex scenes are shown provides a subtle tool to convey agency. Spatial features are therefore investigated as part of the message, whose meaning is reinforced or weakened by congruent or incongruent spatial layout. A third general aim of the present research is therefore to explore some of the applied implications of the spatial agency bias, in particular concerning political communication and advertisement.

Overview and organization

The first two chapters of this Thesis present research investigating the link between gender stereotyping and spatial bias. Chapter 1 addresses this issue at a general level by investigating whether specific traits such as dominance, agency, and communion, that are an essential part of many stereotypes (see stereotype content model by Fiske, Cuddy, Glick, & Xu, 2002) are systematically related to horizontal and vertical spatial representations. We hypothesize that dominance is represented vertically (in line with Schubert's 2005 work), but that agency and communion are represented horizontally, with agency represented by the LR and communion by the RL vector (in line with Chatterjee's Agency Hypothesis, 2002). Thus, the first set of studies simply investigates how people envisage stereotypical traits in space at an abstract level.

The same basic hypothesis is then tested again in Chapter 2, this time referring to individual targets rather than to abstract trait concepts. The studies reported in this chapter all focus on gender, as males are stereotypically perceived as agentic, women as communal (see Spence & Helmreich, 1978). To our knowledge this is the first time that the representation of male and female targets is investigated in a controlled and systematic way. Specifically, the representation of couples and of single targets (male and females) is analyzed in relation to the ascription of stereotypical characteristics, namely agency and communion, to the target. Moreover, the consequences of the SAB are investigated in terms of gender stereotyping and self-stereotyping. As far as we know, possible consequences in terms of social stereotyping have never been considered before although the implication of this outcome is very relevant in terms of stereotype communication and maintenance.

Chapter 3 and Chapter 4 address the processes underlying spatial bias, taking an embodied cognition perspective. An critical issue that has emerged from the literature review is the importance of action and motion as the basis of spatial biases. From an embodied cognition point of view, the simulation of action is particularly relevant for the application of spatial features to abstract concepts schemata. Nevertheless, there is a lack of systematic investigation of the role of motion in Spatial Biases. Chapter 3 and 4 tried to partially fill this gap. In Chapter 3 motion is related to the activity expressed by the represented targets and by their behaviour. If the embodiment of actions is the process involved in the use of spatial schema, targets that express a higher degree of dynamism would facilitate this process and promote the use of spatial schema in cognition. We therefore hypothesize that observers will make use of spatial information only when the represented events are dynamic, whereas spatial information is expected to be largely uninformative in the case of static scenes.

In Chapter 4 the role of embodiment is investigated from a different angle, focussing on the observer rather than on the represented scene. In Study 4 participants perform a leftward or rightward writing exercise before being exposed to a task assessing spatial bias. We hypothesize that the effects of habitual scanning habits can be reduced through momentary sensorimotor experiences such as "writing in the opposite direction". This study therefore tested the hypothesis that motor experiences play a key role in the SAB.

Finally, some possible applications in terms of communication are considered in the last two chapters, in which the SAB is applied to politics (Chapter 5) and to advertising (Chapter 6). The application to politics originates from the revealing use of labels involving the spatial area, namely rightwing and leftwing. The main hypothesis advanced in this set of studies is that observers draw systematic inferences about the political orientation of targets on the basis of whether these targets are right- or left-facing. In this chapter, I will test spatial bias in the presentation of politicians focussing on social psychological processes such as stereotyping and ingroup favouritism. In the last chapter the bias is applied to the area of communication and persuasion, investigating the role of spatial layout in advertisements.

Furthermore, given the importance of cultural aspects in spatial bias, the role writing direction was tested with cross-cultural comparisons involving Italian and Arabic speakers in two of the above studies (Study 3 of Chapter 1 and Study 5 of Chapter 5).

Chapter 1: The use of space to symbolically represent stereotype content

Visual representations are often used to refer to abstract concepts whose meaning is simplified in a symbolic representation. Many of these visual representations are consciously used, such as written words, street signals, or symbols. Other visual representations are used in a less conscious way. For example time is represented with a line evolving from left to right, with the past on the left side and the future on the right (Santiago, 2007). Representations such as this are widely used in communication as in the case of ads of washing powders, where the dirty cloth is usually positioned on the left side of the clean one. This visual position is so commonly adopted that the costumers won't need to wonder whether the soap is actually washing or creating spots on the t-shirt. Given that time is usually represented from left to right, with the left side associated to the past, the t-shirt on the left represents undoubtedly the state before-treatment, the one on the right the state after-treatment, showing the efficacy of the detergent. However, I suspect that costumers won't carry out this complex reasoning, but rather process this information in an automatic way, taking advantage of shared knowledge in order to save cognitive energy and process the ad very quickly and fluently.

Visual representations are therefore often implied in the synthesis of complex and abstract concepts. In fact, they have two main advantages, one at an individual, and the other at a social level. From an individual point of view, we can argue that spatial representations are heuristic cues in the cognitive process that make information processing more fluent. From the social point of view, spatial representations are implicit codes that reinforce the message and reduce the amount of information that has to be provided in the communication. In fact visual representations simplify the communication and facilitate the interaction between people. For example, we use gestures while we speak, and this spatial coding of communication is helpful both for the speaker and the listener who recognizes the gestures the speaker spontaneously creates (Goldin-Meadow, 1999). Gestures and words, although pertaining to two different domains, namely spatial and verbal, are encoded as a single signal in the communication system (Bernardis & Gentilucci, 2005), showing the strong tie between verbal and spatial domains in cognition. Another example of the importance of visuo-spatial information in communication is the widely used practice of supporting presentations with slides, for example at conferences. Thus, visual information is an important component of the information process that is extensively used in everyday life.

Aims of the studies

The goal of the present set of studies is to investigate the spatial representation of those characteristics that are important in definitions of stereotypes. Although originally proposed in the context of neuropsychology, the Spatial Agency Hypothesis represents the critical theoretical background of this exploration. In fact, agency -with its counterpart, communion- has been addressed in many social-psychological models as the key dimension underlying not only gender stereotypes, but also the perception of high vs. low status groups (Conway & Vartanian, 2000; Fiske, Cuddy, & Glick, 2007; Fiske et al., 2002; Judd, James-Hawkins, Yzerbyt, & Kashima, 2005). The names attributed to these dimensions vary across models. They are often defined as competence vs. warmth (e.g. Fiske et al., 2007; Fiske et al., 2002), or as competence vs. morality (Wojciszke, 2005). However similar orthogonal dimensions refer to masculinity vs. femininity (Bem, 1974; Spence & Helmreich, 1978) or to intellectual vs. social (Singh & Teoh, 2000). From a content point of view, the overlap between these models is very high. For simplicity, we will stick to the term used by Chatterjee, namely agency and to the counterpart that has usually been contrasted to it in the social literature, namely communion/communality (Abele, 2003; Bakan, 1966; Conway, Pizzamiglio, & Mount, 1996; Eagly & Kite, 1987).

Agency is a stereotypically masculine characteristic, usually defined with terms like aggressive, powerful, active, competent, assertive, and competitive. Communion is stereotypically related to femininity and is characterized by items such as emotional, caring, cheerful, affectionate, passive, kind. These bi-dimensional models have been applied to explain gender differences as well as status differences, and have been shown to be predictive of specific behaviours. They also appear to be universal as recently shown in a large cross cultural investigation (Abele et al., 2008). Thus, the first question addressed in this set of studies is whether agency is associated, at a symbolic level, with a trajectory from left to right, and communion with a trajectory from right to left.

Although different models greatly overlap in their definition of the two fundamental dimensions of stereotypes, the consistency is stronger in the description of communion, often defined by traits such as friendly and emphatic, and contrasted in previous work either with Agency (e.g., Altermatt, DeWall, & Leskinen, 2003; Bem, 1974; J.T. Spence et al., 1974), or with competence (e.g., Fiske et al, 2002; Fiske et al., 2007; Judd et al., 2005).

Regarding the definition of agency, there are differences across the models that suggest that this dimension may be considered a composite construct. There are at least three main sub-dimensions, namely power, competence, and dynamisms. Power, defined with traits such as powerful or dominant, covers a wide range of traits and behaviour tendencies, typically associated with the masculine pole of the different inventories and represents a central common aspect of theories dealing with gender differences (e.g., Altermatt et al., 2003; Bem, 1974, Spence, Helmreich

& Stapp, 1974). Competence includes among its synonyms characteristics such as effectiveness or intelligence; it is often confused with the dimension of power and represents one of two dimension of the Stereotype Content Model (Cuddy, Fiske, & Glick, 2008). It is particularly important to distinguish these two sub-dimensions here because power has been shown to be associated with vertical representations (Schubert, 2005), whereas competence has not yet been studied. Finally, dynamism represents a wide range of capacities such as being active or energetic and it is particularly relevant here because it is strongly related to the thematic role of agent. According to Chatterjee's hypothesis, agency deploys the horizontal dimension with the agent - that is, the subject of the action- being associated to the left spatial position. It is therefore important to understand the distinct collocation of the four psychological dimensions in space. In fact, all three experiments described in this chapter aim at investigating the way people symbolically represent communion, power, agency, and competence in space.

Moreover, given the relation between these dimensions and valence (Rosenberg, Nelson, & Vivekananthan, 1968; Suitner & Maass, 2008), a further aim of this set of studies is to understand whether Agency is represented horizontally with a LR trajectory and whether this representation is unique to this dimension or simply represents a halo effect of valence. Valence in fact is highly related with both dimensions, agency and communion, and the evaluative judgments can hardly be avoided when describing a target, be it a person, a group, or a behaviour. Importantly, valence is by itself related to spatial representations that can be partially overlapping with the representation of agency. For example, compared with leftward oriented stimuli, rightward stimuli are overall preferred (Christman & Pinger, 1997). However, in terms of position, according to the valence hypothesis (Davidson, Ekman, Saron, Senulis, & Friesen, 1990), the right (vs. left) hemisphere is specialized in processing negative (vs. positive) words, suggesting that more attention is devoted to negative (vs. positive) words when presented in the left (vs. right) visual field (Borkenau & Mauer, 2006). This potential overlap between the representation of agency and valence in the spatial domain and their joint function in the evaluation of social groups creates a possible confound. It is in fact possible that agency and valence have been confused in previous research and that only one of the two elements is associated with a specific spatial representation. However, it is also possible that the two are spatially represented in an additive way, in line with Lakoff and Johnson's (1980) suggestion that different abstract concepts deploy the same spatial dimensions independently. Moreover, Meier and Robinson found valence to be related with the vertical dimension (2005), with positive words being evaluated faster when presented in the up position and negative in the down position (2004) and with depressive symptoms biasing the attention toward the lower vertical field (2006). This suggests a possible alternative representation of valence, namely that the same abstract concept has more than one spatial representation.

Given the pervasiveness of spatial representations of abstract concepts, four main questions arise. First, are people able to indicate the spatial representation of an abstract concept even when the representation is not a conventional symbol? Second, can they distinguish the specific spatial representation of abstract concepts that describe social stimuli? In other words, are there distinct spatial representations for dimensions that describe the stereotype content? For instance, are traits such as agency, communion, intelligence, and dominance associated with specific trajectories? Third, are these spatial representations culturally defined? Fourth, is the representation of stereotype content a halo effect of the representation of valence or is it independent of valence? These questions are addressed a set of three studies.

Overview

The main aim of this set of studies is to explore how characteristics that are relevant for stereotyping are represented in the visual space. Specifically we want to investigate the spontaneous representation of agency and communion when four alternatives – leftward, rightward, upward and downward- are given. In the first study the representation of agency is explored only in terms of direction. The representations of a single target are investigated with a multiple-choice task in which participants indicate which of four arrows best represent a person described with a highly (vs. lowly) agentic adjective of positive (vs. negative) valence. Agency is analyzed as an abstract and isolated construct and is contrasted with valence. This study allows the understanding of the mental representation of the concept as an off-line notion in which there is no implication for action or interaction among people and in which the direction is the only possible spatial tool. This first exploration is important in order to understand (a) whether agency is envisaged with a rightward trajectory and (b) whether agency piggybacks onto valence or occupies the horizontal dimension independently.

In Study 1b the representation of the concepts is extended to the social level, in fact the dimensions are used to describe the relation between two interacting persons. This development is important in order to verify the stability of the representations of the dimensions when they are embedded in a social context and, more importantly, it allows the introduction of a second spatial tool, namely positioning. Participants are asked to schematically draw a spatial representation of two interacting persons that are described with those characteristics that are most popular in the stereotype-content literature. Agency is therefore further analyzed in its sub-dimensions, power, dynamism, competence, and confronted to its opposite, communion. Furthermore, the two-target drawing task allows the comparison of the effect of direction and position in the representations. Thus, participants are first asked to chose among four arrows (⇒ ⇓ ⇐ ⇑) the one that best represents the relation between two targets possessing opposite traits (for instance, one being dominant, the other being submissive). They are then asked to locate each of the two targets at

either the arrow rear or head. Overall, we expect the rightward direction to have primacy over any other representation, given that our Italian participants belong to a culture whose language is written with a rightward vector. Above and beyond this general preference, we expect the four psychological dimensions to be uniquely associated with spatial trajectories, such that power to be represented vertically, in a top-down fashion, with the more powerful person on top. We expect dynamism to be represented horizontally, in a rightward fashion, with the more agentic person envisaged to the left. An opposite (right-to-left) trajectory can be envisaged for communion, being communion a complementary dimension, whereas, in the absence of prior research, it is difficult to advance clear predictions for the last dimension, competence.

The aim of Study 1c, using the same methodology as Study 1b, is to explore the possible role of culture (specifically writing direction) comparing left-to-right readers (Italian speaking participant) with right-to-left readers (Arabic speaking participants). This cross-cultural comparison is a test of the cultural hypothesis. If the horizontal directions (rightward and leftward arrows) are used in different ways by Italian and Arabic participants, this means that the direction in which the language is written affects (but not necessarily determines) the spatial representation of abstract concepts. If no difference is detected between the two groups of participants, the cultural hypothesis will be discarded.

Study 1a: Representing Agency and Valence

In the present study the spatial representation of agency is explored with a direct measure, namely a forced choice task unequivocally assessing the spatial representation. Given that spatial representations have so far been assessed in indirect ways, we wonder whether participants consciously use them in order to schematize abstract concepts and if the answers are consistent with previous results shown at a more implicit level.

Also different from previous work, the representation of agency is investigated controlling for valence. In fact, valence and agency are dimensions that in literature have been shown to be related (Judd et al., 2005; Rosenberg et al., 1968; Suitner & Maass, 2008). Since the relationship between the two can mask the unique spatial representation of agency, it is therefore important to distinguish agency from valence and to investigate their spatial representation jointly. The representations here investigated are the four cardinal directions: upward, downward, rightward, and leftward. Participants were asked to indicate which of the four arrows best represent a target person described by traits that varied in valence and agency. The description consisted in a single adjective that indicated agency (high vs. low), such as aggressive or warm, and could be either positive or negative in valence. The independent variables involved in the study where therefore the content of the adjective, namely agentic vs. communal and its valence, namely positive vs. negative. The direction (⇑ ⇒ ⇓ ⇐) that participants chose as the best representation of the target was the dependent variable. The main hypothesis was that the rightward direction is the most chosen representation for adjectives indicative of high agency, being consistent with the direction of the written/read language of the participants (i.e. Italian). We further expected valence to be associated with upward representations (Meier & Robinson, 2004).

Method

Participants. Ninety-six participants volunteered to participate in this study. They were all students, 42 were males and their average age was 25.

Procedure and Materials. Participants were asked to fill in a pen and paper questionnaire presented as a "study on imagination". The task consisted in an 8-items scale in which participants selected one of four arrows (⇑ ⇒ ⇓ ⇐) as best representing a person described with one adjective. The 8 adjectives were chosen on the basis of a pretest in which a large number of adjectives had been rated in terms of agency (see Suitner and Maass, 2008). The final selection consisted in four adjectives (aggressivo/aggressive, prepotente/overbearing, dinamico/dynamic, attivo/active) rated as high in agency M=3.67, but low in communion M=2.80, and of 4 adjectives (affettuoso/warmth, sensibile/sensitive, timido/shy, fragile/fragile) rated as low in agency M=2.80, but high in communion, M=3.15 (on a scale ranging from 1 to 5). The two groups of adjectives were very

similar in terms of valence ($M_{agentic}$= .10 and $M_{not\text{-}agentic}$= .41, scale ranging from -2 to +2), with two items of each pair being positively and two negatively valenced. Also, we selected only those adjectives that were judged to mainly suit to describe human beings, but not inanimate objects. The 8 adjectives were higher than 20 in use frequency (as reported in the Colfis data base) and no longer than 10 characters.

Results

In order to understand which model best explains the relation between the three variables (agency, valence, and arrow direction), a three-way frequency table was used for a log-linear analysis with the BMDP-4F program. The model that above all fit our data was the two-way interaction model (likelihood-ratio $\chi^2 = 3.74$, df = 3, $p = .29$). The following are the results of this model, where each effect is reported with both the raw frequencies and the parameter estimates, which are estimated frequencies taking into account the effect of each variable (and interactions) included in the model.

The graph below shows the main effect of direction and the ratio of the log-linear parameter estimates to their standard error in the model of two-way interactions, Zcr (α=.05, df=3) =2.13

The main effect of direction is statistically significant ($\chi^2 = 38.81$, df = 3, $p < .0001$). Although an apparent dominance of the *up* level emerged in the untreated frequencies, when the effects of valence and agency are controlled the ratio of the log-linear parameter estimate to its standard error in the selected model (Graph 2) shows that it fails to reach significant level of difference (|Z| >|Zcr|). The rightward direction is instead significantly preferred by participants (p< .05), whereas both the leftward and downward directions are less frequently chosen (p< .05). These results are not surprising results, given that the questionnaire was filled in by Italian persons, whose language is written in a rightward fashion.

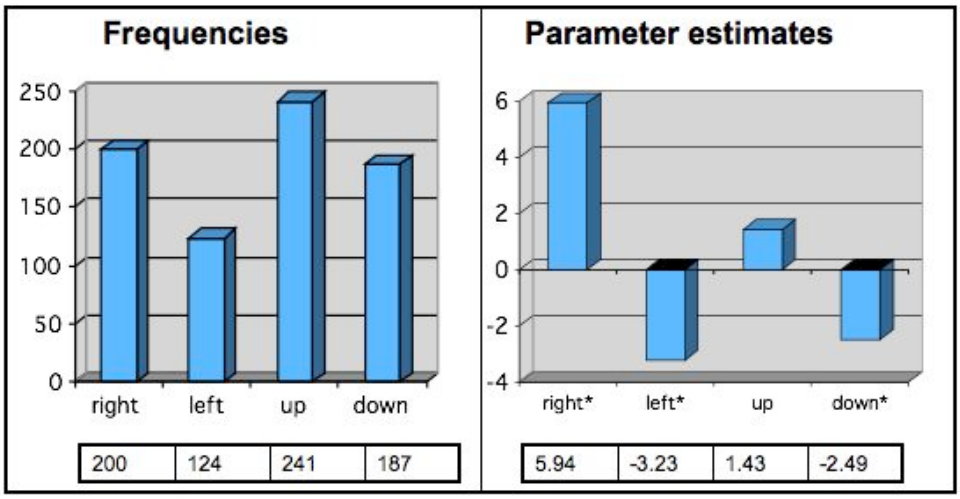
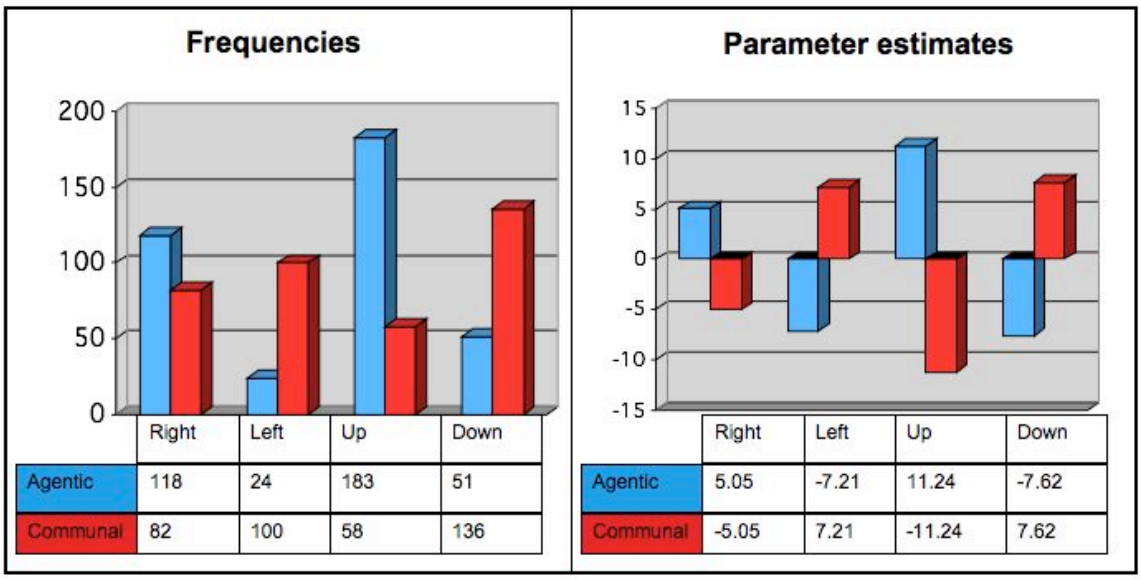


Table 1: Frequency and parameter estimates of Direction.

Looking at the contingency table of agency and direction (Table 2, graph to the left), it is quite clear that agentic adjectives were more strongly associated with rightward and upward arrows than communal ones, whereas communal adjectives are more strongly associated with leftward and downward arrows. The two-way interaction between agency and direction is significant at a level of marginal association ($\chi^2 = 162{,}70$, df = 3, $p < .0001$), and the pattern is fully confirmed looking at the standard parameters estimated by the two-way interaction model. All the parameters are all statistically significant, with Zcr (α=.05, df=3) = 2.13 (see Table 2, graph to the right).

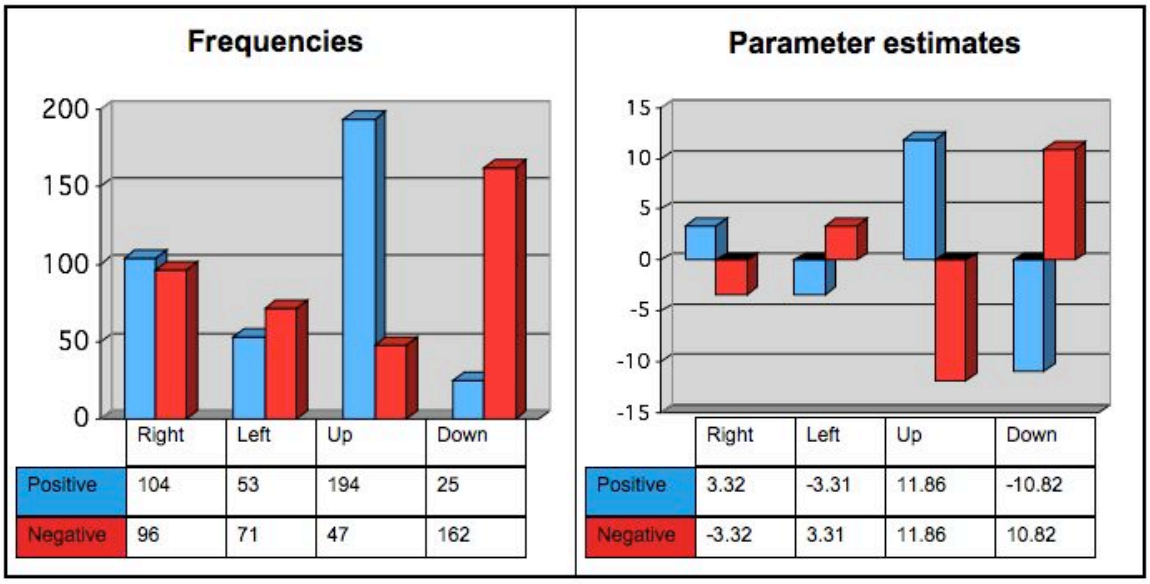


	Right	Left	Up	Down
Agentic	118	24	183	51
Communal	82	100	58	136

	Right	Left	Up	Down
Agentic	5.05	-7.21	11.24	-7.62
Communal	-5.05	7.21	-11.24	7.62

Table 2: Frequencies and parameter estimates of Direction and Agency.

The contingency table of Valence and Direction (Table 3, graph to the left) shows how positive adjectives are more strongly associated to rightward and upward arrows than negative ones, whereas negative adjectives are more often associated to leftward and downward than positive arrows. These effects are all significant ($p<.05$) in the model, Zcr (α=.05, df=3) =2.13 (see Table 3, graph to the right).



	Right	Left	Up	Down
Positive	104	53	194	25
Negative	96	71	47	162

	Right	Left	Up	Down
Positive	3.32	-3.31	11.86	-10.82
Negative	-3.32	3.31	11.86	10.82

Table 3: Frequencies and parameter estimates of direction and valence.

Discussion

Study 1a clearly shows that agentic and positive adjectives are both spatially associated with rightward (and, to a lesser degree, with upward) representations. Importantly, however, the representations of agency and valence are independent. In fact, there was no interaction involving both agency and valence and the preferential presentation of agency and valence as rightward or upward was confirmed even when the other variable was controlled for (see parameter estimates). This confirms our suspicion that agency and valence deploy the same spatial trajectory independently of each other.

The vertical representation of valence is consistent with the previous literature that showed positive-ness being associated with the upper position (Meier & Robinson, 2004, 2005, 2006). Interestingly also agency is here associated with upward arrows. This effect, although unexpected, could be interpreted as a self-projection of our participants. In fact, agency is a characteristic that is desirable for the self (Abele & Wojciszke, 2007), therefore our participants may had projected their desire for agentic characteristics in the spatial representation, associating them with the vertical position. This interpretation is speculative and has the limit that vertical arrows are subject to the viewpoint adopted. In fact in both downward and upward representations the agent's position can be either on top or at the bottom, depending on whether the point of view is placed at the head or the rear of the arrow. The effect of position and the effect of direction in the spatial representation are therefore confused. Although arrows are strongly associated with direction, they are symbols that imply positions as well as roles. In fact, the role of a person positioned at the rear of the arrow is very different from the role assumed by the person at the head position. Generally, when represented at the rear, the person is perceived as the actor of the action, whereas when the person is located at the head, the role is passive, that is she/he is the recipient of the action. Following this

line of reasoning, the conventional use of arrows suggests that the arrow itself represents the action, whereas the actors involved in the action are at the rear and at the head of the arrow that functions as the link between them. In Study 1 the arrow represented a single person described as agentic or not. This is a limit, as the concept we want to analyze is a social concept, therefore it is important to investigate it in an interactive context, which was done in Study 1b.

Study 1b: Arrows: position and direction

To solve this problem, in Study 1b two actors were added that were to be positioned at the arrowhead and -rear. This variation in the experimental task facilitates our understanding of the position (not only of the direction) as a significant part of spatial representation.

As Fiske and colleagues (2002) claimed, the content of stereotypes arises from interpersonal and inter-group relations and it is in a relational context that stereotypes become meaningful. Following this line of argumentation we were interested in understanding not only the visual representation of persons, but also the spatial representation of their relationships. The presence of two interacting targets with opposite traits (e.g. one strong, the other weak or one active, the other passive) creates such an interacting social situation.

Moreover, given the many different terms that have been used in order to define agency (see introduction), we decided to analyze communion (always present across the models) and to distinguish the principal sub-dimensions of agency, namely power (Bem, 1974; Spence & Helmreich, 1978), dynamism (Abele, 2003; Bakan, 1966; Conway et al., 1996; Eagly & Kite, 1987; Eagly & Steffen, 1984), and competence (Fiske et al., 2007; Fiske et al., 2002; Wojciszke, 2005). In this way we cover the various content of stereotypes (for a recent cross cultural comparison see Diekman, Eagly, Mladinic, & Ferreira, 2005).

Many studies have shown that often agency and communion are negatively related attributes (Judd et al., 2005; Suitner & Maass, 2008) and we assume that this relation may be further enforced in spatial representations, such that they are envisaged as opposites, with agency associated with LR and communion with a RL trajectory (Nicholls et al., 1999). In order to investigate such representations in an independent fashion, each couple consisted of two persons that differed only on one dimension, with one person of the couple high and the other low in the given dimension. The variation on only one dimension at a time consented us to understand the representation of each sub-dimension of stereotype content independently of the others.

The relative position of the two persons and the direction of their interaction is measured. Spatial representations cover the two dimensions of linear space, namely the vertical and the horizontal axis, and the direction is also recorded, corresponding to the vectors that are represented by the relation-oriented arrows. The relative position of the two persons involved in the dyadic relation is measured by coding the left vs. right or up vs. down position relative to the other. Therefore the direction of the relation (as leftward, rightward, upward or downward) and the relative position of the persons (at the arrowhead or –rear) are the dependent variables.

The main hypothesis of Study 1b is that different aspects of gender stereotypes lead to different spatial representations. Specifically we hypothesized that power is represented in a vertical fashion, consistently with previous research (Schubert, 2005) and with the common metaphors of power (e.g., "he is my subordinate" or "to be superior"). Similarly we expected competence to be associated with a vertical representation as common sense suggests (e.g., "this is a high level research!" or "these are top researchers!"). In terms of specific directions in the vertical axe, we can hypothesize a downward direction for power, given the typical representation of social interactions, with the powerful person being super ordinate compared to the powerless person (subordinate) and the powerful person acting against the powerless one. For competence, the direction is not so clear as it may depend from the point of view adopted, namely of admiration toward the competent person, suggesting an upward direction, or evaluation of the incompetent person, going back to power-type of relation, evoking a downward arrow. We also expected dynamic aspects being envisaged along the horizontal axis as human motion follows such natural trajectory because of gravitational reasons, namely we hardly fly or climb with vertical movements, we rather walk, run or ride in a horizontal motion. Regarding communion, we expect the representation of this to be differentiated from the representation of agency either with an opposite bias (leftward) or with no bias. We also hypothesized that the person higher in the domain under analysis would be represented as the subject of the action, hence at the arrow rear, showing the additive and hypothesizing a complementary effect of direction and position.

Method

Participants and procedure. A total of 80 participants (46% males, mean age= 25), mainly students volunteered for the study. Participants were asked to schematically draw 16 pairs of two interacting persons and to specify the spatial direction of their interaction. The two persons of each couple were assigned to geometrical symbols (a square and a circle) in order to simplify the drawing task. Participants drew the geometrical figures (■ and ●) in order to symbolize each person of the couple and an arrow (⇑, ⇒, ⇓, and ⇐) indicating their relation. The two persons had to be represented one at the head of the arrow and the other at the rear (e.g., ■ ⇒ ●). The position of the person at the head or at the rear of the arrow suggested the role that participants assigned to the represented person, namely the person at the rear (in the example, the squared) of the arrow is playing active role and the person at the head of the arrow plays the passive role (in the example, the circle).

The adjectives used to describe the two components of each couple belong to one of four dimensions: power, dynamism, communion, and competence. The two adjectives of each couple were semantically the contrary of each other, such that in each couple one adjective was *high,* the other *low* in a given dimension. For example, if the dimension was dynamism, one person was

described as "fast", the other as "slow". When the dimension was communion, one person was described as "extroverted" and, the other as "introverted". The adjectives were selected on the basis of two pretests to assure independence of the dimensions (see Appendix n. X)

Participants were randomly assigned to two types of questionnaire (39 in order 1 and 41 in order 2) in which the presentation order of the adjectives was counterbalanced (for instance first mentioning "fast" followed by "slow", or vice versa).

Results

The data were analyzed in a log-linear model using the BMDP-4F software. The model was built according to the hypotheses, namely we tested for a main effect of direction (four levels) and of thematic role (two levels) and for an interaction between direction and dimension (four levels). Given that in the model each sub-ordinate level is automatically included, the main effect of dimension was also tested with no results (as the four dimensions were equally represented by the method we used), $\chi^2 = 0$. Order of mentioning was included as a control variable in our experiment since we expected, in line with previous research, that the target mentioned first would be preferentially placed to the left in horizontal and on top in vertical representations. A preliminary analysis confirmed this suspicion. However, for reasons of simplicity, order of mentioning was excluded from the interaction terms in the model since our material was perfectly counter-balanced and our theoretical interest concerned spatial positioning above and beyond order of mentioning.

Overall the model failed to explain a significant amount of variance, $Y^2 = 288.86$, df=47, $p < .05$, confirming again the fragile character of the bias. However the single effects that emerged are consistent with our predictions. The main effect of thematic role assignment confirmed a preferential assignment of the active role (positioning the target at arrow rear) to the person described as *high* rather than *low* on the given dimension, respectively, $f = 830$ vs. 437, $Z = \pm 10.31$, $p < .05$, χ^2 (1, N = 80) = 111.27, $p < .0001$. For instance, persons considered dominant (rather than submissive), intelligent (rather than unintelligent), or warm (rather than cold) were positioned at the arrow rear in about 66% of all drawings.

Given that the spatial bias has been theoretically interpreted as a consequence of writing direction (see Maass and Russo, 2003), we wondered if the preference for some directions would parallel the direction of the written language, that for our participants was Italian. The well-known direction of read/written Italian is in rows from left to right and downwards. The main effect of the direction (χ^2 (3, N = 80) = 292.93, $p < .0001$) paralleled the direction of the language, showing that rightward ($f = 469$, $Z = +10.65$, $p < .05$) and downward ($f = 478$, $Z = +7.71$, $p < .05$) directions were the most frequently chosen, whereas upward ($f = 156$, $Z = -7.22$, $p < .05$) and leftward ($f = 164$, $Z = - 6.81$, $p < .05$) directions were the least preferred.

We further aimed to investigate if different dimensions are spatially represented with different direction. The interaction between Dimension and Direction, χ^2 (9, n = 80) = 234.49, p < .0001, confirmed the hypothesized differences. Looking at the frequencies (Table 4), power was mainly represented downwards and dynamism rightwards. Regarding communion and competence there was no pronounced preference. At a parameters level (again reported in Table 4), the situation seems even clearer: the dimension of power was most likely to be represented downwards and least likely to be presented rightwards. On the contrary dynamism, was more likely to be represented rightwards and least likely to be represented downwards. Communion was most frequently represented leftwards and least frequently upwards. Finally, the dimension competence was most likely to be represented upwards, with all mentioned parameters significant at an alpha level of α = .05. Therefore each dimension is distinctly associated with one particular vector of the Cartesian space.

	power			dynamism			communion			competence		
	f	%	Z	*f*	%	Z	*f*	%	Z	*f*	%	Z
right	50	11	-6.05	**185**	**40**	**8.56**	127	27	0.57	107	23	-1.58
left	28	17	-1.41	33	20	-0.01	**69**	**42**	**4.33**	34	21	-2.21
up	28	18	-1.17	35	22	0.72	32	21	-2.34	**61**	**39**	**3,29**
down	**212**	**44**	**11.31**	66	14	**-7.07**	87	18	-2.32	113	23	0.58

Table 4: Interaction between direction of presentation and dimension represented, Zcr (α=.05, df=9) =1.96

Discussion

The definition of agency from a social psychological point of view varies across theoretical models. Although there is a general agreement on the bi-dimensional differentiation of social groups and although the definition of the characteristics that are typically assigned to lower status groups are generally consistent (i.e., friendly, warmth, comprehensive), the characteristics that define the upper status groups are not entirely overlapping across models. This is suggesting a possible further differentiation of the dimension that is typically ascribed to males and high status groups -and that we call agency- in additional sub-dimensions. After a careful examination of the experimental material of previous research, we individuated three sub-dimensions of agency, namely power, dynamism, and competence, which, together with communion, constituted the four psychological dimensions investigated here. Although we do not claim that focusing on one sub-dimension or another would completely change the consequences of the bi-dimensional stereotype content model, we found that the variations in the content are captured in their spatial representations, with dynamism being associated with rightward, communion with leftward and competence with upward. In line with Schubert's (2005) results according to which power is associated with the vertical dimension, power was mostly represented with the downward arrow. In

contrast, dynamism was preferentially represented with a rightward arrow, a result that can be interpreted in light of the Agency Hypothesis, according to which the agent is positioned to the left of the recipient, with the action evolving from left to right. In our study, dynamism is the dimension that is most strongly associated with a rightward representation, presumably because expresses activity. As hypothesized, communion was represented differently from the other dimensions, however we do not have a specific interpretation of its association with the leftward arrow. One possible explanation is that this result reflects the lack of agency ascribed to the communal target, thus being communal may imply being inactive and non-dynamic. In line with this argument, sitters tend to show their right cheek (exposing a rightward directed profile to the observer) when asked to pose as scientists, showing their cold and firm (i.e. agentic) character, but turn the other cheek (the leftward profile from the observer's point of view) when asked to pose for a family portrait, showing their affectionate and friendly (i.e., communal) character (Nicholls et al., 2002). The association between competence and vertical dimension was also hypothesized, however we did not have a specific hypothesis for its upward representation. One speculative interpretation is that this relation is suggesting the admiration of the non-competent target toward the competent, with a bottom-up motion.

A second result regards the thematic role assignation. The role of the subject of the action was mainly assigned to the person that was high in the given dimension. In fact the target described as high on the dimension was more likely placed on the rear of the arrow. This is suggesting the supremacy of agency over non agency. Although this result may seem obvious, it is important in order to untangle the direction effects from the position effects, and vice versa. In other words, if the agentic target is positioned on the left side because he is also thought to be the subject of the action (see Chatterjee, 2002), we can also claim that the action is rightward directed, as represented by the arrow in the present study. This effect is suggesting that the bias has two faces, one regarding the relative position, the other the direction.

The findings also speak to the primacy of rightward and downward over the less chosen upward and leftward directions. Downward is a motion that we naturally experience because of gravity. Things fall down, things are heavy to lift. The upward direction is much harder to experience, not without an extra effort, and that's why activity such as climbing seems so special. The supremacy of rightward over leftward is not necessarily natural; rather it may be cultural. Writing and reading thousands of words, every day, all from left to right, is a habit that is strongly internalized and that may –at least partially- be responsible for this preference for rightward direction. This hypothesis is tested in Study 1c, in which Arabic speakers are compared to Italian speakers.

Study 1c (Arabic speakers vs. Italian speakers)

In Study 1c the experimental material of Study 1b was used to replicate the effects and to investigate a possible role of writing direction in the spatial representations of abstract concepts. We hypothesized to find significant differences between Arabic- and Italian-speaking participants in their use of the horizontal dimensions of rightward and leftward. A growing body of literature shows that reading direction is associated with congruent spatial biases in scanning visual information (Nachson, 1985; Spalek & Hammad, 2005), in drawing direction (Chokron & De Agostini, 2002; Vaid et al., 2002), in visual imagery (Hatta & Kawakami, 1997), in aesthetic preferences (Chokron & De Agostini, 2000; Heath, Mahmasanni, Rouhana, & Nassif, 2005; Maass et al., 2007; Nachson, 1985; Nachson et al., 1999), and in thematic role assignment tasks (Dobel, Diesendruck, & Boelte, 2007; Maass & Russo, 2003). Given that readings habits also affect the spatial representation of abstract concepts (Boroditsky, 2001; Zebian, 2005), we expected a difference between Arabic- and Italian-speaking participants, with the difference being congruent with their writing direction, namely rightward for Italian and leftward for Arabic. We further hypothesized this difference to emerge in the representation of dynamism, the dimension most strongly related to action and to the horizontal vector.

Method

Participants and procedure. Fifteen Italian-speakers (1 female and 15 males) and 14 Arabic speakers (1 female and 14 males), with mean age of 35.43 (age ranging from 21 to 55) volunteered for this experiment. The two samples were matched as closely as possible for sex, social class, age group, and type of profession. Arabic-speaking participants came from different Arabic countries (Morocco, Egypt, Palestine, Syria, Tunisia, Algeria, Iraq) and had been living in Italy for an average of 10 years. Arabic was the first language they had learned to read and to write, but they were all fluent in Italian as well. On the average, they spoke Arabic and Italian with about equal frequency in their daily lives, but they wrote or read Arabic less frequently (M = 3.86) than Italian (M = 4.71, on a scale from 1 = never to 5 always). None of the Italian participants had learned a right-to-left writing language and none had lived in a country where language is written from right to left. Procedure and material are identical to Study 1b, except that Arabic-speaking participants received all the materials and instructions in Arabic language (translated form Italian by a professional interpreter).

Results

Similarly to Study 1b, the data were analyzed in a log-linear model built according to the hypotheses. The variables included in a three way model are therefore participants' cultural-linguistic background, the four sub-dimensions, and the four possible arrows. Thematic role assignment was added to the model as a main effect.

Again, the main effects of culture and dimensions are necessarily not significant given that that are equally likely by construction. The model was not significantly explaining the variance in the data, Y^2= 195.69, df =95, p<.05. Nevertheless the effects are in the predicted direction and reach standard levels of statistical reliability.

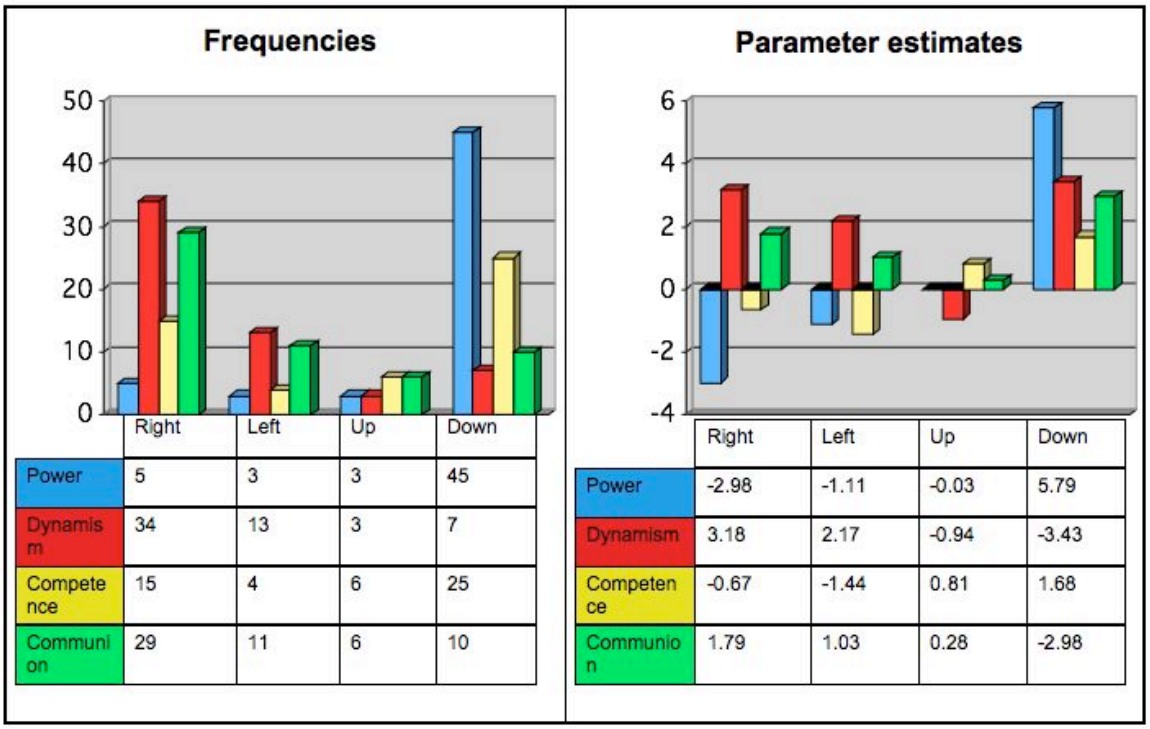
Consistently with the previous study, the active role was more frequently assigned to the target described as *high* rather than *low* on the given dimension, respectively, f = 236 vs. 213, Z = ±2.60), χ^2 (1, N = 28) = 6.80, p = .009, z_{cr}=1.65.

The most interesting interaction is between the preferred horizontal Direction and Culture, χ^2 (3, N = 28) = 12.19, p = .0007, z_{cr}=2.13. Confirming our hypothesis, the preference is mirroring the writing direction, with rightward direction chosen more frequently by Italian participants than by Arabic participants (respectively 58% vs. 42%, Par= |2.33|. In a mirroring fashion, the leftward direction is chosen more frequently by Arabic rather than by Italian participants (respectively 62% and 38%), however the difference is not significant at the parameter level, P= |1.24|. For the entire pattern see table 5.

	ARABIC SPEAKERS	ITALIAN SPEAKERS
RIGHWARD	**-2.33** (F= 60, 42%)	**2.33** (F=83, 58%)
LEFTWARD	1.24 (F=50, 62%)	-1.24 (F=31, 38%)
UPWARD	2.08(F= 43, 70%)	-2.08 (F=18, 30%)
DOWNWARD	-1.76 (F= 71, 43%)	1.76 (F= 93, 57%)

Table 5: Parameters and frequency of directions chosen by Italian and Arabic Speaker participants.

Also, a three-way interaction emerged between Direction, Dimension and Culture, χ^2 (9, N = 28) = 32.53, p =.0002, z_{cr}=2.53. We therefore ran the model used in Study 1b separately for Italian and Arabic participants. For Italian participants the pattern of results found in Study 2 was replicated. The model was overall not significant, Y^2= 76.42, df= 47, p<.05, however the effects are statistically reliable. Regarding the interaction between Dimension and Direction (χ^2 (9, N = 14) = 69.98, p < .0001, z_{cr}=2.53), the pattern of Study 1b was replicated for dynamism, mainly represented with rightward arrows and power, mainly represented with downward arrows, whereas communion and competence were not associated to any specific direction. For the entire pattern of frequency and parameter estimates see Table 6.

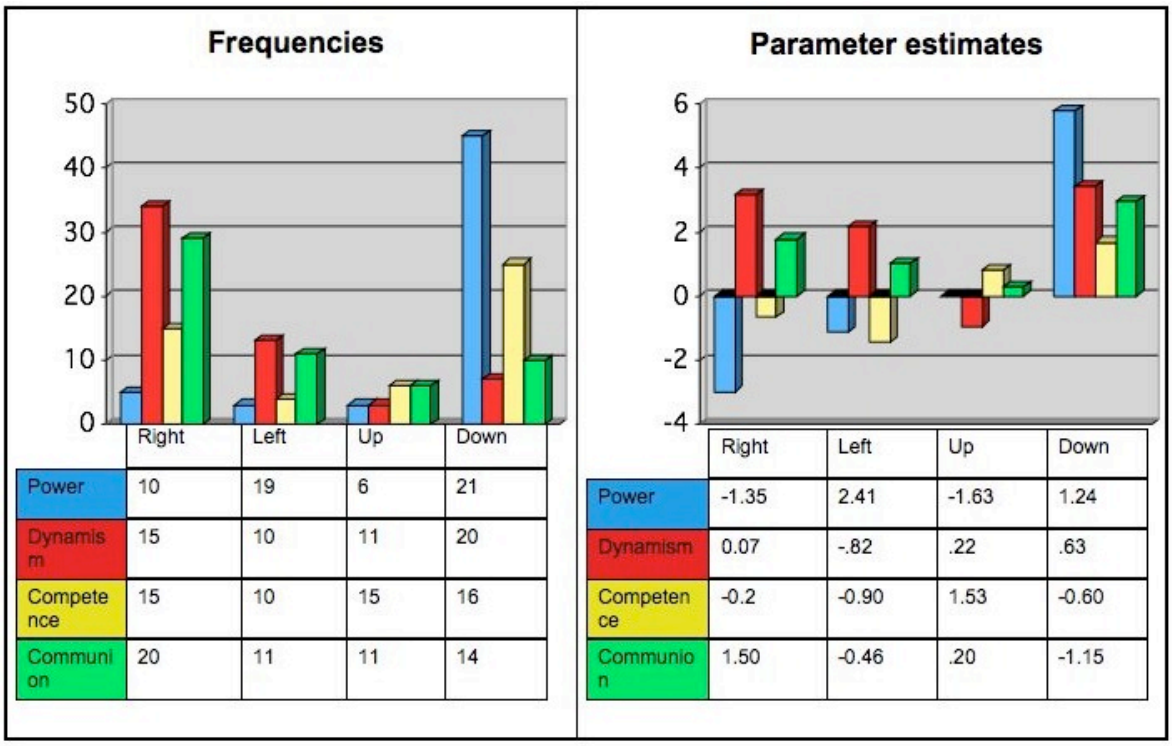


	Right	Left	Up	Down
Power	5	3	3	45
Dynamism	34	13	3	7
Competence	15	4	6	25
Communion	29	11	6	10

	Right	Left	Up	Down
Power	-2.98	-1.11	-0.03	5.79
Dynamism	3.18	2.17	-0.94	-3.43
Competence	-0.67	-1.44	0.81	1.68
Communion	1.79	1.03	0.28	-2.98

Table 6: Italian Participants. Interaction between Dimension and Direction, z_{cr}=2.53

Regarding Arabic participants, the model was again not significant, Y^2= 88.00, df= 47, p<.05. The interaction between dimension and direction (χ^2 (9), N = 14) = 11.68 p = .23, z_{cr}=2.53) failed to show a clear pattern, confirming the possibility that the use of spatial representation by Arabic immigrants may be confused by their high exposition to rightward stimuli given that they live in Italy and currently speak and read Italian. The entire pattern is reported in table 7.



	Right	Left	Up	Down
Power	10	19	6	21
Dynamism	15	10	11	20
Competence	15	10	15	16
Communion	20	11	11	14

	Right	Left	Up	Down
Power	-1.35	2.41	-1.63	1.24
Dynamism	0.07	-.82	.22	.63
Competence	-0.2	-0.90	1.53	-0.60
Communion	1.50	-0.46	.20	-1.15

Table 7: Arabic Participants. Interaction between Dimension and Direction, z_{cr}=2.53

Discussion

The comparison between Italian and Arabic participants provides evidence for the role of culture in the spatial bias. In fact, the preference for rightward direction was present only among Italian participants, whereas Arabic speakers showed a stronger use of the leftward representations. Not surprisingly, the pattern of results found in Study 1b was fully replicated for the two main dimensions under investigation, namely Dynamism and Power, in the present Study by Italian participants, whereas the result pattern was less clear for communion and competence. On the contrary, Arabic participants did not show a clear use of direction in order to represent the abstract concepts of stereotype content. This is predictable, as they are not living in a right-to-left reading country. Not only do they currently live in Italy, but they have, on the average, been living in right-to-left reading countries for 10 years. Consistently with previous research suggesting that the bias is proportional to the strength of the reading habit (Maass & Russo, 2003; Padakannaya, Devi, Zaveria, Chengappa, & Vaid, 2002), our Arabic participants did not show an opposite bias, rather they showed a mixed bias pattern, a confuse use of spatial representations. In fact, they did prefer neither the rightward nor the leftward direction. In the future it would be interesting to conduct a cross-cultural comparison between Italian and Arabic participants that are familiar only with their own language, in order to have clearer effects.

Conclusion

Together, the three studies suggest that abstract concepts related to stereotype content are mapped onto metaphorical spatial representations. The use of spatial symbols, to account for abstract concepts is coherent with the idea that abstract concepts are linked to physical modalities even if they do not have a direct physical character (Barsalou, 2008b; Casanto & Boroditsky, 2008). The passage from the non-sensory domain of the abstract concepts to their sensory-based spatial representations can be defined as the creation of a conceptual metaphor (Gallese & Lakoff, 2005). The three studies show that the abstract concepts are represented with specific and culturally shared spatial metaphors. The rightward direction represents agency (Study 1a) and dynamism (Study 1b and c) in a culture in which the language is written from left to right. We argued that this spatial representation of abstract concepts related to action (i.e. agency and dynamism) is the consequence of the motor-visual habit of writing and reading in that same direction. The lack of this specific representation among Arabic participants sustains this hypothesis and is consistent with previous findings in the field showing that the use of spatial information is affected by the direction of the written language (Chokron & De Agostini, 2000; Dobel et al., 2007; Heath et al., 2005; Maass & Russo, 2003; Vaid et al., 2002). Regarding Italian participants, Study 1b and c confirmed previous evidence that power is mainly associated with the vertical position (Schubert, 2005), and specifically with the downward vector, the representation of communion is associated with the horizontal dimension without a consistent prominence of the rightward or leftward vector.

The representation of competence appeared to be related to the vertical dimension, although it is not clear whether to the upward (Study 1b) or downward direction (Study 1c). Given the similarity in methodology and in the stimuli used in the two studies, the reasons for this contradiction are unclear at this point and remain to be explored in future studies. One possibility is in the sample composition, in fact in Study 1b participants were students, in Study 1c we had mainly workers. Possibly competence is more likely to be associated with rightward dynamic-like representations among workers and to downward power-like represention by students. Importantly, valence can be represented with two possible directions. It shares with Agency the rightward representation, but in an independent way, ruling out a possible halo effect of the representation of valence in the representation of agency. Additionally, valence can be associated with upward arrows, confirming the metaphors already shown by Meier and colleagues that associate good with being up (Meier et al., 2007; Meier & Robinson, 2004, 2005, 2006).

The studies reported in this chapter all focus on the conscious use of spatial means to represent abstract concepts and show that people consistently rely on them to symbolize socially relevant attributes (Study 1a) and interpersonal interactions (Study 1b and c). However it is still unclear to which extent this association between spatial representations and social concepts are automatically used in tasks that do not require the decoding of spatial information to be performed.

Chapter 2: Space Agency Bias and gender stereotypes

In the previous chapter we analyzed the symbolic representations of trait concepts that are related to stereotype content. In particular, the studies reported in Chapter 1 showed that agency-related traits such as *dynamic* or *powerful* are systematically located in space, both when they refer to a single person or to the interaction between two persons having opposite traits. Whereas power is represented vertically, dynamism occupies the horizontal dimension, at least in the Italian samples. If this is true, then the same may also hold for social categories that are stereotypically associated with high or low agency such as women and men. Considering that the gender categories are strongly related to the notion of agency, male and female targets appear to be particularly appropriate social groups for studying the SAB at the level of social category membership.

Gender stereotypes and agency

Although Agency (and its counterpart Communion) can, in principle, be used to define the stereotype content of any social group (for a review see Cuddy et al., 2008), the two dimensions have frequently been applied to gender. In particular, women are stereotypically characterized by a lack of agency, thus they are seen as more passive and less assertive compared to men. On the other hand, men are stereotypically defined by agentic characteristics, such as power and dominance. This differentiation is by no means new and has been widely confirmed across different models, times, and cultures (e.g., Abele, 2003; Altermatt et al., 2003; Bem, 1974; Diekman, Goodfriend, & Goodwin, 2004; Heilman & Okimoto, 2007). This difference in ascribed agency has been related to the different success that males and females typically achieve in society. Groups, such as males, that are judged as more active, decisive, and as acting independently are usually of high status (Conway et al., 1996), whereas groups, such as women, that are described as receptive, sensitive, caring, and so forth, are usually less powerful in society. In fact agency is a good predictor of, and is affected by, career success, whereas communion is associated with success in the domain of romantic relationships (Abele, 2003). Agency is therefore a very important characteristic, able to affect the position of a social group in society. Moreover, it is strongly linked to specific spatial representations, as shown in the previous chapters. The spatial representation can therefore be interpreted as a possible way to convey such characteristics and corroborate the stereotype content. If agency and communion are symbolically represented in space as shown – at an abstract level - in Chapter 2, will people also show a SAB when envisaging specific individuals? For instance, when thinking of a known couple, will they imagine the male to the left of the female? Vice versa, when trying to understand quickly whether a person is male or female, will spatial information be used in this decision?

Given the pervasiveness of the concept of agency in gender stereotypes, we hypothesize that gendered targets will be associated to the spatial representations that are congruent with the Spatial Agency Bias. In other words, if males are typically perceived as more agentic than females, they will also be associated with the spatial representations that express this feature, namely a left position and a rightward direction. Specifically, we hypothesize a positioning bias in the representation of heterosexual couples, with the male partner positioned to the left of the female partner, suggesting a rightward direction of the action (Study 2a). Moreover, the bias is thought to be a direct consequence of the difference in the agency ascribed to the two partners of the couple (Study 2b). If this assumption is correct, males should be positioned to the left of females only for couples in which the male is perceived as more agentic. In contrast, no spatial bias is expected for couples that do not show traditional gender roles. Thus, if presented with two identical mirror photos of the same person, one right, the other left-facing, participants were expected to falsely believe that the right-facing images of males (but not of females) were the "true" (that is original) photo. An additional question addressed in this chapter is whether spatial orientation (rightward or leftward) is used to identify the gender of a target person. If spatial information is useful in the disambiguation of stimuli, people should find it easier to identify a person as male when the target is right facing, whereas the opposite should hold for women. A final issue, investigated in Study 2d, is whether spatial bias has consequence for stereotypic beliefs and attitudes. It is hypothesized that a spatial bias associating males with rightward orientation bolsters existing gender roles, hence leading to increased endorsement of traditional gender stereotypes.

Together, all four studies test the same general hypothesis, but focus on different stages of information processing (encoding vs. decoding), on different spatial features (position vs. direction), and use different methodologies (content analyses vs. experimental designs). Studies 2a and 2b analyze the relative spatial position of males and females in existing artwork or cartoons, whereas Studies 2c and 2d investigate the subtle effects of space in decoding, employing an experimental methodology. Importantly Study 2d also investigates the possible role of Spatial Agency as a tool for maintaining or changing the status quo in gender stereotyping.

Study 2 a: Adam and Eve

The aim of this study (part of the paper by Maass et al., 2008, in press) was to test the positioning bias regarding males and females in art production. The advantage of analyzing artwork is that, on one side, the hypothesis can be tested on already existing material that was created for reasons unrelated to psychological experimentation. On the other side, it offers a much wider historical perspective as it allows to go back in time and to investigate spatial positioning biases over centuries.

Different from previous research investigating head rotation in portraits of individual women or men (e.g., Humphrey & McManus, 1973; Latto, 1996; McLaughlin & Kimberly, 1994; Suitner & Maass, 2007), we were interested in the global spatial positioning in paintings in which both a male and a female were depicted. Assuming (a) that the more agentic person will occupy the left position and (b) that men are stereotypically perceived as more agentic than women, we expected males to have a higher likelihood than females to be placed on the left. To our knowledge, this question has rarely been investigated, an exception being the analysis of the Annunciation, showing the angel Gabriel together with the Virgin Mary. (McManus, 2005) reports that in 97% of the 209 paintings considered, the angel enters from the left (from the perspective of the observer) whereas the Virgin Mary is located to the right. Although consistent with the SAB hypothesis, this finding may either be due to the more active role of Gabriel in this specific scene, due to his sex, or both. To untangle these explanations, we decided to analyze paintings in which males and females display a similar degree of (in)activity (for example both standing).

In order to test this hypothesis, we selected art work of what we believe is the most emblematic representation of man and woman in Western civilization, namely Adam and Eve. We therefore analyzed images of the couple available on the web (*Google Images*), hypothesizing that Adam would be positioned to the left of Eve more often than vice versa. Since word-order regularities are rather common (McGuire & McGuire, 1992) and are systematically linked to spatial representation (Chatterjee et al., 1999; Maass & Russo, 2003), we varied the order in which Adam and Eve were mentioned in the search (*Adam and Eve* vs. *Eve and Adam*). If spatial positioning of Adam and Eve varied as a function of keyword order this would suggest that the bias is due to a linguistic order effect rather than to stereotype content concerning gender differences.

Method

Materials were selected through a *Google Images* search using "Adam and Eve" and "Eve and Adam" as key words (search done in January 2006, using the Italian version of Google). All 120 images appearing on the first 3 pages of the two searches were included in the analyses. After exclusion of images that could not be coded (such as abstract representations, animals, single individuals), the final material consisted of 90 representations of Adam and Eve of different nature, including paintings, frescos, photographs etc.. We coded the relative position in which Adam and Eve appeared in the composition, as seen from the observer's perspective.

Results

In line with our hypothesis, we found that Adam appeared to the left of Eve in 62% (*f*= 56) of the images whereas Eve occupied the left position only in 38% (*f* = 34) of the cases. A bi-variate log linear analysis showed that this gender effect is statistically significant, $\chi^2 = 5.31$, *d.f.* = 1, $p = .02$. There was no interaction with word order, $Y^2 = 1.34$, *d.f.* = 1, $p = .25$. The positioning bias emerged in both keyword-ordering conditions although it was slightly weaker when Eve preceded Adam. Using the keywords "Adam and Eve", Adam occurred on the left in 67% (*f* = 35) of the representations (vs. Eve's 33%, *f* =17), whereas using the keywords "Eve and Adam", Adam occurred on the left in 55% (*f* = 21) of the images (vs. Eve's 45%, *f* =17). Thus, there was no evidence that the spatial bias would reverse when using "Eve and Adam" as search criterion.

Discussion

The findings of this content analysis suggest that Adam, presumably the more agentic figure, appears predominantly to the left of the composition, confirming our main hypothesis. The effect due to word order in the Google research was partially excluded, but the possibility remains that the common order of naming the couple in European languages, with Adam mentioned before Eve, affected the positioning of Adam to the left of Eve.

Study 2b: Addams, Flinstones, Simpsons

In Study 2b (again part of the paper of Maass et al, in press), we tested a series of male-female pairs, that are not labeled with any specific word-order but that are generally referred to with an overarching label. For example, people generally refer to Groenings's famous cartoon characters of Springfield as "the Simpsons" rather than as "Marge and Homer" or as "Homer and Marge". We therefore analyzed still representations of three male-female couples in the media, namely the Simpsons, the Flintstones, and the Addams. Again, the main hypothesis was that, overall, the male protagonist would be portrayed to the left of the female more frequently than would be expected by chance.

We further predicted that the SAB, will occur only when males are indeed associated with greater agency. We therefore tested the perceived agency of male and female in each couple predicting that the left positioning bias would only occur for those families in which the male is perceived – in line with traditional gender stereotypes - as more agentic than the female. For instance, the Simpson couple does not fully comply to traditional gender stereotypes with Homer being a rather lazy character who exerts little influence in the family and who is certainly on the receiving rather than on the dominant side in his work environment.

Pilot research

We initially asked a pre-test sample (N = 134), to rate 12 adjectives indicative of dominance (e.g., dominant), agency (e.g., active), and communion (e.g., affectionate) as typical of females vs. males on a 66 mm "continuous rating scale" while counterbalancing order of presentation and scale endpoints (male to left and female to right, or vice versa). A principal component analysis showed that the adjectives could be grouped into three main factors, accounting for 59% of the variance, that can be easily interpreted as Communality (cordial, altruistic, affectionate, compassionate, helpful, humble; alpha = .83), Agency (active, productive, efficient; alpha = .67) and Dominance (strong, dominant, authoritative, alpha = .69). Only the agency subscale is of theoretical relevance for the aims of this study.

We then asked a small sample of participants (N = 13) who were "quite" or "very" familiar with each TV program, to rate all three families on the 12 items. Participants responded to each item (e.g., *Who is more active?)* on a 4-point scale in which the endpoints represented the male and female of each couple (e.g. *Marge – Homer or Homer – Marge,* counterbalanced).

An ANOVA on the mean agency ratings showed that the three families differed reliably in perceived agency, F (2, 24) = 11.70, $p < .001$, $\eta^2_p = .49$. The male (relative to the female) was rated most agentic for the Addams family ($M = 2.90$) and least for the Simpsons ($M = 1.51$), with the

Flintstones (M = 2.23) occupying an intermediate position. A pair-wise comparison (Bonferroni corrected), showed that the Addams are rated more agentic than the other two families, p_s <.05, with no difference in agency ratings between Simpsons' and Flintstones' agency ratings, p = .21. Comparing the means for each family with the neutral scale-midpoint (no difference in agency between male and female of each family), only in the case of the Addams family was the male rated more agentic, one-sample t (12) = 2.88, p = .01, whereas no difference emerged for the Flinstones, one-sample t (12) = -.93, *n.s.*, and a reversal was found for the Simpsons, one-sample t (12) = -5.00, p < .001. This suggests that a left positioning of the male should only be expected for the Addams family.

Main study: Spatial positioning

For each family, we then examined the first 60 images in Google using "the Simpsons", "the Flintstones", and "the Addams" as key words. We simply recorded the number of times in which the male vs. the female of each couple occupied the left position (from the perspective of the observer).

Overall, males were positioned to the left in 60% of all images, which deviates reliably from chance, binomial test p = .008, thereby confirming our first hypothesis. However, looking separately at the families, this was entirely due to the Addams family where the male was presented to the left in 82% of all representations. Binomial tests comparing the distribution to the baseline probability of 50% indicated that only the Addams family deviated systematically from what would be expected by chance, p < .001. No systematic bias was found either for the Simpsons (males to left in 53% of all cases) and the Flintstones (males to left in 43% of all cases). Thus, in line with the second hypothesis, the spatial agency bias was found only when the male was perceived as more agentic than the female.

Discussion

Together, Study 2a and b suggest that people tend to position the more agentic person to the left when portraying two people of different activity levels. Thus, Adam was presented to the left of Eve and Gomez to the left of Mortissa in about 3 out of 4 images. In addition, Study 2b also informs us about the role of stereotypic perceptions in the SAB, considering that the bias was strictly linked to how agentic the male and the female in each couple was perceived. The spatial agency bias was not found in the two cartoon couples in which male and female were perceived as equally agentic or in which perceptions were actually opposite to stereotypic expectancies, as in the case of Homer and Marge. One may wonder why the spatial pattern did not reverse for the Simpsons, given that Marge was rated as more agentic than Homer. We believe that the bias was possibly mitigated by two competing tendencies, At the social level, gender stereotypes prescribe that males are to be considered more agentic (thus placed to the left), but at the individual level it is

Marge who is considered more agentic than Homer. The interplay between these two ways of conceptualizing agency may be responsible for the fact that spatial bias in the unconventional couple (Simpsons) was eliminated, but not reversed.

Obviously, content analyses of this sort have all kinds of limits. In particular, we cannot exclude that other uncontrolled factors may have influenced the choices of professional cartoonists, artists, photographers, and the like. We therefore tested the SAB in a more controlled way in Study 2c.

Study 2 c: Profile direction in picking of original (vs. mirror) face profiles

Study 2a and b showed the SAB in terms of position, with the most stereotypically agentic targets positioned to the left side of the less agentic counterpart. This is in line with the literature using role assignation tasks (Chatterjee et al., 1995) that focus on relative positions in the visual field. However, the analysis of portrait paintings in the history of art also suggests the importance of direction in the representation of male and female targets. In fact, rather than drawing their sitters fully facing the observer, painters generally depict half profiles that confer depth to the figures. This implies a necessary choice of which of the two half faces should be dominant. Several studies have revealed that the choice is affected by specific characteristics of the described targets. First, there is a general leftward bias (from the observer's perspective) such that the sitter's left cheek is exposed above chance (Conesa et al., 1995; Gordon, 1974; Grüsser et al., 1988; McManus & Humphrey, 1973). Second, this bias is opposed to a rightward bias in self-portraits (Humphrey & McManus, 1973; Latto, 1996). Third, the above-mentioned leftward bias in portraits is enhanced when the portrayed sitter is a woman (Gordon, 1974; Humphrey & McManus, 1973; ten Cate, 2002). Fourth, there also is evidence that this gender-related bias may have undergone considerable changes over time, presumably due to women's emancipation (Grüsser et al., 1988; Suitner & Maass, 2007; ten Cate, 2002). Fifth, the bias varies as a function of the artists' gender such that only male painters show the bias, suggesting a possible in-group bias in the representation of own gender sitters (Suitner & Maass, 2007). Furthermore, there is some indication that spatial positioning may vary as a function of the social status of the sitter (Grüsser et al., 1988), with lower status targets being portrayed with a stronger left orientation. Finally, right-oriented portraits are considered more "potent" and more "active" (Benjafield & Segalowitz, 1993), terms that are easily interpreted as sub-dimensions of agency. Consistent with this idea, Schirillo (2007) has shown that Rembrandt's female sitters are perceived as more attractive when they are depicted with a left-facing profile, whereas male sitters are evaluated as more attractive when their profile is facing rightward, suggesting a link between gender differences and spatial representation that is coherent with the difference in the attribution of agency. A limit of Schirillo's study is that only the original version of the paintings were used as stimulus material, therefore we cannot distinguish if the differences are due to the direction or due to other stylistic features of Rembrandt's portraits. It is possible that the bias derives from the painter's personal preferences, from his worldview. Altogether, the mentioned results suggest that rightward face profiles are used to represent targets that are stereotypically agentic whereas the rightward direction conveys agency of the represented target. However, the results are mainly derived from the observation of existing material. On one side this methodology has a high ecological validity, on the other, however, it doesn't allow a strong control

over confounding variables. To our knowledge, the direction of male and female targets has not yet been analyzed in a systematic way using an experimental methodology in which target gender and profile direction are systematically varied.

Aim of Study 2c was therefore to investigate the association between target's profile direction and gender with a new methodology, namely the selection of one of two profiles, one being the mirror version of the other. The two profiles were therefore identical, except for their direction, and the participants' task was to identify the original profile. In line with the SAB, I predict that, in the case of male faces, the right-facing profile should over-proportionally be selected as the "original" photo, whereas the opposite should hold for female faces. A secondary goal of the study was to exclude the possibility that participants consciously distinguish between original and mirror faces. The use of mirror-reversed images is not uncommon in the field (Benjafield & Segalowitz, 1993). For example Zaidel and Fitzgerald (1994) found that the original rightward profiles of female sitters were overall liked more than original leftward profiles, whereas the preferences were in the opposite direction for mirror images, raising the question whether the direction of the sitter's face profile or the other stylistic features selected by the painters are responsible for the differences between rightward and leftward faces. A secondary goal of the study was therefore to test the possibility that participants are able to consciously distinguish between original and mirror faces. Although this may sound like a remote possibility, it can not be excluded a-priori since previous studies have shown that the left hemiface is more expressive than the right hemiface (Wolff, 1933). Thus, observers may be able to correctly guess which of two identical photos is the "original" one, by choosing the left facing photo in the case of more expressive and the right facing photo in the case of less expressive faces. Given the main aim of the present study, it was therefore important to first rule out that people are, indeed, able to distinguish original from mirror images.

Method

Participants. Fifty-seven Italian participants volunteered for the study (average age = 25, 73% females, 93% right-handers). One participant was replaced in the sample because he could speak Hebrew, a language that is read and written from right to left.

Material and procedure. A sample of face profiles of different actors (all available in left, right and fully facing version) was selected from the KDEF (Lundqvist, Flykt, & Oehman, 1998) and organized in pairs, in order to compare the original profile with its mirror image. The photos, all with a neutral emotional expression, were pre-tested for attractiveness, agency, and dominance. To avoid any spatial bias during pilot testing, the pretest was conducted on fully facing photos. First, a sample of 12 participants (6 males and 6 females) rated the attractiveness of a large sample of photos. Photos were admitted to the final material only when they had been rated as moderately

attractive, that is with values between 4 and 5.6 on a 7-point scale (from 1 = beautiful to 7 = ugly). Subsequently, the pictures meeting the above criterion were pre-tested for perceived dynamism (frenetic vs. calm, dynamic vs. static, fast vs. slow, and active vs. passive) and power (strong vs. weak, dominant vs. submissive, powerful vs. fragile, vulnerable vs. invulnerable) by a sample of 24 participants (11 males and 13 females, mean age 24.88, SD=2.86). Photos were included in the final material only if agency and dominance fell in the intermediate range of the 7-point scale, that is between 3.3 and 4.7. The final material consisted of 8 male faces and 8 female faces of similar attractiveness (males = 4.93, females = 4.90), dynamism (males = 4.00, females = 4.10), and dominance (males = 4.38, females = 3.80).

To construct the final material, we selected the left- and the right-oriented profile of each of the actors selected during the pre-testing. We then produced a mirror image of each photo so as to obtain 2 left-oriented (the original left-facing and the mirror image of the right-facing photo) and 2 right-oriented photos (the original right-facing and the mirror image of the left-facing photo) of each actor. The final stimuli consisted in pairs of images in which one was the original image and the other was its mirror image. The two pictures of each pair were therefore identical except for their direction. Participants were first asked to indicate which profiles of each pair was, in their opinion, the original one, secondly they indicated how agentic they thought the target person was on a rating scale from 1 (not at all) to 4 (very much). The term agency was defined using a standard definition (Abele et al., 2008). Presentation order of male and female targets, rightward and leftward profiles as original and mirror images, position of the two images in each pair (convergent vs. divergent combination[3]) were counterbalanced across participants by administering 8 different questionnaire versions. The 8 versions were built such as each target person was presented only once to each participants. Participants were randomly assigned to the questionnaire versions. Finally, basic demographic information was recorded and participants were debriefed.

Results

Agency attribution. Since the spatial bias is theoretically thought to be related to the agency attributed to the target (Chatterjee, 2002; Suitner & Maass, 2007), we first analyzed the agency attributed to male and female targets (α=.70). Contrary to the results of the pre-test, male targets were viewed by our participants as more agentic than female targets, respectively M=2.37 vs. 2.12, t (54)= 3.22, p = .002. This result replicates the long tradition of studies showing that agency as a key attribute in gender stereotyping (Abele, 2003; Altermatt et al., 2003; Conway et al., 1996; Eagly & Steffen, 1984). The difference between the results in the pre-test and in the study may be due to the mere application of gender stereotyping rather than to an actual perceived difference between male and female face profiles. In fact in the pretest many more pictures were evaluated and

[3] In the convergent layout, the two profiles were facing each other, whereas in the divergent layout they were facing away from each other.

the final material was selected to have equally dynamic and attractive faces of male and female actors. The pre-tested evaluation of the final selection is therefore de-contextualized and compared ignoring the relativity of evaluations. The participants to the main Study differentiated male and female targets probably re-applying gender stereotypes.

Correct recognition. Participants recognized an average of 8.04 original faces out of a total of 16, thus about 50%. This result suggests that participants' answers were completely random and that they were not able to discriminate between original and mirror faces. A repeated measures ANOVA with target gender and layout (convergent vs. divergent) as factors and the number of correct answers as dependent variable did not evidence any effect.

Choosing the rightward profile as the "original". In order to test for a possible preference for the rightward profile, the number of times the rightward profile was indicated as the original one was calculated. Participants showed a small preference for rightward profiles, in fact of a total of 16 images an average of 8.64 (54%) rightward profiles were selected as the original, t (55)= 1.79, p = .08. A gender-unspecific preference for the right facing profile is therefore present, but it is neither strong nor significant.

Most importantly, we had predicted that this preference should only be observed for male targets, assuming that males are stereotypically associated with high agency. Looking separately at male and female targets, the rightward profile was mostly indicated as the original (57%, M= 4.52), t (55), = 2.43, p = .018, for male targets, whereas the bias was absent when the target is female (52%, M= 4.13, t (55) < 1), one-tailed $t(55) = 1.74$, p = .05.

A 2 x 2 ANOVA with target gender and layout of the images (convergent vs. divergent) as repeated factors and the number of rightward selections as dependent variable failed to show any significant effects. However, looking separately at responses for male and female targets, the choice of the rightward profile as the original exceeded chance in the case of male targets positioned on the left (convergent layout), t (55)= 2.32, p = .024, M=2.36, chance level=2, but not in the case of male targets positioned on the right (divergent layout (M=2.11). This result suggests again an additive role of position and direction in the SAB. Female targets were selected randomly regardless of type of layout (convergent: M = 2.05; divergent: M = 2.13).

Attribution of agency. We also tested whether the choice of the rightward profile was correlated with the attribution of agency. We therefore computed the difference between the agency attributed to male minus female targets was computed. However, contrary to our hypothesis, there was no relation between the relative choice of rightward profiles for male and female targets and the level of attributed agency (r= -.116, p = .40). This relation was absent in both convergent and divergent couples of images.

Discussion

The present study shows that participants were unable to consciously differentiate original and mirror face profiles, being the target male or female. This result strongly reduces the likelihood that spatial bias is due to a differential expressivity of hemi-faces and it is in line with Brady's argument sustaining that the bias lies in the perceiver and not in the target (2004). Interestingly, although participants were unable to distinguish original from mirror photos, they did differentiate between rightward and leftward profiles, showing a bias toward rightward profiles which were identified as the "original" more often than would be expected by chance. Importantly and in line with hypotheses, the bias was modified by target gender, such that only rightward profiles of male targets were perceived as more likely to be original. In contrast, for female targets, participants randomly identified the rightward or the leftward profiles as the original. This is in line with results in art history showing a preference for rightward profiles for male sitters and with the results of Nicholls and colleagues according to which leftward oriented faces are perceived as more emotionally expressive than rightward oriented ones, independently of their originality (Nicholls et al., 2002). However, it is not in line with findings by McLaughlin and Kimberly (1994) who reported a right-cheek (namely rightward) advantage independently of target gender and (consistently with our findings) from originality. The lack of effect of target gender in their study may be due to the methodology used. In fact, they asked participants to choose which version they preferred (rightward vs. leftward face profile). Probably participants were not highly motivated in differentiating the two versions and they simply selected the most "fluent" version, namely the version that had the direction congruent with their scanning habits (i.e. rightward). Our participants were challenged in guessing which version was the original one; this might have promoted a more refined processing of the stimuli, with a further differentiation between male and female targets.

Study 2d: Profile direction in categorizing male and female profiles and its relation to gender stereotype endorsement.

Study 2c showed that spatial information is used when processing social stimuli. Apparently the direction of a face profile is evaluated as possible index of social characteristics of the represented target, with rightward profiles suggesting higher levels of masculinity. The stimuli of Study 2c differed only in their direction; therefore participants could either respond randomly considering the two images identical or take the direction of the face profiles into account and use this information with a criterion. Our participants did not ignore spatial information and performed the task applying a specific strategy, namely they associated the rightward profile with male, but not with female targets. However, the fact that the stimuli differed only in their direction might have pushed participants to use this only available information. In Study 2d, we therefore investigated whether spatial information irrupts in cognition even when the task does not necessarily require the elaboration of such information to be performed accurately. Participants were asked to perform a label-matching task indicating if a picture (the profile of a female or male target) matched a previously presented label (i.e. "Male" or "Female"). In three experimental conditions, the exposure to facial profiles was varied so that rightward (vs. leftward) profiles were predominantly associated with males or with females, or they were equally distributed across target gender. In one condition, the Stereotypical Condition, the majority of male profiles were rightward oriented and the majority of female profiles leftward oriented; in the Counter-Stereotypical Condition the majority of male profiles were leftward oriented and the majority of female profiles were rightward oriented. In the control condition, the number of rightward and leftward male and female profiles was equal. We expected the subsequent performance in the categorization to be consistent with the exposure to a specific direction of male vs. female profiles. In other words, we hypothesized that participants would process the profiles better when in the direction in which they are more often presented, resulting in opposite spatial biases in the two experimental conditions (male-rightward & female-leftward vs. male-leftward & female- rightward). In the control condition, however, we expected a spatial bias similar to Study 2c, considering that in both cases right- vs. left-facing profiles were balanced across male and female targets. More specifically, we expected a bias similar to that in the Stereotypical Condition, with male targets categorized easier when rightward oriented and female targets categorized easier when leftward oriented. This result would support that participants use spatial information even when completely irrelevant to the task to be performed.

Most importantly, the present study also investigated the relation between SAB and a) stereotype endorsement and b) ambivalent attitudes toward males and females. It was hypothesized that participants who showed a spatial bias associating the right- (vs. left-) trajectory with males (vs.

females) would subsequently show a stronger tendency to endorse traditional gender stereotypes. Given that the Spatial Bias is thought to be consistent with the exposure to images that promote such associations, we argue that, as a logical sequence, the exposure to stereotypic representations of men and women reinforces the SAB, which in turn will bolster stereotypic beliefs about men and women. The attribution of stereotypic traits to the self was also measured in order to explore a possible application of the same process to self-stereotyping.

Method

Participants. Fifty-four Italian participants (47 females, 52 right-handed, average age 20) took part in the study in exchange of course credit. None of them knew any language written in the left-to-right direction.

Material

Questionnaire: The pen and paper questionnaire consisted in the Agency-Communion scale used in Study 1b and c (see Appendix 1) in which participants were asked to evaluate "women in general", "men in general", and themselves. The order of evaluation of women and men was counterbalanced across participants; whereas self-ratings came always last to assure that the gender stereotype was activated by the time participants rated themselves. Besides basic demographic information, the questionnaire also included a measure of political affiliation and the Italian version (Manganelli Rattazzi, Volpato, & Canova, 2008) of the Ambivalent Sexism Inventory (Peter Glick & Fiske, 1996) and of the Ambivalence toward Men Inventory (P. Glick & Fiske, 1999). The questionnaire was filled out twice, once about two weeks before and once immediately after the computer task.

Computer task: Twenty (10 females and 10 males) actors from the Kdef (Lundqvist et al., 1998) collection were randomly selected and pre-tested on a sample of 14 participants (7 males and 7 females) as equally beautiful (for females M= 5.02, for males M= 4.68, t (13) = 1.37, p= .20), and dynamic (for females M= 4.59, for males M= 4.30, t (13) = .89, p=.40). For each actor 4 images were used: original and mirrored left and right profiles from Kdef with neutral facial expression. All the pictures were bitmap images, size 1.2 MB, width 562 pixels, height 762 pixels, resolution 72 pixels / inch. The computer test was implemented with the E-Prime v.1.1 software (1.1.4.1., cfr. http//www.pstnet.com) and run using E-Run v.1.1 (1.1.4.1., cfr. http//www.pstnet.com).

Procedure. All participants were conducted into a quiet room and tested separately. They were asked to sit in front of a pc that was positioned at about ten centimetres from the edge of the table. Written instructions asked participants to reply carefully using the spacebar as response key. The instructions explained that they had to press the space bar (go) only if an image matched a key word preceding the image. If the word was not predictive of the image they had to wait (no go) for the next cue-image pair. The cue was either the word "male" or "female" and the picture was a

photo of either a female or male actor. The cue word appeared on the screen after a 500 ms fixation point (+) and remained centrally on the screen for 250 ms. Immediately after the cue word the images appeared and remained again centrally on the screen for 200 ms. A blank wait window remained available for 1000 ms for participants to provide their response before the subsequent fixation point was presented. Each picture appeared twice (once as a go trial and once as a no go trial) on the screen and the presentation order of images was fixed. The presentation order was determined on the basis of a random order constrained by the following fixed criteria: each image was maximally far away in the presentation sequence from its mirror image and from the picture of the other profile of the same actor. This limit was set in order to minimize learning effects. Each participant had a practice block of 8 trials and an experimental block of 80 trials.

Experimental manipulation. Participants were randomly assigned to the three experimental conditions, namely Control Condition (N= 18) in which male and female profiles were half leftward and half rightward oriented, Stereotypic Condition (N= 19) in which 80% of male profiles was rightward and 80% of female profiles leftward, and Counter-stereotypic Condition (N= 17) in which 80% of male profiles was leftward and 80% of female profiles was rightward oriented. Due to a technical problem, the data of one participant of the Stereotypic Condition were not recorded by E-Prime, so this participant was deleted from the analyses involving the variables related to the computer task. Given the small number of male participants who returned at time 2 (N=6) and their uneven distribution across conditions we decided to exclude them from the analyses[4].

After the computer task, participants were asked to fill in the questionnaire that was identical to that of the pretest. Participants were thanked and debriefed during a lecture of the course they were attending.

Results

Accuracy. Each participant completed the face categorization test in one of the three experimental conditions. In order to test whether the manipulation affected the accuracy of responses in the three conditions, we conducted a 3 (experimental condition) x 2 (target gender) x 2 (profile direction) x 2 (original vs. mirror image) ANOVA with repeated measures on the last 3 factors, in which a d' prime accuracy index was the dependent variable. The only significant effects were a main effect of target's gender, $F(1,43)= 4.45$, $p= .041$, $\eta_p^2= .09$, according to which male targets (M=3.045, SD= .19) were categorized more accurately than female targets (M=2.78, SD= .23) and the predicted interaction between condition, target gender, and profile direction, $F(2,43)= 16.84$, $p= .0001$, $\eta_p^2= .44$. Most importantly, in the control condition, participants showed a SAB, consistent with gender stereotypes. In fact, accuracy was greater in case of rightward

[4] For most VD's results are similar when males are maintained in the sample, except for self-stereotyping, where spatial bias was actually expected to exert an entirely different effect.

(M=3.19,SD=.34) than leftward (M= 2.57, SD=.29) oriented male targets, F (1,43)=6.69, *p*= .013, η^2_p=.14; whereas a non-significant trend in the opposite direction was observed for female targets (leftward: M=2.55, SD= .39 vs. rightward M=2.31, SD=.37, F (1,43)=.80, *p*= .38, η^2_p=.02).

In the experimental conditions, performance tended to be better when classifying the more frequent targets. In the Stereotypic Condition, participants were more accurate in the categorization of female targets when left- (M=3.18, SD=.44) rather than rightward oriented (M=2.37, SD=42), F (1,43)=7.45 *p*= .009, η^2_p=.15 , whereas a non-significant trend in the opposite direction was found for males (rightward: M= 2.90 vs. leftward: M=2.37, F (1,43)=.84, *p*= .37, η^2_p=.019). A complementary pattern was found for the Counter-stereotypic condition, where the more frequent leftward oriented male (M=3.93, SD=.33) and rightward oriented female targets (M=3.66, SD=.42) were classified more accurately compared to the less frequent targets, namely rightward oriented male targets (M=3.02, SD= .39, F (1,43)=1.13, *p*= .002, η^2_p=.21) and leftward oriented female targets (M=2.65, SD= .44, F (1,43)=1.14, *p*= .002, η^2_p=.21).

SAB Index. A different way to analyse the same data is to compute an overall spatial bias index by subtracting the accuracy (d') of leftward oriented male from that of rightward oriented male targets and a female spatial bias index by subtracting the accuracy of rightward oriented female targets from that of leftward oriented female targets. The sum of the two served as overall index as spatial bias with higher scores indicating that males were associated with rightward and females with leftward orientation. An ANOVA with Condition as independent variable showed that the spatial bias index varied congruently with the experimental manipulation, with the Counter-stereotypic condition having a lower level of space bias (M= -1.91, SD=1.11) compared to both the Stereotypic condition (M= 1.06, SD= 1.71) and the control condition (M=.85, SD=1.67), with stereotypic and control condition not differing from each other.

SAB and Stereotype endorsement. The questionnaire answers were recoded so that high values indicated that the underlying dimension (Power, Dynamism, Communion, Competence) was strongly ascribed to the target (males in general, females in general, and self). Reliabilities, means, and standard deviations of agency/communion and sexism and ambivalence subscales are reported in Appendix 2.

Separate 3 (experimental condition) by 3 (target group) ANOVAs with the second factor being a repeated measure on the questionnaire responses showed that experimental condition did not exert any direct influence on the responses to the questionnaire regardless of which dimension (Power, Dynamism, Communion, and Competence) and which target group was considered (females, males, or self). Also neither the ASI nor the AMI were reliably affected by experimental condition regardless of whether the two sexism scales were considered separately or together.

However, it is still possible that the SAB, revealed in the accuracy measure, may have affected gender stereotype endorsement. In order to explore this hypothesis two indeces were computed. The ambivalent attitude index was computed by averaging the ASI and AMI, including both the hostile and the benevolent subscales, considering that these scales were highly correlated. Higher scores indicated a higher level of sexism. The stereotype endorsement index was computed as the average score of power attributed to females minus power attributed to males and warmth attributed to females minus warmth attributed to males. Thus, higher values indicated an overall attribution of power to males (rather than females) and of communion to females (rather than to males). The sub dimensions of competence and dynamism were not included because of their poor discriminatory power between male and female gender stereotype (see appendix 2). Both, the ambivalent attitude index and the stereotype endorsement index were calculated separately for the questionnaire at T1 (assessed before the computer task) and T2 (after the computer task). The two indices were correlated with the spatial bias index partialling out participants' political attitude. Congruently with the hypotheses, the stereotype endorsement index was positively correlated with the spatial bias, r (41)= .29, p = .055 when stereotype endorsement was measured after the computer task (T2), whereas it was weaker and not statistically reliable, r (41)= .16, *p* = .30 when the measure was taken before the computer task (T1). Similarly, the ambivalence index at time 2 positively correlated with the spatial bias, r (41)= .40, p= .008, whereas the correlation was weaker and not reliable at Time 1 r (41)= .28, *p* = .07. Importantly, both of the T2 correlations remained significant when controlling for the T1 measure.

An index of self-stereotyping subtracting self-attribution of power from self-attribution of warmth, was correlated with the Spatial Bias Index, showing a correlation almost equal to zero in the self-stereotyping index at time 1 r(41)= .01, *p*= .95 and a very small and unreliable positive relation with the measure taken after the computer task , r(41)= .14, *p*= .38. Thus, spatial bias seemed to affect stereotyping and sexism more than it affected self-stereotyping. We conclude that the gender stereotype endorsement and an ambivalent attitude toward males and females is strengthened by the Spatial Agency Bias.

Discussion

The spatial bias observed in the present study is coherent with the exposure to directional images manipulated in the Stereotypical and Counter-Stereotypical Conditions. When participants were presented with mainly rightward (vs. leftward) male profile and leftward (vs. rightward) female profiles they congruently processed rightward (vs. leftward) male profile and leftward (vs. rightward) female profiles easier. However when the exposure of the profiles was even across gender and direction (i.e. in the control condition), participants still showed a Spatial Bias with rightward male and leftward female profiles being processed easier. This is in line with the Agency Hypothesis, according to which agentic targets are associated with the rightward direction. This is also in line with previous findings of this chapter showing that social targets are object of the bias because of the attribution of agency (Study 2b). Together, these results suggest that people use spatial information consistent with the Spatial Agency Hypothesis even when spatial information is irrelevant to the task at hand. Spatial information is therefore automatically decoded in order to facilitate the categorization of social targets.

The second important result regards the implication of the Spatial Bias for gender stereotype endorsement and ambivalent attitudes toward males and females. Our female participants' gender stereotype endorsement and ambivalence was positively related to their previous performance on the categorization task. The more they showed a Spatial Agency Bias, associating male with rightward and female with leftward direction, the more they attributed stereotypic characteristics to male and females and the more their attitudes toward male and female were ambivalent. The relations between the Spatial Agency Bias and the stereotype endorsement and the ambivalent attitude measured before the categorization task were weaker and not reliable, suggesting that the Spatial Agency Bias has an important role in strengthening gender stereotypes. The same pattern was too weak in the self-attribution of stereotypic characteristics, possibly due to the fact that beliefs about the self are well anchored and stable enough not to be influenced by minor spatial variations in our material.

Conclusion

Together the studies presented in this chapter show the application of the Spatial Agency Bias to male and female targets. Agency and communion, as mentioned in the introduction to this Chapter, in fact characterize gender stereotypes. The stereotype content is consistent with the bias, namely that targets that are stereotypically perceived as more agentic and less communal (i.e. males) are also associated with the agentic position, namely to the left (Study 3a and b) and facing rightward (Study 3c and d). This association is present both at the encoding level (Study 3a and b) and at the decoding level (Study 3c and d), and emerges regardless of whether it is studied with a content analysis method of archive material present in the web and with an experimental method using controlled visual stimuli. The bias is analyzed with a focus on the relative position of two targets (Study 3a and b) or on the direction of a single target (Study 3c and d), showing that there are two possible features expressing spatial information in the representation of social targets. The bias was shown to be directly related to the attribution of agency at both encoding and decoding. In Study 3b, the spatial representation of heterosexual couples was congruent with the difference in agency of the two partners, with couples in which the male partner was perceived as more agentic being represented with the male positioned to left of the female partner. Therefore the agency of the represented target is an important characteristic that affects the encoding of the spatial representation. At a decoding level, the use of spatial information for differentiating male and female targets in a categorization task was shown to be related to subsequent measures of stereotype endorsement and ambivalent beliefs. The more accurately male (vs. female) targets were processed when rightward (vs. leftward) oriented, the more female participants attributed stereotypical characteristics to males and females and the more they endorsed an ambivalent attitude toward males and females. To our knowledge, this is the first time that the possible consequences of the bias have been addressed. The consequences are particularly relevant as they suggest that the spatial representation can be considered as a further tool that society uses to maintain and reinforce the status quo. Spatial representations of males and females are responsible for the Spatial Bias participants exhibit in the disambiguation of male and female faces. This bias in turn relates to stereotype endorsement and ambivalent attitudes. This chain underlines the importance of studying this type of bias as it may play an important role in the communication and in the preservation of stereotypes.

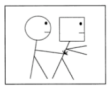
Chapter 3: The role of motion in the SAB

At this point, we know that spatial information is consciously used to symbolically represent stereotype contents (Studies 1a, b, and c), that social targets are associated to spatial representations, consistently with the stereotype that describes them (Studies 2a, b), that spatial information is automatically used in the interpretation of social categories (Studies 2c and d) and that the spatial bias is related to stereotype endorsement (Study 2b and d). Across studies, we have seen that spatial biases occur similarly during encoding and decoding and in all experiments the left-to-right trajectory was associated with acts or with actors characterized by greater agency. The Spatial Agency Bias is therefore present in many social-cognitive processes. However, it is still unclear which are the characteristics of this bias, and in particular what characteristics a target or an interaction must have to be systematically associated with spatial vectors. In this chapter we specifically focus on the feature of the represented target trying to outline the type of target that becomes most easily subject to spatial bias. If the origin of the bias lies in the embodiment of action, the perception of targets that strongly recall the action should be most effected by the bias. The underlying idea is that we process information by reenacting behaviors and bodily states that are connected with the target (for a recent review see Barsalou, 2008). Following this logic, targets that are closely associated with well grounded actions (such as actions that have the same direction of writing and reading) are hypothesized to be more strongly affected by the bias. Thus, if the SAB derives from a visuo-motor activity (writing and reading) that involves motion, then the bias should mainly occur for dynamic human actions, implying momentum, but not for those that are relatively static. This general idea was explored in 4 studies that will be presented in this chapter.

In the first study (3a), two types of actions are compared, namely friendly and aggressive behaviours. Although both type of actions involve interactions (eg. a handshake vs. a punch), the aggressive interactions are thought to have a stronger relation with the left to right direction compared to friendly interactions because they are more dynamic and suggest higher levels of activity. The role of motion of the represented action is explored in a more direct way in Study 3 b, c, and d in which moving and still targets are compared. Action often implies movement, therefore targets that recall motion are thought to show a stronger association with action and with the subsequent bias. The role of motion in the Spatial Agency Bias is analyzed at three levels: categorization (Study 3a and d), representation (Study 3b), and evaluation (Study 3c). Across experiments, the common hypothesis is that interactions should be most strongly associated with the left-right vector the greater the implied momentum of the action.

Study 3a: Spatial Bias in categorizing interpersonal behaviours

The main question addressed in the present study is whether the spatial layout of a social interaction is able to affect its interpretation. For example, if we witness an interaction between two persons, are we able to interpret the type of interaction independently of its spatial configuration? Let's assume that we have to decide if two persons are arguing or are just chatting, in order to decide whether or not to alert the police or to ask for help. Will the point of view from which we witness the interaction determine the ease or the accuracy of our decision? Naturally, such an effect would have interesting consequences in the processing of events that are socially relevant.

In the present experiment, participants were shown images of two actors engaged either in friendly or aggressive interactions. In each image the two persons were facing each other and one person (the agent) was acting upon the other person (the recipient). Is the position of the agent important in order to understand if the interaction is positive or negative? Moreover, is the position equally important for both negative and positive interaction? The innovative character of Study 3a is the introduction of social psychological properties in a task that is similar to a sentence matching task. In this type of task participants are presented with drawings of interacting partners. Similarly to the role assignation task, the two partners were defined as the agent and the recipient of the action. The task is to match the sentence (e.g. The square pushes the circle) to the correct spatial representation of the sentence (e.g ) as quickly as possible. The position varies placing the agent on the left or on the right of the recipient. The analysis of reaction times showed that both direction and position had a main effect in facilitating the sentence-matching task, with faster responses when the agent is positioned on the left of the recipient and when the action was moving from left toward right (Chatterjee et al., 1999). In the present study, the variation of the type of behaviour presented in the task (friendly vs. aggressive) is the first step for understanding whether the well-known positioning bias is content-dependent, namely whether it is sensitive to the type of situation that is spatially represented. If there is an intrinsic link between human action and the left-right trajectory, then a representation with the actor on the left should facilitate the identification of dynamic aggressive scenes (such as hitting or kicking somebody). In contrast, the spatial arrangement should be less relevant when perceiving actions implying little motion such as greeting or hugging somebody.

Hypotheses

We hypothesized that aggressive behaviours are processed easier than friendly behaviours because they are more arousing. More importantly for the aims of this thesis, we also hypothesized that images in which the agent is positioned on the left side of the recipient (agentic layout) are processed easier than images in which the agent is positioned on the right side of the recipient (no-agentic layout). We also expected an interaction between type of behaviour and layout, with the advantage of the agentic (agent left) layout being stronger in the case of aggressive behaviours.

Method

Participants. One hundred and fourteen Italian participants volunteered for the study (94% females, 91% right-handed, 19.90 average age), the majority of them was University Student.

Material and procedure. Two male actors (25 and 26 years old) were pictured while performing two friendly and two aggressive behaviours. The photographs, taken with a digital camera, had a plain background and the two actors were standing one in front of the other. The actors, one of whom was always the agent and the other the recipient, performed two friendly and two aggressive behaviours. In the friendly situations, the agent was moving the open hand towards the recipient, as for a handshake, or he was opening both arms toward the recipient as for a hug. In the aggressive situations, the agent was moving the fist toward the recipient, as in punching, or he was moving both arms against the recipient, as for a push. The 4 four images were all 400X400 pixel and 640.056 bytes. Importantly, two layouts (agentic vs. non agentic) were created, duplicating each image in its mirror reverse, so that the agent appeared either to the left or to the right of the recipient.

The study was the second task of a larger experiment (that included also Study 3d) and each experimental session was conducted in a quiet room. Participants were instructed to respond as fast and as accurately as possible. The task consisted in a go-nogo task in which participants were asked to press the space bar (go trials) only when a cue-word correctly predicted the subsequent picture. If the cue-word and the subsequent image did not match they were asked to wait (no go trials) for the next pair of cue-word/image. The cuewords were “FRIENDLY” or “AGGRESSIVE” and they could match or not match (50%) the type of behaviour represented in the subsequent picture (aggressive vs. friendly). The picture stimuli were presented twice in a fixed quasi-random order maximizing the probability that each picture appeared as distant as possible from its mirror version. The presentation order of keys in matching and non-matching cases was counterbalanced across participants. Participants performed an exercise block with 4 pictures (similar to the experimental task) in order to familiarize with the task.

Both the exercise and the experimental task consisted in:

- a fixation cross presented centrally on the screen for 500 ms
- the cue word (either "FRIENDLY" or "AGGRESSIVE") presented centrally on the screen for 250 ms
- the image (either "FRIENDLY" or "AGGRESSIVE") presented centrally on the screen for 250 ms
- a blank window that waited for the response for 800 ms

The study was carried out with E-prime software on a Toshiba personal computer.

Results

The task was altogether quite easy, with an average of 84% of correct answers. D-prime (d') accuracy index was computed according to the procedure proposed by Stanislaw and Todorov (Stanislaw & Todorov, 1999) as a corrected difference score between hit and false alarms, with larger d' values meaning a more accurate performance.

An ANOVA for repeated measures was conducted on the d_s' with layout (agentic vs. non-agentic) and behaviour type (friendly vs. aggressive) as repeated factors. Consistent with our expectations, aggressive behaviours (M=1.91) were processed more accurately than friendly behaviours (M= 1.77), however this difference does not reach the canonical level of significance, F (1,113)= 1.99, p = .161, η_p^2= .017. More import to the aim of the study, the layout influenced participants' performance, F (1,113) = 7.60, p = .007, η_p^2= .06. When the agent was presented on the left side of the recipient (agentic layout, M= 1.98) participants performance was more accurate compared to the non-agentic layout (M= 1.70). This advantage of the agentic layout is further modified by the type of behaviour represented, F (1,113)= 8.17, p = .005, η_p^2= .067. The agentic (vs. non-agentic) layout is facilitating in the processing of aggressive behaviours (respectively, M= 2.20 vs. 1.62, F (1,113) = 15.96, p =.001, η^2_p= .124), but not in the processing of friendly behaviour (agentic: M= 1.76 vs. non-agentic : M = 1.79, n.s.).

Discussion

The (non-significant) advantage of aggressive stimuli over friendly stimuli can be interpreted as the result of the arousing effect of negative stimuli (Berntsen, 2002). From an evolutionary point of view, the individuation of aggressive behaviours is more important than the individuation of friendly behaviours (Fiske et al., 2007). In fact, an effective recognition of aggressive behaviours is critical in order to prepare a congruent action (e.g. fight or flight). In the case of friendly behaviours there is no need for a quick response because the consequences of erroneous processing are less dangerous.

More important for the present discussion are the effects of the layout. Chatterjee (2002) originally claimed that the agent is represented on the left side of the recipient of the action. This

hypothesis finds full confirmation in our study, where the agentic layout, with the agent positioned to the left of the recipient, was found to facilitate the categorization process of the images more than a non-agentic layout, in which the agent is positioned to the right of the recipient. Interestingly, this effect emerged only in aggressive scenes, suggesting that being the agent of an action is not enough in order to be associated to the left position. Presumably, the action has to be dynamic, as in the case of the aggressive behaviour that was better recognized when the agent was positioned on the left side. The layout turned out to be irrelevant in the case of a friendly interaction that implies little or no motion. This difference can be interpreted in terms of agency, and specifically as the result of different levels of activity or dynamism suggested by the two behaviours. A friendly situation is not dynamic enough to create a preferred direction of the action. In contrast, the aggressive behaviour is so strong that its recognition activates an embodied processing of the action observed. From this embodied cognition perspective, the action is processed easier when it flows from left toward right rather than from right toward left. In fact, for our participants this was the direction congruent with the culturally promoted "standard" direction, namely the writing direction. This hypothesis is tested more explicitly in the following studies that directly assess the effect of dynamism and motion in the spatial bias.

Study 3 b: Representation of moving or still targets

In order to test the possible role of implied motion in the spatial bias we asked participants to choose the best representation of a series of events, each described by a simple phrase. In each described event, two characters where interacting, one in the agentic and active role, the other receiving the action, such as A pushing B.

Since the order in which agent and recipient are mentioned has been shown to affect spatial representations, the order of mentioning was varied using relative clauses. For example, the same action was either described as "A meets R and pushes him", thus with the agent presented before the recipient of the action, or as "R meets A who pushes him", thus with the recipient presented before the agent. The counterbalancing was essential to avoid an order effect, considering that the first-mentioned target is generally drawn to the left of the other. Participants where asked to choose which of two drawings better represented the event. Importantly, in the drawings, the two targets were represented either facing the viewer in a motionless representation or facing each other in a representation that suggested motion. An example of the still and moving representations is shown in Fig. 3.

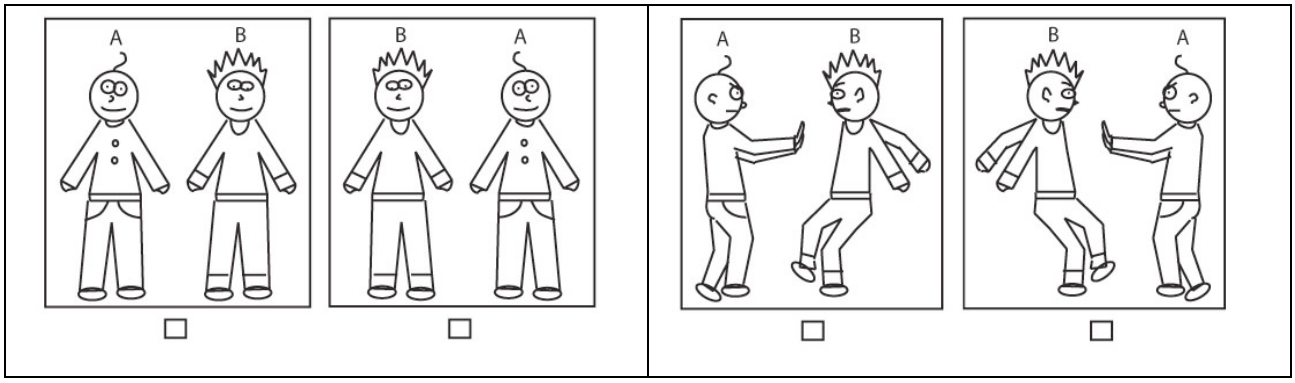


Fig. 3: Example of still (to the left quadrant) or moving (to the right quadrant) targets in the event "A pushes B".

We hypothesized a stronger positioning bias, namely more selections of representations in which the actor is presented on the left side, when the drawing clearly emphasized motion.

Method

Participant. Forty-eight (50% males, age range 19-35, 92% right-handers) students volunteered for the study.

Material and procedure. The study material was developed in a Research Seminar in collaboration with Mariangela Cardinale, Claudio Carlesso, Laura D'Alberton, Silvia Pinato, Emanuela Rossanese. Participants were presented with eight simple events. Each event was described in two sentences in which information regarding the situation, the two targets involved, and the action were included. The event descriptions were very simple such as "È uscito il nuovo

film di Jonny Depp. Ad un certo punto Marcello (A), alla cassa, incontra Giovanni (B) e lo spinge per rubargli il posto" ("The new Jonny Depp movie has just come out. At some point, Marcello (A) meets Giovanni (B) at the ticket counter and pushes him to take his place"). The representations were drawings in which the two characters were represented either in motion or in a motionless fashion. The presentation order of the two characters was counterbalanced with the use of relative clauses. Therefore the description used in the previous example would become "È uscito il nuovo film di Jonny Depp. Ad un certo punto Giovanni (B), alla cassa, incontra Marcello (A) che lo spinge per rubargli il posto" ("The new Jonny Deep movie has just come out. At some point, Giovanni (B), at the ticket counter, meets Marcello (A) who pushes him to take his place"). Half of the actions were positive (namely to kiss, to say hallo, to caress, to offer) and half negative (to push, to kick, to step on, to soil). Each description was followed by two alternative representations that varied only in the position of the two characters. In one representation the agent was to the left of the recipient, in the other to the right. Participants were asked to select the representation that in their opinion better suited the description of the event. Half of the verbal event descriptions were followed by static, half by dynamic vignettes (counterbalanced across scenes and across participants, so that the same event was associated with a dynamic vignette for half of the participants, but with a still vignette for the remaining half).

Results

Out of eight cartoons, participants on average selected 4.66 times (58%) the vignette in which the agent was positioned to the left of the recipient as the better representation of the scene. Interestingly, this tendency was present only for moving vignettes (M=2.58, 64%, one sample $t(47)=4.01$, $p= .000$, test value=2). For still vignettes, the selection was almost random (M=2.08, 52%, $t(47)<1$, test value=2). The difference between left-positioned-agent representations between moving and still vignettes is statistically reliable, paired sample $t(47)= 2.53$, $p= .015$.

Discussion

In line with hypotheses, the SAB emerged only for moving, but not for still representations of interactions, providing additional support for the idea that the horizontal spatial trajectory is deployed to represent activity or motion. Compared to still representations, the dynamic vignettes are, presumably, more likely to activate the abstract schema of motion and, as a consequence, participants then use space as a tool to represent the action, positioning the Agent to the left of the Patient with the action evolving from left to right. The effect of motion therefore clearly plays a role in the representation of human interaction, at least at an encoding level. In the following study this same relation is studied at the decoding level, by comparing the perception of moving vs. unmoving targets.

Study 3 c: Evaluation of moving or still targets

In order to test the possible role of suggested motion in the SAB at the decoding level, we asked participants to evaluate pictures whose contents varied in terms of direction and activity (vs. inactivity) of the represented target. The targets were all people engaged in a sport activity, namely dancing, cycling, skiing, and running, they were either facing right- or leftward (from the observer's point of view) and they were either actively performing the activity or taking a break from the activity (e.g., a dancer dancing or a dancer sitting on the floor relaxing; a cyclist racing or standing next to his bicycle). One example is reported in Fig.4.

Fig.4: Example of moving (to the left) and still (to the right) rightward oriented targets.

If the action suggested by the spatial representation is an important factor in the spatial bias, the images suggesting motion should be processed with a stronger bias compared to the motionless images. We therefore hypothesized that images suggesting motion would be perceived as more dynamic than images suggesting stillness. Also, in line with the SAB, we expected rightward oriented images to be evaluated as more dynamic compared to leftward images. More importantly, we expected the association between rightward and dynamism to be stronger for images suggesting motion rather than for images suggesting stillness.

Method

Participants. Fourteen (7 males and 7 females) students volunteered for the study.

Material and procedure. Participants were asked to independently complete the questionnaire at a university library. A set of 16 black and white photographs was presented in random order as part of a questionnaire on "picture evaluations". Each participant was asked to rate each picture on dynamism using a 10-points Likert scale (only one item: dynamic). The 16 pictures represented four kinds of athletes (4 dancers, 4 cyclists, 4 skiers, and 4 runners) facing right or left (from the viewer point of view). The pictures represented the target either while performing the sport activity or while taking a break from the activity. The images were selected from the web and their size was 85.4 K.

Results

A Cronbach Reliability Analysis showed a high internal reliability for both the sample of still (α = .93) and moving images (α = .70). A 2 x 2 repeated measures ANOVA tested the effect of direction and motion on the dynamism attribution. Contrary to our prediction a main effect of direction failed to be significant, showing that the evaluation of dynamism is practically identical for rightward pictures (M= 5.72) and leftward images (M=5.73). The expected main effect of motion showed that the two samples of images are different in dynamism, with moving images (M=7.57) rated as more dynamic than still images (M = 3.45), F (1,13) = 94.51, $p < .001$, $\eta^2_p = .88$. More important, the predicted interaction between direction and motion, F (1,13) = 8.037, $p = .014$, $\eta^2_p = .382$, showed that rightward images of moving athletes (M= 8.21) were rated as more dynamic than leftwards images (M = 7.80), F (1,13)= 4.41, $p = .056$, η^2_p=.254, whereas still pictures were rated higher in dynamism when facing left (M = 3.66) than right (M = 3.23), F (1,13)= 6.46, p =.025, η^2_p=.33.

Discussion

The study showed that the role of motion is evident also when participants are asked to evaluate a visual stimulus. Rightward moving targets were perceived as more dynamic than the exact same targets represented in an opposite leftward moving fashion when the target is represented while performing an action. We hypothesized a weaker bias in still targets, whereas we found an opposite bias. When the represented target is in a still position, it is overall perceived as less dynamic, and the dynamism attribution is greater to leftward than rightward directed targets. Eventually participants differentiated as much as possible still and moving targets using spatial information in opposite ways. This provides further evidence for the importance of embodied processes in the use of spatial schemata. Although the direction in which the action evolves is logically irrelevant to the task at hand (judgment of dynamism), people are clearly influenced by the spatial directory. However, it remains unclear if the same intruding effect of direction also comes into play in the understanding of the motion itself. To explore this possibility, the task of the participants in the last study was to categorize scenes as either representing motion or not.

Study 3d: Categorization of moving or still target

The moderating effect of implied motion in the spatial bias was shown during encoding (Study 3a) and during decoding of human action (Study 3b). The question then arises whether spatial information also affects the categorization of actions as representing motion or not. In other words, when people have to decide whether a scene represents motion or stillness, will a rightward orientation facilitate this categorization for moving but not for still representations? In a picture-matching task, participants first saw the label "motion" or "stillness", followed by the photograph of an athlete either performing an activity or resting. In both cases, the orientation of the athlete was either rightward or leftward. The participants' task was to decide as fast as possible whether the photograph matched the label or not. We hypothesized that people would it find it easier to correctly categorize rightward moving than leftward moving targets. We did not expect this advantage of rightward direction for unmoving targets.

Method

Participants. One-hundred-fourteen persons (7 male and 107 females, average age 20, 104 right-handers and 10 left-handers) volunteered to participate in the study. This study was the first task of a larger experiment that included also Study 3a.

Material and procedure. The set of images of the previous study and the corresponding reversed (mirror) images was used in present study, for a total of 32 images. Participants were conducted in a quiet and isolated room and tested separately. All participants were asked to sit in front of the pc that was positioned at about ten centimetres from the edge of the table. Similarly to the paradigm used in Study 3a, participants were asked with a written instruction to press the key bar only when a cue label correctly predicted the subsequent image. The cue word was either the word FERMO ("still") or MOTO ("movement") and the picture was the photo of an athlete either training or resting. The cue word appeared on the screen after a 500 ms fixation point (+) and remained centrally on the screen for 250 ms. Immediately after the cue word the images appeared and remained again centrally on the screen for 250 ms. A blank window appeared, waiting for the participants' answer for 800 ms before the subsequent fixation point was presented. Each picture appeared twice on the screen and the presentation order of images was fixed. The presentation order was built on the basis of a random order under some fixed criteria: each image was maximally far away in the presentation sequence from its mirror version and from the previous identical picture. This constraint was used in order to reduce learning effects. Each participant had a practice block of 10 trials and an experimental block of 64 trials.

Results

Participants correctly categorized 77% of the targets. We therefore analyzed the data both using the reaction times of hits and the accuracy index d' as dependent variables. An ANOVA for repeated measures was carried using direction (rightward vs. leftward) and motion (moving vs. not moving target) as independent variables. The results on the reaction times of the 109 participants who had at least one hit in each condition, evidenced a main effect of motion, $F(1,108)= 101.36$, $p = .0001$, $\eta^2_p= .48$. This effect was not surprising giving the arousing character of moving images (M=236.80) compared to unmoving images (M=284.31). More interestingly, the effect of direction was contrary with our predictions, $F(1,108)= 7.31$, $p = .008$, $\eta^2_p= .06$, with leftward images categorized faster (M=254.91) compared to rightward images (M=266.20). Again contrary to our expectation, the interaction between direction and motion, although not reaching the statistical reliability, $F(1,108)= 2.06$, $p = .15$, $\eta^2_p= .02$, showed that the arousing effect of motion was stronger when the motion was leftward rather than rightward oriented (respectively, M= 228.00 vs. 245.61, $p <.05$). Motionless images were processed similarly in their rightward or leftward orientation (respectively, M= 286.80 vs. 281.82, n.s.).

The d' analyses failed to produce any significant effect (Fs <1), with rightward and leftward oriented images being similarly processed when representing moving or unmoving targets, respectively M= 1.22 vs. 1.26 for rightward images and M= 1.29 vs. 1.29 for leftward images.

Discussion

Congruent with our hypothesis, spatial information was affecting only the processing of moving targets, and not unmoving targets. However the effect of direction was in the opposite "direction" of what we had hypothesized. In fact, leftward targets were categorized faster compared to rightward targets. This result not only contradicts our expectation but it is also puzzling, as we don't see any reason able to explain it.

Conclusion

Together the four studies showed that the Spatial Agency Bias is strongly associated to the activity that is represented. In the first study, the processing of aggressive, but not friendly, interactions was affected by the position of the agent in the representation. Only with aggressive interactions, the scene was easier processed when the agent was positioned to the left of the recipient of the action. This effect was interpreted as the result of the stronger dynamism and activity expressed by aggressive compared to friendly actions. This result is relevant from an ecological point of view. In fact the task performed in this study is likely to be part of everyday life. For example, the accuracy of a witness may be affected by the point of view from which she/he observed the scene. Similarly, a referee might be biased by the spatial layout of the sport players.

The role of motion was also tested in the target, namely the bias was studied with moving/unmoving targets. Study 3b and c showed that moving targets were strongly affected by the Spatial Bias, with rightward moving targets being preferred to represent active roles (Study 3b) and evaluated as more dynamic (Study 3c). This kind of evidence strongly supports the idea that the bias is the outcome of a LR spatial schema for action promoted by congruent repeated motions. Writing and reading habits are actions that strongly promote a specific direction. This direction is later "recycled" to envisage actions in general. The effect of the preferred direction emerges with stimuli that are strongly related with motion, providing evidence to the embodied character of the mental schema for action. Surprisingly, this result was not replicated in Study 3d, where moving targets were categorized faster when leftward directed (rather than rightward). This result is puzzling as the leftward direction should not be of any help in the categorization task. One limit of the study may be the long time participants had available to categorize the targets (the wait window was of 1000 msec). What argues against this interpretation is that the very same stimulus material was also used in Study 3c in a paper and pencil procedure in which participants were free to observe the images as long as they wanted to. Alternatively, what may be responsible for the opposite result pattern is the fact that, in Study 3c, participants responded in handwriting rather than on a computer. The use of a pen may have played a crucial role, as it involves a motor activity, that promotes at a local level the already preferential rightward direction. However, neither account can explain why the bias not only disappeared, but actually reversed in Study 3d. Although we are unable to offer a convincing account for this reversal, we will explore the possible role of the very action of writing in the following Chapter.

Chapter 4: The malleability of the bias: Distal causes vs. proximal causes.

From the cross-cultural comparison of Study 1c and from previous evidence (Altmann, Saleem, Kendall, Heilman, & Rothi, 2006; Maass et al., 2007; Maass & Russo, 2003), we know that the bias has a cultural character. Namely, agentic actions or actors are represented with a LR trajectory in LR-writing cultures, whereas the spatial bias is generally reversed in RL-writing cultures such as Arabic, Hebrew, or Urdu and often reduced or absent in multi-cultural participants. Presumably, the direction of the language in a given culture creates a mental schema for action, through the visual scanning habit of reading and the motor activity of writing. The schema, initially originated from a practical behavior, is later applied -beyond the practical level of action- to the abstract domain of symbolic representations. This explanation of the bias, the so-called Cultural Hypothesis, is schematically represented in Fig. 5.

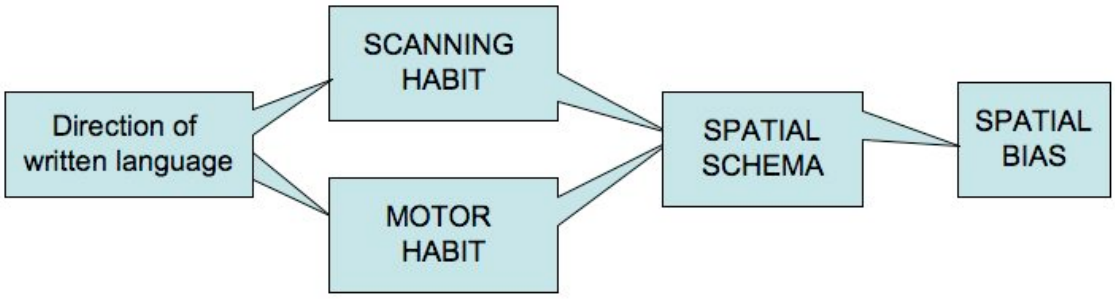


Fig 5. The Cultural Hypothesis

The cultural hypothesis takes its starting point from the connection between action and cognition proposed by Embodiment theories. The physical action and the resulting bodily states promote a preferential direction that is strongly associated with the concept of action and with targets that are connected to this idea, namely agentic targets. The direction of written language can be considered a distal cause as it does not operate hic et nunc, but rather creates a chronic activation deriving from a habit that is culturally promoted. Similarly, the hemispheric specialization can be interpreted as a distal cause that drives the bias in a constant way. On the contrary, situational constraints may work as proximal causes that exert short-term effects and that determine whether the habitual trajectory will surface or whether it will be overridden. Imagine a person from a European country being repeatedly exposed to a light signal that moves with a RL trajectory across a computer screen. Or imagine a person from that same country practicing Hebrew writing for half an hour. Will this person show the usual LR bias (as prescribed by the culture of origin) or will the momentary visual or motor experience with the opposite spatial trajectory lead to an opposite bias? From an

embodiment perspective one may hypothesize that such momentary visuo-motor experiences - much like habitual scanning habits - will create mental schemas, but that these will be much weaker and situationally confined. The reasons for this prediction are mainly two: First the culturally promoted direction is much more frequently activated and therefore creates a habit that is more constant and more deeply rooted. Second, the culturally promoted direction has a motivational advantage, as it is useful in simplifying communication, moreover it is socially shared and embraced in conformist ways. We can therefore argue that the culturally promoted direction functions as a base line on which proximal causes operate. In line with this idea, Study 4 investigated the hypothesis that momentary motor action opposite to the dominant writing direction would weaken, but not necessarily override the usual LR bias. Participants were asked to engage in a fictitious writing task (either towards the right or towards the left). This exercise was expected to work as a proximal cue of the bias and to affect the subsequent evaluation of directed targets.

Study 4: Writing exercise of a writing direction

In order to test if a motor behavior can work as a proximal cause for the spatial bias, we had people perform a right or left moving task and then view a series of stimulus pairs representing two identical targets (either both males or both females) running in opposite direction (one rightward, the other leftward). The participants' task was to choose, for each stimulus pair, (a) the person who appeared to be running faster and (b) the person who seemed to be more masculine/feminine. In addition, we assessed the degree to which participants endorsed traditional gender stereotypes.

Hypothesis

First, after the activation of the rightward direction, we expected the right-moving target person to be perceived as (a) faster and (b) more masculine than the left-moving target (usual SAB). However, assuming that momentary scanning activation is relevant, we expected this directional bias to be eliminated after performing a leftward priming task (analogous to languages such as Arabic and Hebrew).

Second, we tested the relation between gender stereotype endorsement and spatial direction bias, hypothesizing that the more participants endorsed traditional gender stereotypes (associating males with greater agency) the more they would chose the right-moving (vs. left-moving) target as more masculine when exposed to a rightward priming procedure. An opposite tendency was predicted for the leftward priming procedure. We did not expect gender stereotyping to affect the speed task, since gender is irrelevant to this task (given that people were never given the possibility to choose between a male and a female target person).

Methods

This Study was part of the research internship of Katharina Bachmeier which I co-supervised.

Participants. A total of 61 participants, all Italians and mainly students from the University of Padua, volunteered to take part in this study. One participant was excluded because of technical problems. Therefore we used the data of 60 participants (mean age = 23.6 years, 50% males, 97% right handed). None of our participants knew how to speak or write a language written from right to left. Participants were randomly assigned to experimental conditions consisting of a task intended to either prime first LR then RL writing direction, or vice versa. They then judged the perceived speed and the perceived masculinity or femininity of stimulus pairs.

Procedure. Participants were performing the experiment in a silent room without interruptions. Depending on conditions, they first performed a LR or a RL priming task, in which they had to write a string of simple letters such as "ℓ" (see Appendix 2) for one line in either

rightward or leftward direction. Participants were then exposed to a series of stimulus pairs and asked to perform the first dependent measure (speed judgment). This part of the experiment was run on a portable computer using the e-prime software. Important, all instructions for this task were read out by the experimenter in order to avoid any effects due to reading direction. Participants saw a black fixation cross on a white background in the centre of the screen for 500 milliseconds, followed by the stimuli that were shown for 100 milliseconds. Each stimulus pair consisted of two identical mirror images of people in motion and the participants' task was to judge which of the two appeared to be running faster (speed judgment). Participants completed their choice by pressing one of two (blue or red) bottoms corresponding to the D and L keys on the keyboard. They could take as much time as they wanted to make their decision. Speed judgments were made for a total of 24 trials.

Subsequently, participants performed a second priming task by writing other simple letter strings such as "η" (see again appendix 1), but this time in the opposite direction with respect to the previous priming task. They were then exposed to the same 24 stimulus pairs, but this time, the participants' task was to judge which of the two persons appeared more masculine (or more feminine). At the end of the masculinity judgment task they filled out a pencil and paper questionnaire assessing their endorsement of gender stereotypes, in addition to basic personal information (sex, age, field of studies, knowledge of languages written from right to left, etc.).

Activating the writing direction. In order to activate the writing direction, we used simple pre-writing exercises as those used in k-grade education in many countries, showing letters either on the left or on the right side of the sheet which had to be copied by participants throughout the whole line (see Appendix 3). The rightward priming procedure was assumed to activate the conventional writing/reading direction in Italian culture and was therefore expected to lead to a strong spatial bias. Leftward priming was thought to create a completely new situation, which was expected to momentarily replace the culturally determined writing/reading habit, thus eliminating the usual spatial bias after leftward priming.

Stimulus materials. Forty-eight pictures of persons (half male, half female) running either rightward or leftward were used to create the 24 image-stimuli. For each stimulus pair, the same picture appeared twice: in its original version and in its mirror version. The two pictures in the image were arranged in a way that the two runners were either running towards each other (convergent layout) or away from each other (divergent layout, see Fig. 6). Also, half of the stimulus pairs portrayed male, half female targets. Target persons on the images were of normal body-build and conventionalized so that particularities such as age etc. were not cognizable at first glance.

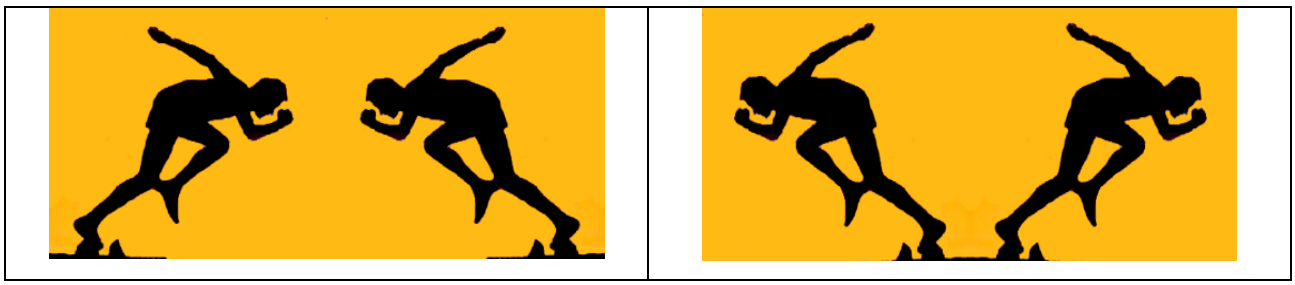


Figure 6. Male targets: convergent layout vs. divergent layout

Dependent variables

Speed and masculinity judgment. During the first phase of the experiment, all participants chose the person of each pair that appeared to be running faster. For the *speed judgments*, the number of times participants chose the rightward running target as faster served as dependent variable.

Turning to the *masculinity judgments,* to avoid a gender bias due to instructions, half of the participants were asked to identify the person who seemed more masculine, half the person who seemed more feminine. The responses were recoded so that higher scores indicated a greater number of rightward running targets rated as more masculine.

Since the stimulus pairs varied as a function of the sex of the target persons and the convergent vs. divergent layout, scores for both ratings could vary from a minimum of 0 to a maximum of 6 for each combination, with a chance value of 3 (indicating the absence of spatial bias). Thus, higher values indicate that the right-running target was associated with higher speed (for the first dependent variable) or higher masculinity (for the second dependent variable).

Gender stereotype endorsement. We used two scales to assess the degree to which participants endorsed traditional gender stereotypes, the Personal Attributes Questionnaire (PAQ) and the Agency scale. As far as the PAQ is concerned, we administered an Italian adaptation of Helmreich and Spence's scale (1974). Participants were asked to judge 22 adjectives and clauses describing stereotypically masculine (e.g., "aggressive", "competitive", "resists well under pressure") or feminine (e.g. "ready to help others") characteristics and behaviours, and to indicate for each whether the statement was more typical of men or women. Participants made their decision on a 6-point scale with "men" and "women" as endpoints counterbalanced across participants so that females appeared either on the right or on the left side of the scale. After exclusion of two items, the internal consistency of the scale was $\alpha = .70$. The scale was coded so that higher values indicated that more masculine and fewer feminine traits were attributed to males than to females.

Using the same response format as above, the 8-item scale used in Study 1b and 1c (see Appendix 1) assessed how dynamic (fast, dynamic, active, vital) and dominant (strong, dominant, forceful, fragile – reversed scoring) males were perceived compared to females ($\alpha = .70$). Again, higher scores indicate that males were perceived as more agentic than females.

Demographic information. A final set of questions covered information such as sex, age, time spent reading, whether participants speak and write languages that are written from right to left (none did) and what they think could be the aim of this study. Since none of these variables affected responses, they will not be discussed further.

Results

Speed judgment. We performed a 2 (activated direction: rightward vs. leftward) x 2 (layout: convergent vs. divergent) x 2 (target gender: male vs. female) ANOVA in which the last two factors were repeated measures, using the speed judgment as dependent variable. Overall, the mean speed estimation was close to the scale midpoint (3), regardless of whether participants were activated with a rightward (M = 2.94) or leftward priming procedure (M = 2.99). Neither of these means differed from chance (one-sample t-test).[5]

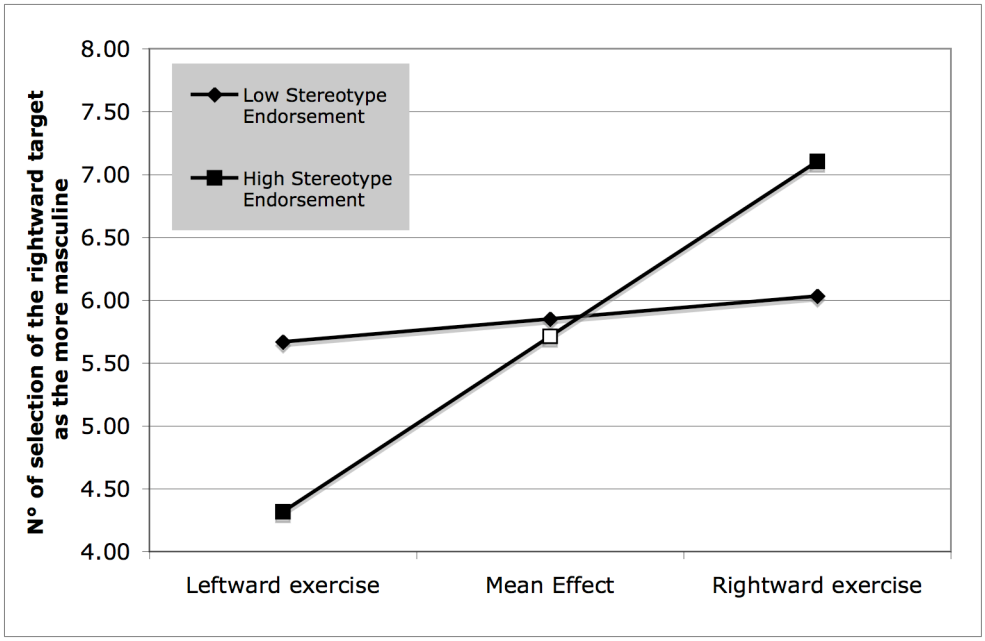
Masculinity judgment. We performed a 2 (activation: leftward vs. rightward) x 2 (target sex: male vs. female) x 2 (layout: convergent vs. divergent) ANOVA using the masculinity judgment as dependent variable, with higher scores indicating that participants perceived the right-moving actor as more masculine. The analysis revealed three effects. First, a main effect for target gender, F (1,58) = 2.96 p = .09, η_p^2 = .048, revealed that the right-ward moving target was seen as more masculine mainly when stimulus pairs consisted of two women (M = 3.26) rather than of two men (M = 2.89), however the effect does not reach the standard significance level. Image layout was affecting participants selections, F (1,58) = 4.16, p = .046, η_p^2 = .067, such that rightward selections were more likely when the rightward target positioned to the right, such that rightward selections were more likely when the layout was divergent (M= 3.22) rather convergent (M=2.93). More important to our hypotheses is the main effect for writing exercise, F(1,58) = 6.89, p = .011, η_p^2 = .11. In line with our main hypothesis, participants perceived the right-running target as more masculine after having done a left-right writing task (M = 3.27) than after an opposite (right-left) writing task (M = 2.89). Comparing each mean to the chance value of 3, we found that, following a rightward writing exercise, the right-running target was perceived as more masculine more frequently than would be expected by chance, t(28) = 2.17, p = .039. A non-significant tendency in the opposite direction was observed after a leftward writing exercise, suggesting that people perceived the leftward running target as slightly more masculine, t(30) = – 1.42, p = .17.

Gender Stereotype Endorsement: PAQ and Agency. Overall, males were perceived as more masculine (M= 4.10 on a 6-point scale) and as more agentic (M= 3.93 on a 6-point scale) than females, as supported by comparisons with the neutral scale midpoint of 3.5, one-sample t (59) =

[5] The only marginally significant effect emerging from the ANOVA is a main effect for layout, $F(1, 58)$ = 3.39; p = .07; η_p^2 = .06, suggesting that – contrary to Hypothesis 3 - rightward running targets were considered faster in the divergent (M = 3.15) than in the convergent (M = 2.75) layout. Thus, rightward images were selected more often in the divergent condition – that is when presented on the right side – whereas leftward stimuli were chosen more frequently when represented on the right side (convergent layout).

11.17, p < .001, for PAQ, and one-sample t(59) = 5.34, p < .001, for Agency. Also, not surprisingly male participants tended to endorse these stereotypes more strongly than female participants (PAQ: M_{males}= 4.20, $M_{females}$= 4.00, t (58) = 1.90, p = .06, Agency: M_{males}= 4.18, $M_{females}$= 3.69, t (58) = 1.90, p = .001). The two scales correlated moderately with each other, r(60) = .49, *p* = .0001.

More important for our argument was whether a greater endorsement of gender stereotypes would predict spatial bias. We had predicted that gender stereotypes and the priming task would jointly predict spatial bias, when participants were asked who of the two targets appeared more masculine. We therefore ran regression analyses in which spatial bias (with greater masculinity being associated with the right-moving target) was predicted on the basis of five predictor variables: Writing exercise (dummy coded), z-transformed PAQ, z-transformed Agency, and the interactions between PAQ and Writing exercise, and between Agency and Writing exercise. In line with predictions, Writing exercise was a significant predictor, B = .79, β = .34, t = 2.74, *p* = .008, suggesting that the right-moving target was perceived as more masculine (compared to the left moving target) after a right-ward exercise, thus confirming our previous analyses. Importantly, although falling short of significance, the interaction between PAQ and Writing exercise direction emerged as a reasonable predictor, B = .61, t = 1.79, *p* = .080. The endorsement of traditional stereotypes strengthened the above effect such that with increasing gender stereotyping (PAQ) the spatial bias increased after a rightward writing exercise, *B=.54, t= 2.17*, p= .034. The slope was not significant after leftward writing exercise, *B*= -.069*, t* < 1. The regression slopes are presented in Graph 1.



Graph 1: Masculinity judgements in function of stereotype endorsement and activated direction. Chance level =6.

Discussion and conclusion

In this study we investigated the question whether the tendency to perceive motion with a left-to-right trajectory is chronic and reflects culturally determined, stable habits in writing direction (Chokron & De Agostini, 2000; Maass & Russo, 2003; Padakannaya et al., 2002; Vaid et al., 2002) or whether it is malleable and can be modulated by a situation, i.e. by applying a writing task as prime.

Following the general (and culturally stable) left-to-right scheme of action in Western cultures we had assumed that, in the speed task, participants would perceive the right-moving target as faster. Contrary to our hypothesis, participants' selection of the faster target was not affected by direction, hinting at the instability of cultural effects. The writing exercise failed to lead to a spatial bias as well. However it is important to note that the images were presented for a very short time (namely, 100 msec) and that many participants complained that it was very difficult to evaluate such quickly presented images. As a consequence, participants may have had little time to process the direction of the stimuli, giving more importance to the position of the targets. Since participants were asked to press the key that was on the same side as the picture they wanted to select, position was indeed the primary characteristic in order to perform the task. In fact, the only effect that emerged was for position, with a preference for right positioned targets. Possibly, the right positioned target had an advantage because participants selected it with the right key, hence with their right hand, which for 96% of our participants was the dominant hand.

Not surprisingly, the same effect of position was present in the evaluation of masculinity as well. More importantly, we had expected that right-moving targets be perceived as more masculine, but only when the writing task enforced the usual writing habit, whereas the SAB was expected to disappear after leftward writing exercise (mimicking languages such as Arabic and Hebrew). This was indeed found. Although the presentation time of the target images was the same as in the previous task, the processing of direction in this task may have resulted easier due to greater familiarity with the task. The masculinity judgments was the second task and involved the same stimulus material, therefore it was the second time participants were seeing the images. It is possible that this familiarity with the material helped them in the elaboration of additional information (such as direction) that was ignored at the first glance.

We also investigated the relation between gender stereotype endorsement and selection of male or female targets in rightward direction as a function of the writing task, namely rightward vs. leftward. After rightward writing exercise, the more participants shared traditional gender stereotypes the more they tended to perceive the right-moving target person as masculine. This relation was absent after performing the leftward writing task. This shows that the embodied writing exercise of a direction can promote it but that the association of the promoted direction with other

abstract concepts (such gender stereotype) needs time to be well grounded. The activity is in fact efficacy in strengthening the bias but it fails to reverse it. In fact, the rightward writing activity was more efficient in strengthening the existing bias, than the leftward writing activity was in reversing it.

Summarizing we can say that the findings of the speed task were inconclusive whereas the results of the masculinity task supported our hypothesis that the SAB is malleable and subject to momentary motor experiences. In line with hypotheses, right-moving targets were perceived as more masculine only after participants had performed a writing task that corresponded to the usual direction in which language is written in their culture. This effect disappeared after participants had just written in a direction opposite to their normal writing habit. Together, these findings indicate that the cultural effects of rightward writing and reading in Western cultures are not stable, but rather subject to context-specific variations in visuo-motor activity.

There are several limits to this Study that should be addressed in future research. First, the experimental design is lacking a control group in which participants are not primed with any movement. Such a condition should serve as a baseline of comparison for the experimental groups, as it represents the spontaneous bias related to the participants' scanning habits. A second limit of the study regards the short time participants were given to inspect the images (100 msec). Longer exposure time of the stimuli and a counterbalance of the two tasks (speed and masculinity evaluations) is recommendable. A final note regards the future directions. In fact, in the present study the motoric aspect of the writing action is confounded with the visual one. The two aspects could be disentangled by asking participants in one condition to perform a writing task using a keyboard (a writing activity with no spatial trajectory) and checking the written text on the screen (visual-only condition). In another condition, participants may be instructed to write with a pen without looking at the sheet (motor-only condition).

Although the problem of the degree of stability of cultural scanning habits remains to be explored more deeply, our study allows at least a preliminary answer to the question, suggesting a joint effect of distal and proximal causes in producing spatial bias. These first findings suggest that proximal causes such as momentary visuo-motor activity are relevant and may indeed determine whether culturally grounded preferences for the LR trajectory do or do not emerge in a given situation. Our findings add to the existing literature showing that the LR trajectory has a previliged status in our cultural context and is related to a large amount of daily activities that are unrelated to writing or reading, such as the imaginary number line (Dehaene et al., 1993) and inhibition of return (Thomas M. Spalek & Hammad, 2005). Yet this field still needs further investigations concerning other cultural areas apart from the Anglo-European one, preferably right-to-left writing cultures.

Chapter 5: The role spatial information in advertisement

In the Global Era we can buy anything we can pay for almost any place in the world using e-commerce. The competition between products is more and more relying on the ability of the sellers in catching the attention and the favors of the customers through appealing ads. We are in fact bombarded by tons of publicity, promoting any type of object and service. Naturally, the first tool of an ad in order to catch the attention of the potential customer is the first-glance visual appeal of the ad. Spatial arrangements are therefore important because they balance the elements of an ad, direct the attention and facilitate (or impede) the fluency of the scanning. Aim of this study is to test the role of spatial direction (Task a and b) of a represented object and the relative position of text and image (Task b) in the aesthetic preferences of hypothetical advertisements.

Given that different cultures promote different spatial directions, the spatial information has to be contextualized in the culture in order to facilitate the customers' cognitive and perceptive processes. Culturally congruent information is customized to conform to the script of the target's culture in order to facilitate the fluency of the cognitive processing of the given information. Specifically, *cultural congruity* in marketing is achieved at two levels, the content level and the structural level (Luna, Peracchio, & de Juan, 2002). Part of the structural level is the spatial arrangement of the information. This is the object of the present study in which Italian-, Arabic-, and English-speaking participants are compared. Specifically, in the first task participants were asked to indicate which of two mirror images of cars or trains (one rightward and the other leftward moving) they would choose for advertising the object. We hypothesized that preferences be congruent with the direction of the language primarily spoken by the participants, namely rightward for Italian and English-speakers, and leftward for Arabic speakers. The space bias is also thought to be moderated by additional cultural variables, namely the exposure to the writing system (i.e. time used to read in the given writing system and years spent in a country with a given writing system) and the presence of different cultural scripts promoting a specific direction (i.e., driving side). In fact the exposure to experiences involving a specific direction are hypothesized to influence the strength (and the direction) of spatial biases. Therefore, the stronger is the exposure to a specific direction, the stronger is the correspondent bias. In the case of writing the scanning habits are obvious. For the driving side the scanning habits are subtler and consist in the automatic behaviour of scanning the streets before to cross. The driving direction is affecting the scanning of the traffic, namely in Venice or in Barcelona this will involve a first check to the left (were the cars are closer) and a subsequent check to the right (where the cars are more distant), in London or in Melbourne the order of the scans will be inverted. Moreover, as we have seen in Chapter 4, the salience of the

writing system is hypothesized to strengthen the spatial bias. In order to test this latter hypothesis, half of the Australian participants were given verbal and half written instructions.

In the second task participants were asked to rank four advertisements of cars according to their preference. The ads differed only in the spatial arrangement of the elements, namely rightward vs. leftward moving cars and left vs. right positioned text. Again we hypothesized a main effect of object direction congruent with the direction of the language, such that Italian- and Australian-speaking participants would prefer the right-moving, Arabic speaking participants the left-moving care. Moreover, given that images were found to catch the initial attention of the observer more than the text (Rayner, Miller, & Rotello, 2008), we expected the text to be preferred at the right of rightward cars and at the left of leftward cars because this layout facilitates the movement of the gaze from the attention-catching picture to the text.

Study 5: Ads' layout and cultural background

Method

Participants. The same 15 Italian and 13 Arabic participants of Study 1c took part in this study after the completion of the tasks of Study 1c. Forty-nine Australian participants also volunteered for this Study. Given that 12 of them knew a right-left (1 of them) or top-down (11 of them) written language, only 37 participants (54% females, 87% right-handed, average age 22.24) were included in the analyses.

Procedure. The questionnaire was introduced as a study on advertisement. For Arabic and Italian speaking participants the writing direction was primed by the previous tasks they completed (see Study 1c) in which instructions were given in their mother language. Regarding Australian participants, 17 of them were instructed orally and therefore did not receive a prime of writing direction. The other 21 were given written instructions that primed the direction of their language (namely English), identical to those used for the Italian- and Arabic-speaking samples. The data of Australian participants were collected in Melbourne.

In the first task (selection task) participants were shown 4 pairs of photographs of cars and 4 pairs of trains, and asked to choose which car or train of each pair they would select if they were working for an advertising agency ("Imagine to be an advertisement agent. For each pair of cars, please, choose the image that you would prefer"). In each pair of otherwise identical images one was leftward and the other was rightward oriented. The images of each pair were positioned one on top of the other (counterbalanced). The materials were selected through a *Google Images* search using the following criteria: (a) half of the car and half of the train images were originally presented with a rightward, half with a leftward orientation, (b) all gave the impression of being in motion (based on the evaluations of 4 raters), (c) no potentially distracting information (houses, trees, people, etc. were present), and (d) the driver was not visible in the photo. For each image we then produced a mirror image so to have a leftward and a rightward representation of each car and each train. In order to reduce the influence of additional factors, all photos were converted into black and white images. Also, the license plate information was erased as to prevent people from recognizing mirror images as such

In the subsequent task (ranking of ads), participants were presented with four possible layouts of a car advertisement and asked to rank order the ads according to their preference (from 1= first choice to 4= least preferred). Four otherwise identical ads were created showing a car together with 6 lines of Russian-like characters that looked like a text. The car was presented either rightward or leftward directed and the text was positioned either to the right or to the left of the car. The four resulting types of ads were positioned top-left, top-right, down-left, and down-right on a single A4 paper. The position was rotated across participants such that each layout appeared in each

position. Before thanking and debriefing the participants, demographic information was recorded and participants were asked to indicate which languages they were able to read and speak and how often they read/wrote each language during a typical week (Never, Occasionally, Sometimes, Often, Always).

Results

Image selection. A preliminary analysis revealed no reliable differences between cars and trains, so the responses were collapsed. The number of times a rightward car and train (combined, min 0, max 8) was selected was compared in an ANOVA with culture (Australian, Italian, or Arabic) as independent variable. Consistent with our predictions, the participants' native language significantly affected participants' responses, $F(2.63) = 4.27$, $p = .018$, $\eta^2_p = .12$, with Arabic speakers (M= 2.93, SD=1.44) choosing significantly fewer rightward images compared to both Italian (M= 4.67, SD= .98, $p = .036$) and English speakers (M=4.43, SD=2.14, $p = .03$), with no difference emerging between the latter two. Also consistent with the hypothesis, Arabic participants showed a bias congruent with their language direction, namely preferring leftward images, one sample $t(13) = -2.79$, $p = .015$, test value= 4. An opposite pattern was observed for Italian participants who preferred rightward images, again congruently with their language direction, one sample $t(15) = 2.65$, $p = .019$, test value= 4. Although Australian participants showed the same tendency to prefer rightward images, this preference was not as strong and was not statistically reliable, one sample $t(36) = 1.23$, $p = .23$, test value= 4.

We therefore tested two possible factors that might have affected the preferences of Australians participants. The first is a cultural factor. It is possible that the driving habit (namely on the left side of the street) reduced the preference for rightward cars among the Australians. In fact, standing on a sidewalk and facing the street (e.g. waiting for a bus or to cross), the closer car passing on the street is moving in a right to left fashion in Australia, but left to right in Italy. If so, this should affect the preference for rightward moving cars but not for trains. Congruently with this hypothesis, Australians showed a small preference for rightward trains (M= 2.32, SD=1.16, one sample $t(36) = 1.71$, $p = .097$, test value= 2), but no preference for rightward cars (M= 2.11, SD= 1.26 one sample $t < 1$, test value= 2). The second factor that may account for the modest preference of Australians for rightward moving cars is related to the experimental situation. In fact, only 20 Australian participants were primed with the language direction by written instructions. The other 17 received oral instructions. Hypothesizing that reading strengthens the predominant LR trajectory (analogous to writing in Exp. 5), we expected the rightward bias to be stronger among participants that read (rather than listened to) the instructions. Again, looking separately at the preferences expressed regarding the images of cars and trains, after written instructions participants showed a preference for rightward trains (M= 2.50, SD=1.23, $t(19) = 1.81$, $p = .086$, test value= 2), but not for

rightward cars (M= 2.15, SD=1.46, t<1, test value= 2). After verbal instructions, participants' preferences were random for both cars (M=2.06, SD=1.03, t<1, test value= 2) and trains (M= 2.12, SD=1.05, t<1, test value= 2) images. We conclude that both situational and cultural factors should be taken into account and further investigated.

Following the same line of reasoning, a third possible moderator of the bias is testable among participants used to write and read in both directions (i.e., Arabic participants living in Italy), considering in particular their expertise with the written language. For the Arabic-speaking subsample, we therefore correlated the number of rightward selections with the number of years they had lived in Italy and with the frequency with which they used Arabic and Italian in their daily lives. The greater the number of years spent in Italy, the more they tended to preferred the right-moving cars or trains, $r(14) = .61$, $p = .02$. In other words, the more time they had spent in Italy, the more they showed the preference for the right-moving car that we had observed for our Italian participants. Interestingly, spoken language was unrelated to speed judgments, both r's below .13, as was reading/writing of Italian language. The only other variable that exerted a (non-significant) effect on preferences was the frequency with which our participants wrote or read Arabic texts; the more frequently they wrote or read in Arabic, the more they tended to perceive the left-moving car or train as faster, $r(14) = -.42$, $p = .13$. Together, the correlational data seem to be in line with our hypothesis, although statistical power is low due to the small sample size.

Ranking of ads. In order to simplify the data, the first two and the last two preferences were combined, resulting in a dichotomous index of preference. A log-linear analysis in which we included culture (3 levels), direction of car (rightward vs. leftward), and position of the text (to the right or left of the car), was run on the frequencies of the expressed preference (2 levels, first choices vs. last choices). Given that the variable culture did not produce any significant effect, we ran the model including position, direction, and their interaction, controlling for the size of the cultural groups, Y^2 (14)= 4.79, p = .99. Participants showed no particular preference for right- vs. left-moving cars, χ^2 <1. Overall, they preferred the layout in which the text was positioned to the left rather than right, with 59% (vs. 42%) of first choices and 41% (vs. 58%) of last choices, χ^2 (1)= 3.32, $p < .07$, par=|1.83|, z_{cr}=1.65.

A specific analysis on the preferences of the overall layout (χ^2 (3)=7.05, p= .07) showed that the layout with the cars moving rightward toward the right positioned text was clearly preferred over any other layout, with 35 % of the participants indicating this ad as one of the two best (chance value being 25, PAR=2.04); the rightward car moving away from a left positioned text received only the 21% of preferences (PA=-2.78). The ads with the leftward car both received 30% of preferences (Par=.11 for left text and Par= .70 for right text).

Discussion and Conclusion

The preference for the direction of a moving object appeared to be coherent with the direction of the written language. Arabic participants –whose language is written from right to left – were less likely than both Australian and Italian participants –whose languages are written from left to right– to prefer a rightward object over a leftward one. This is consistent with previous findings regarding aesthetic preferences that showed that the preference for a specific direction is coherent with the writing direction (Chokron & De Agostini, 2000; Nachson, 1985; Nachson et al., 1999).

Interestingly, this main effect of language seemed to be moderated by further variables also related to direction. In fact, although Arabic participants overall preferred images of leftward moving cars and trains, in line with the direction of their native language, the magnitude of this leftward bias was negatively related to the number of years spent in Italy and, although to a smaller extent, positively related to the time they spend reading Arabic texts in their daily lives. Similarly, Australian participants showed no reliable rightward bias when evaluating cars, presumably because of the concurrent habit of seeing closer cars moving leftward when approaching a street. These variables can be defined as additional cultural variables and contribute to the bias related to writing habits either strengthening it, such in the case of occurrence of the action (for Arabic participants the frequency of reading Arabic texts) or weakening it, such in the case of exposure to habits promoting an opposite bias (for Arabic participants the years spent in Italy, for Australian participants the driving direction in their country). The effect of the degree of exposure to the writing systems is congruent with previous findings by Dobel and colleagues (2007), who compared the direction used to represent interacting targets among German and Israeli adults and children. The cultural differences among adults were congruent with the direction of writing, with Germans using the rightward and Israelis the leftward vector. However the space bias was absent among pre-school children from both cultures, presumably because they had not yet been exposed to reading/writing experiences.

In the present study, situational factors also appeared to play a role, as suggested by the absence of the bias when Australian participants received only verbal instructions and, hence, the writing direction was not made salient in the questionnaire. Notably, the data, although in the hypothesized direction, are not strong enough to allow a reliable contrast of the two experimental conditions, namely written vs. verbal instructions. In fact the space bias among Australians is not very strong, especially for cars, probably due to driving direction. The comparison between written and oral instructions should therefore be replicated in a country where one direction is consistently promoted, such as in Italy.

The preference for the advertisements in which the car is moving toward the text can be interpreted as the result of the dominance effect of images over the text in the aesthetic evaluation

of the ads (Rayner et al., 2008). After inspecting the image that attracts the participant's attention initially, the eye gaze shifts towards the text portion of the ad, and this movement is facilitated by the congruent direction of the picture, that naturally directs the gaze toward the text. Although this interpretation should be further analyzed with an eye-tracking procedure, it finds confirmation in the theoretical comment of Nielsen regarding web design (1999). According to the author's opinion, the standard position of the menu to the left side of the screen is a poor design element. In fact the users' attention is at first caught by the content (i.e., images and text) of the web page, and only when "the users are done with the content, their gaze could naturally shift to the right to decide where to go next. In contrast, placing the navigation rail to the left requires users to skip over it before they can start scanning the content area." The right positioned text therefore seems a sensitive choice.

Contrary to our predictions, the same layout was found to be preferred in a cross-culturally consistent way, suggesting that the layout is globally appreciated and may therefore be applied in international ads whose target is culturally diversified. However, additional research is needed before this strategy can be proposed to professionals in advertisement and marketing.

The present study also has potential applications to the construction of web sites. According to Internet World Stats (http://www.internetworldstats.com/stats.htm) there are about 1,464 million Internet users (as of July 2008). Moreover, according to Wikipedia (http://en.wikipedia.org/wiki/Global_internet_usage), 295.4 million Internet users are English speakers. This makes English the most used language in the web. We can therefore argue that information is globally available and that English may serve as the standard for constructing websites. However, there are approximately 13.5 million Arabic and 3.8 Hebrew speakers that are users of internet and whose languages are written from right to left. This is particularly relevant for products that need to be promoted at a local level. For example, an archive research on 100 e-commerce websites from the US and from China showed that the layout of the sites is different in the two countries (Lo & Gong, 2005). Specifically, the websites had different navigation models in terms of direction, with Chinese websites favouring a top-down direction of navigation and American websites equally using left-, top- or centre-oriented navigations. As the authors noted, the top-down preference in Chinese web sites mirrors the writing direction of their language. It is therefore important to take cultural differences into account when promoting a product. In fact, the cultural differences in aesthetic preferences found in the present study have important practical applications, as the direction of a promoted object should be taken into account in marketing studies and in the construction of advertisement. One may conclude that the design of advertisements should find a balance between global validity and cultural congruity, with particular attention to the customers at which the ad is targeted.

Chapter 6: The Spatial Agency Bias in Politics

The political terms of *rightwing* and *leftwing* originated from a practical matter of spatial organization during the French Revolution. It was in 1789 when the king of France called the Estates General, and the liberal deputies of the Third Estate sat to the left of the president, whereas the nobility sat to the right side. From there on, rightwing has been synonymous of a conservative political attitude, and leftwing of liberalism. The step from the distribution of bodies in space to a metaphorical representation of political ideology was short and *la gauche et la droite* are now much more than mere spatial coordinates. This spatial origin is here revived.

Although the abstract meaning of rightwing and leftwing is well known, the historical origins of the two terms are rarely acknowledged. In this chapter, I want here to return to the spatial origins of political definitions in the context of the Spatial Agency Bias. In fact, a possible spatial representation coherent with the historical origins of rightwing and leftwing is proposed here, hypothesizing an association of political right (and left) with physical right (and left), albeit of a different sort. Particularly, in the case of leftwing and rightwing, the association between the abstract concept and its sensory-based origins is constantly activated by its signifiers, namely the two words that are used to indicate the political attitudes: right<u></u>wing and left<u></u>wing. The two signifiers are in fact a case of polynoms, as they have multiple meanings, namely the abstract sense of political ideology and the physical sense of spatial positioning. However, the fact that two different concepts partially share their signifiers could be completely irrelevant. It is well possible that the historical origin of the terms is lost in the memory of people and that the original association becomes completely extraneous in everyday life. In this case, speaking of politics should be a space-free argument, especially if left and right are not mentioned at all, for example when the political positions (in this case metaphorical) are addressed with specific names (e.g. Conservative vs. Liberal party) rather than with *rightwing* and *leftwing* labels that linguistically recall spatial information.

On the contrary, it is also possible that politics is not a space-free concept and that rightwing and leftwing are associated with spatial positions, albeit in a somewhat different way than the origins of the terms would suggest. If we simply apply the original spatial arrangement of rightwing and leftwing parties as it can still be found in the parliaments of many modern democracies, we would expect that the rightwing parties are envisaged to the right, the leftwing parties to the left. A very different prediction can be derived from the SAB if one assumes that members of rightwing parties are seen as possessing (stereotypically masculine) traits such as dominance and dynamism whereas those of leftwing parties are seen as more communal and caring. To our knowledge there is not much literature about the stereotype content of political membership. However, previous

research has shown that leftwing orientation is associated with Openness and Agreeableness (Caprara & Barbaranelli, 1999), whereas rightwing orientation is associated to Dominance and Conscientiousness (Caprara & Barbaranelli, 1999; Caprara, Barbaranelli, Consiglio, Picconi, & Zimbardo, 2003). Although this research addressed the actual personality of voters or of politicians and not the stereotype content, we can deduce that political stereotypes mirror to some extent the actual content of personality of politicians. We therefore expect rightwing politicians to be stereotypically perceived as more agentic and less communal than leftwing politician. This is specifically tested in Study 7a.

Assuming that the concept of agency can, indeed, be applied to politically defined targets, with rightwing target perceived as more agentic than leftwing targets, this would provide good reasons to hypothesize a spatial bias in politics. Given that stimuli presented with a rightward vector are associated with agency, we would expect that also the attribution of political attitude will be influenced by the direction of the target person (facing rightward vs. leftward). Thus, if a rightwing political attitude is associated with agency and if agency is associated with the rightward vector (as suggested by the SAB model), then, by extension, people and parties of rightwing political persuasion should be envisaged facing rightward.

However, there is an alternative possibility that can be derived from the ingroup bias literature. It is well-known that people are strongly motivated to maintain a positive image not only of themselves but also of the groups they are affiliated with. We also know that people generally value communion more than agency when judging others, but they greatly value agency when it comes to themselves (Abele & Wojciszke, 2007). If this reasoning also applies at a group level, then we might expect that people will perceive their own group, including the political party they are affiliated with, as more agentic than a relevant comparison outgroups. Following this reasoning, one may hypothesize that, regardless of political affiliation, will judge their own parties as more agentic and, as a consequence, envisage them in a rightward fashion.

Thus, one may advance two alternative hypotheses, one predicting that rightwing party members are seen as the stereotypically more agentic group and, hence, be associated with the rightward vector (stereotype-driven spatial bias), the other predicting that people will perceive their own party as more agentic and, hence, envisage their own party with the rightward vector (ingroup-driven spatial bias).

Furthermore, the spatial bias is analyzed in an off-line situation, namely when the linguistic cue (rightwing and leftwing) is not present as a stimulus and political parties are identified through the content of their description (e.g., orientation to social vs. individual goals) rather than thorugh the labels. We expect the concepts of conservative political attitude (namely rightwing) and liberal political attitude (namely leftwing) respectively associated with right and left spatial representation

even when the way they are addressed to does not directly refer to spatial information for two possible reasons:

-the first reason is that the association is thought to be present at a metaphorical level as part of the embodied meaning of the two concepts;

-the second reason is that the left-to-right trajectory is present as culturally promoted track that is used to guide the representation of concepts defined in terms of agency.

In sum, aim of the present work is to investigate the stereotype content of politics and its relation with the spatial bias at both the individual and the group level. Being political orientation hypothesized to be stereotypically defined in terms of agency, with rightwing attitudes associated to stronger agency than leftwing attitude, agency is examined as a possible key characteristic in the spatial bias in politics (Study 6a). Moreover, the spatial bias is proposed as a possible manifestation of the political ingroup bias (Study 6a). We further investigated whether the spatial direction that characterizes a social target affects the subsequent attribution of political attitudes, defined as leftwing or rightwing political orientation. In particular we examined whether this bias is present when the target is a single person (Study 6b and 6c) and a group (Study 6c).

Study 6a: Political stereotypes and spatial representations

Aim of this first study was to investigate the stereotype content of political membership and the spatial representation of political groups. Specifically, we hypothesized that people ascribe higher levels of agency and lower levels of communion to rightwing than to the leftwing politicians. This hypothesis was tested asking participants to evaluate typical leftwing or rightwing politicians on an agency/communion scale. The two groups were defined with a brief description of their political program without using any label related to spatial information (e.g., rightwing or leftwing). The second aim of the study was to test a possible role of spatial information in the identification of political groups. Therefore participants were asked to match the two described groups with two visually represented groups. The represented groups varied according to the number of member that were facing rightward or leftward. In one group the majority of the members was facing leftward, in the other rightward. We hypothesized that the predominant direction of the group would affect the choice of participants. Two alternative hypotheses were advanced regarding the effect of spatial representation on participants' choice, namely a stereotype driven spatial bias or an ingroup-driven spatial bias. According to the first hypothesis, the right (vs. left) facing group would be more likely chosen as the rightwing (vs. leftwing) group. According to the second hypothesis participants' political orientation would affect both the attribution of agency/communion and the spatial bias, such that participants would attribute greater agency to the group matching their own political attitude and that they would identify the rightward facing group as representing their own political affiliation. This final hypothesis can be defined as an ingroup bias, considering that agency is a desirable characteristic for the self (Abele & Wojciszke, 2007).

In sum, two alternative hypotheses were tested:

- Hyp. 1. In line with the idea of a stereotype-driven spatial bias, I hypothesized that rightwing politicians (a) are perceived as more agentic and (b) are more likely to be associated with a rightward spatial representation than leftwing politicians.
- Hyp. 2. From an ingroup bias perspective, I predicted that participants will (a) attribute greater agency and (b) a righward representation to their own political group.

Method

Participants. Fourty-seven Italians, 16 males, 29 females and 2 who did not specify their gender, with a mean age of 27.11 years (ranging from 18 to 56) volunteered for this study.

Procedure and stimulus material. Participants were approached by a female experimenter and asked to fill in a questionnaire titled "The faces of politics". Participants were informed about the existence of two political parties in Croatia. Without ever mentioning "right-" vs. "left-wing", one of the parties, called "Lista Unita" (United List), was described as "mainly interested in economic

issues, the stock market, and the economic and financial development of the country, thus adopting policies to foster the competitiveness and economic interests, rather than the social realm". The other, called "Democrazia Sociale" (Social Democracy), was described as "paying great attention to environmental protection, to the integration of immigrants into society, and to inter-culturalism, and as being oriented towards social welfare". For simplicity, we will from now on refer to the two parties as right- (the more competitive and economy-oriented) vs. left-wing (socially oriented). For half of the participants, the right-wing group was mentioned and described first, for the other half the order was reversed.

A cover story explained participants that the study was investigating if members of a group look alike because people within very cohesive groups tend to mimic each other. Participants were then shown 2 groups of people who were supposedly members of the same political party and asked to indicate the membership of each group (United List and Social Democracy). Each group was composed of photos of four male actors. The photos, all with a neutral emotional expression, were taken from the KDEF (Lundqvist et al., 1998) collection and pre-tested for attractiveness. To avoid any spatial bias during pilot testing, the pretest was conducted on fully facing photos. First, a sample of 12 participants (6 males and 6 females) rated the attractiveness of a large sample of photos. Photos were admitted to the final material only when they had been rated as moderately attractive, that is with values between 4 and 5.6 on a 7-point scale (from 1 = beautiful to 7 = ugly). Subsequently, the pictures meeting the above criterion were pre-tested for perceived agency (frenetic vs. calm, dynamic vs. static, fast vs. slow, and active vs. passive) and dominance (strong vs. weak, dominant vs. submissive, powerful - mighty vs. fragile, vulnerable vs. invulnerable) on a sample of 24 participants (11 males and 13 females, mean age 24.88, SD=2.86). Photos were included in the final material only if agency and dominance fell in the intermediate range of the 7-point scale, that is between 3.3 and 4.7. The final material consisted of 8 male faces and 8 female faces of similar attractiveness (males = 4.93, females = 4.90), agency (males = 4.00, females = 4.10), and dominance (males = 4.38, females = 3.80). To construct the final material, we selected the left- and the right-oriented profile of each of the persons selected during pretesting. We then produced a mirror image of each photo so as to obtain 2 left-oriented (the original left-facing and the mirror image of the right-facing photo) and 2 right oriented photos (the original right-facing and the mirror image of the left-facing photo) of each person. In this way, four photos were available for each of the 8 actors: the original photo facing right, the original foto facing left, plus the two mirror images of the originally right- and left-facing photos. The 8 actors were randomly assigned to two groups that were composed by three (one) rightward profiles and one (three) leftward profiles (see Fig.7). The presentation order of the two groups was counterbalanced. Half of the questionnaire contained only original faces, the other half only mirror faces. Participants were randomly assigned to the eight questionnaire versions.

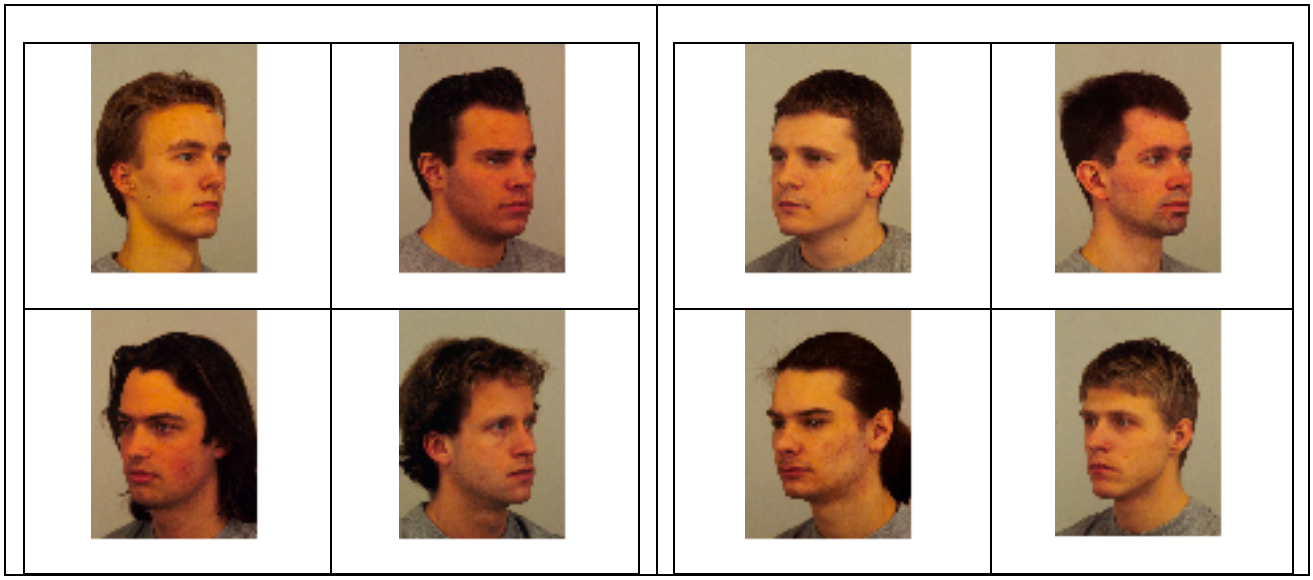


Fig.7: Example of layout of profiles of the rightward (to the left) and leftward (to the right) groups used in Study 6a.

After the inference of political affiliation of the groups, participants responded twice to the agency scale used in Study 1b and reported in Appendix 1. On the first scale the targets to be compared were a leftwing and a rightwing politician. Participants where instructed to indicate if the presented characteristics better described a rightwing or a leftwing politician in general ("Indipendentemente dalla tua affiliazione politica, per favore indica con una crocetta se le seguenti caratteristiche descrivono meglio un generico politico di destra o di sinistra"). In the second scale the targets were a member of the group *Social Democracy* and a member of the group *United List.* The scales endpoints were counterbalanced. Participants also indicated the extent to which a definition of agency (adapted from Abele et al., 2008) was more descriptive of a leftwing or rightwing politician (4 point scale). As a manipulation check participants indicated the political affiliation (namely rightwing vs. leftwing) of the two described parties. Finally participants indicated demographic information (age, gender) and their political affiliation (on a 100 mm left-rightwing continuum, whose poles were counterbalanced).

Results

Manipulation check. As expected the large majority of participants (over 90%) correctly identified the group described as socially oriented as a leftwing political group and the group described as economy-oriented as a rightwing group. From now on, we will therefore refer to the two groups simply as right or leftwing group. Participants who failed to identify the two groups in line with our intentions (N=8) were excluded from the analyses.

Spatial Bias. The hypothesis that a rightwing political group is more likely to be associated with a rightward spatial representation than a leftwing political group was not confirmed. In fact, only 17 (i.e. 44 %) participants indicated the right facing group as the rightwing group (χ^2 =.64, df=

1, p = .423). However, in line with the ingroup bias hypothesis this effect might be the result of the imbalance of the political affiliation of our participants who were mainly leftwing oriented (M=36.3, t (39)= -2.70, p = .01, one sample t-test with 50 as test value). In order to test the possible moderating effect of political affiliation of our participants on the spatial bias, two groups of participants were created: the leftwing oriented participants (M<50, N=24) and the rightward oriented participants (M>50, N=24). Seven participants did not indicate their political attitude and were excluded from the analyses. This split variable of political affiliation and the categorical variable of the spatial bias were analyzed in a saturated log-linear model. Again, the main effect of spatial bias was not significant (χ^2<1). Similarly, the difference between the number of rightwing and leftwing-oriented participants was not significant in the model (χ^2<1). However the interaction between political affiliation and spatial bias (χ^2(1, 36)=6.39, *p* = .012, parameters estimated |2.42|> $1.96_{z.crit}$) showed that the rightward group was more likely to be assigned to the own political party. Therefore, rightwing participants assigned more often the rightward group to the rightwing party rather than to the leftwing (N=10, 67%) and leftwing participants assigned more often the rightward group to the leftwing party rather than to the rightwing (N=16, 76%). This result can be interpreted as a spatial ingroup bias, with the rightward direction being the most desirable for the ingroup. The analysis of the data according to the in-group bias clearly showed that people indicate the rightward group as their ingroup (F=26, 72%, χ^2=7.11, *p*=.008). This tendency is identical among male (73%) and female participants (73%).

Agency attribution. We further hypothesized a difference in attributed agency to right and left wing politicians. Given the high correlation between the scale attributing agency to a general politicians and the scale attributing agency to a politician from the described groups (r=.87, N=39 *p* = .0001) the two measures we merged together in a average score for each sub-scale. Altogether the attribution of communion (M=3.43, t (46)= 4.51, *p* = .001, α= .75) and power (M= 4.62, t (46)=6.45, *p* = .0001, α= .65) confirmed that a rightwing politician is thought to be more agentic and less communial than a leftwing politician (Test Value = 4, with high vs. low values indicating the attribution of the dimension to the rightwing vs. leftwing politician). However the two groups do not differ in competence (M= 3.96, t (46)<1, α= .93) and dynamism (M= 4.02, t (46)<1, α= .90, without the item "static" that was negatively correlated with the scale).

The third hypothesized effect was an ingroup bias in the attribution of agency, namely we expected participants to attribute more agency to the political group they belong to. Four t-tests using as grouping variable the split political orientation showed that the attribution of communion, power, competence, and dynamism differed between leftwing and rightwing oriented participants ($|t_s|$>1). Each dimension was generally attributed to the ingroup. The exception was attribution of

communion to the rightwing politicians and the attribution of power to the rightwing politician by both right- and left-wing participants. See Table 8 for further details.

Communion		Power		Competence		Dynamism	
Leftwing Participants	Rightwing Participants	Leftwing Participants	Rightwing Participants	Leftwing Participants	Rightwing Participants	Leftwing Participants	Rightwing Participants
M = 3.09	M= 3.76	M= 4.49	M=4.91	M=3.43	M= 4.63	M= 3.65	M= 4.54
t (24)= -5.14, *p*= .001	t (15)=-1.18, *p*= .26	t (24)=4.28 *p*= .001	t (15)=4.83, *p*= .001	t (24)=-4.31, *p*= .001	t (15)= 2.80, *p*= .014	t(24)= -2.14, *p*= .044	t (15)= 2.23, *p*= .04
t (38)= 2.43, *p*= .02		t (38)= -2.0, *p*= .05		t (38)= -4.9, *p*= .0001		t (38)= -3.17, *p*= .003	

Leftwing attribution: values < 4
Rightwing attribution: values > 4

Table 8: Attribution of agency/communion to left- and rightwing politicians from left- and rightwing participants

Finally, we tested a link between the agency attributed to the ingroup politicians and the ingroup-driven spatial bias. The scores of the 4 sub-dimensions of agency/communion were therefore recoded in order to have high values corresponding to the attribution of the dimension to the ingroup. The only dimension that was related to the ingroup-driven spatial bias was competence. The more participants attributed competence to their ingroup the more they envisage it in the rightward oriented group, r (40)= .385, p =.014.

Discussion

Although the spatial bias failed to emerge as a main effect, thus disconfirming our first hypothesis based on the idea of a shared stereotype, the selection of the rightward group as the group matching participants' own political attitudes is indicative of the use of spatial information to express a political ingroup bias. The emergence of an ingroup bias was probably also facilitated by the way the study was presented to the participants. In fact the instructions explicitly stressed the group situation, presenting the two political groups as cohesive and distinct groups. This presentation probably made the participants' own political membership salient facilitating group processes such as ingroup bias. In fact, an group bias was found for the attribution of agency and communion. Although, in general, the rightwing politician was perceived as more powerful and less communal than the leftwing politician, participants attributed more competence to the politician of their own political party. Probably the attribution of power and communion is specific to the stereotype of politics, therefore participants attributed these dimensions according the stereotype content. In contrast, competence may a dimensions that is less specific to the stereotype content referring to politicians and therefore more subject to ingroup favouritism. Although to our knowledge the content of political stereotypes has not yet been systematically studied, the hypothesis that power and communion are the fundamental dimensions is consistent with the description of Lakoff of the Nation-As-A-Family metaphor (Lakoff, 1995). According to the author, the Nation can be described with the metaphor of the family, in which the government is

represented by the parents and the citizens by the children. Rightwing conservative politics is described as a Paternalistic Family, whereas the Nurturant Parent Model is the base of liberal leftwing politics. Interestingly the two family models differ in terms that are very similar to agency and communion. In fact, the Partenalistic Family hypothesized by Lakoff matches the strict father model, with characteristics such as being strong, self-disciplined, strict, authoritarian, and unemotional. These characteristics mainly express high power and low communion. On the contrary, the Nurturant Parent Model promotes values such as being careful, supportive, emotionally connected to others, self-sacrificing, in other words communal. The two types of family have political consequences that clearly reflect their respective political orientation, with the Paternalistic Family supporting strong military and criminal justice system, while opposing feminism, homosexuality and the Nurturant Parent Model supporting social programs, business regulation, environmentalism, feminism, gay rights, multiculturalism, and affirmative action.

Competence does not appear in Lakoff's metaphor model, and indeed our participants used them to differentiate ingroup and outgroup rather than leftwing and rightwing. Interestingly the ingroup bias in the attribution of these two dimensions matched the ingroup bias expressed with the use of spatial information. In fact participants were likely to select the rightward group as the ingroup and simultaneously reinforced this bias with the attribution of competence to the ingroup. In the present study therefore space is mainly used to express ingroup favouritism, leaving open the question whether spatial information is specifically associated with politics.

Study 6b: Is right- (vs. left-) ward right- (vs. left-) wing?

The present study explores the hypothesized association between the spatial representation (i.e., the direction of the target's profile) and the perception of the political attitude of a target person. Given that in the previous study the group situation was favouring ingroup biases, which indeed emerged as the overwhelming effect in the use of spatial information, we addressed the issue in the next study at the individual level, maximally reducing the salience of participants' political attitude in the completion of the task. The study was introduced with a minimal preamble about the same political groups described in the previous study. However, this time participants were asked to guess the partisanship of individual target persons that were presented in pictures either facing left or right (from the observer point of view). We expected targets whose face profile is rightward oriented to be more strongly associated to a rightwing political attitude than left-oriented targets.

Method

This study was conduct as part of the Master Thesis work of Laura Torresan, in collaboration with Luciana Carraro.

Participants. Ninety-six Italians, 41 males and 55 females, with a mean age of 26.02 years (ranging from 18 to 58) volunteered for this study. Of the 96 participants, 44 were students and 52 were employed. None of the participants was left-handed.

Procedure and stimulus material. Participants were asked to volunteer for a questionnaire study. Similarly to Study 1, the two political groups "Lista Unita" (United List) and "Democrazia Sociale" (Social Democracy) were described in counterbalanced order. Participants then viewed 8 close-up photos, either portraying all male or all female targets. However, different from the previous study, the photos were not presented as a group but as single persons. The photos were selected following the procedure of Study 7a. Importantly, 4 of the 8 faces were three-quarter profiles facing left, the remaining 4 facing right. Thus, within target gender, two versions were created so that the same target person that appeared in a left-orientation in one version, appeared in a right-orientation in the complementary version. Also, half of the participants saw only original (right- or left-facing) photos, whereas the remaining participants saw only mirror images. Thus, gender of target and original vs. mirror image was varied between participants, whereas facial orientation (left- vs. right facing) was varied within participants.

In a forced choice procedure, participants were asked to indicate for each photo whether the person belonged to the "socially oriented" or to the "competitive and economy-oriented" party. Data were coded so as to obtain two scores for each participant: the number of times they assigned a right-facing person to the right-wing (vs. left-wing) party and the number of times they assigned a

left-facing person to the right-wing (vs. left-wing) party with both scores varying from 0 to a maximum of 4. For half of the participants we also assessed political orientation at the end of the questionnaire (from 1 = left to 15 =right). Participants were then thanked and fully debriefed.

Results

A preliminary ANOVA involving original vs. mirror photo as an additional factor showed that this variable played no role either in itself or in interaction with the remaining variables. This factor was therefore dropped from the analysis. The main analysis consisted of a 2 (participant's gender) x 2 (target's gender) x 2 (order of presentation of the two parties) x 2 (orientation: right-facing vs. left-facing) ANOVA in which the last variable represents a within-participants factor. Two effects emerged, namely a main effect for gender of participant and a main effect for orientation that was not modified by any interaction with other variables. Compared to women (M = 1.88, s.d. = .06), men (M = 2.08, s.d. = .07) showed a greater overall tendency to assign targets to the right-wing party, $F(1,88) = 4.57$, $p = .035$, $\eta^2_p = .05$. More importantly, right-facing targets (M = 2.32) were more frequently assigned to the right-wing party (and less frequently to the left-wing party) than left-facing targets (M = 1.59), $F(1,88) = 17.96$, $p < .001$, $\eta^2_p = .17$. Comparing these means to the chance value of 2, one-sample t-tests indicate that right-facing targets were assigned to the right-wing party more frequently than would be expected by chance, $t(95) = 3.52$, $p = .001$, whereas left-facing targets were assigned to the left-wing party more frequently than would be expected by chance, $t(95) = -4.31$, $p < .001$, lending full support to our hypothesis. The results were not affected by participants' political affiliation.

Discussion

The obtained results support the hypothesized relation between spatial representation and assigned political attitude at a person level. The spatial bias is interpreted in terms of agency, namely a rightward oriented target is more likely to be thought as rightwing oriented because perceived as more agentic than a leftward oriented target and therefore associated with the political group that is stereotypically more agentic, namely the rightwing group. However this relation is only hypothesized, but not explicitly investigated in Study 6b, therefore the activation of agency by rightward target stimuli was directly tested in Study 6c.

Study 6c: Agency and spatial bias in politically defined single and group targets

Aim of Study 6c was to replicate the results of Study 6b at a person perception level and to investigate a possible relation between rightward direction and agency. Moreover the relation between of space and politics is investigated at a group level. Given that the group-level investigation in Study brought ingroup favouritism processes rather than stereotypically matching representation, we tried to investigate the group level without strongly involving participants in the group situation. Namely, we created two political groups, but we individually presented the members in order to minimize the probability of participants' identification with them. In sum, we hypothesized that a rightward target person is more likely to be perceived as politically rightwing oriented than a leftward target person. We also hypothesized that a group whose members are mainly rightward oriented is perceived as more agentic than a target group whose members are mainly leftward oriented. Finally, we expected that a rightward (vs. leftward) group is more likely to be associated to a rightwing (vs. leftwing) political attitude.

Method

This study was conduct as part of the Master Thesis work of Laura Torresan, in collaboration with Luciana Carraro.

Participants. Thirty-two Italians, 16 males and 16 females, with a mean age of 27.78 years (ranging from 18 to 65) volunteered for this study. All participants reported to be right-handed.

Procedure and stimulus material. Participants were approached by a female experimenter and asked to participate in a study on "visual perception and impression formation". They were then seated in front of a computer and asked to view 16 faces (8 males and 8 females), presented one at a time at the centre of the screen. Photos (11 cm x 15 cm) were presented a first time in random order and remained visible for 200 ms, followed by a 1500 ms interval (blank screen). The same series of photos was then presented for a second time for 100 ms each, followed by a blank screen that remained visible for 500 ms. Thus, exposure time was chosen so as to allow participants to identify the stimulus as a face and, importantly, to perceive the spatial orientation of the face, but without being able to observe facial characteristics or expressions in detail.

The photographic material was taken from the same pool and selected on the basis of the same pretest as that of Study 6a. Four photos were available for each target person: the original photo facing right, the original photo facing left, plus the two mirror images of the originally right- and left-facing photos. Each participant saw 16 photos, 8 portraying female, 8 male targets, of which half were presented right-facing, half left-facing. Also, half of the participants saw only original photos, half only mirror photos (between-participants variable). Original vs. mirror image represented a mere control variable that was not expected to moderate our main hypothesis.

Importantly, we added a green or blue frame to each photo, thereby creating two groups. One group consisted of a majority of people facing right-wards (6, including 3 males and 3 females) and a minority of people facing left-wards (2, including one male and one female), whereas facial orientation was reversed for the other group (6 left-wards and 2 right-wards). To avoid bias due to a specific collection of photos, two versions were randomly created. Also, frame colour was counter-balanced across participants so that either the blue or the green group consisted of a majority of target people facing right-ward. To be able to form an impression of the groups, each participant saw the same series of slides twice. They then responded to three dependent measures. They first rated the two groups comparatively on a series of traits (e.g. which is more dominant?), they then indicated which of the two groups (blue or green) was more likely to represent a left- or right-wing party, and finally they rated the likely political opinion of each target person, this time providing individual ratings without considering the person's membership in the blue or green group. Participants also provided demographic information (gender, age) and indicated their political orientation on a scale from 1 (left) to 15 (right). At the end of the experiment, participants were thanked and fully debriefed.

Dependent variables. Participants responded to three dependent variables, namely trait attributions, group-based party assignment, and individual party assignment.

Group-based trait attribution. The first task consisted of comparative ratings of the two groups on 32 different traits referring to the four dimensions of Power (α= .55), Dynamism (α= .50), Communion (α= .68), and Competence (α= .69) used in Study 7a and reported in Appendix 1. For each trait, participants were asked to provide a comparative rating, indicating which group (blue or green) possesses the trait to a greater degree from 1 (definitely the green/blue group) to 8 (definitely the blue/green group). The scale endpoints were counterbalanced so that 1 was either associated with the blue and 8 with the green group, or vice versa.

Group-based party assignment. The second dependent variable assessed which of the two groups was more likely to be perceived as a right vs. left-wing political party. Just as in Study 7b, participants were informed that the photos they had seen represented people belonging to two political parties, one called "Democrazia Sociale" (Social Democracy) and described as focussing on issues such as environmental protection, integration of immigrants, social welfare etc., the other called "Lista Unita" (United List) and described as mainly concerned about economical issues, the stock market, and the economic and financial development of the country. The order of mentioning of the two parties was counter-balanced. On two separate items, participants were then asked to indicate which of the two groups represented the "socially oriented" (e.g., 1 = definitely blue, 2 = probably blue, 3 = probably green, 4 = definitely green) and, subsequently, which represented the "competitive and economy-oriented" party. The order of the two questions was counter-balanced, as was the scale (with either the blue or the green group to the left end of the scale). Responses to

the two items were exactly complementary (r = 1), so we only analyzed one of the two items, namely which of the two groups was seen as the right-wing ("competitive and economy-oriented") party. Responses were scored so that low scores (1 and 2) indicated that the left-facing group was seen as right-wing and that high scores (3 and 4) indicated that the right-facing group was seen as right-wing. Thus, the higher the scores, the stronger the right-facing group was associated with the right-wing ("competitive and economy-oriented") party.

Individual party assignment. The final dependent variable consisted in having participants judge the likely party membership of each target person. For this reason, all the photos were shown once more, but this time without the blue or green frame. Each pictures appeared on the screen for 300 msec, followed by a screen representing, on white background, the scale that participants were to use for their responses. Indeed for each photo, participants were asked to press one of two different keys on the keyboard: 1 = social oriented or 8 = competition oriented, depending on whether they thought the person belonged to the left- or the right-wing party. Again, the spatial layout of the scale was varied so that half of the participants had to press 1 for the socially oriented group, and 8 for the economy-oriented group, whereas the endpoints of the scale were reversed for the remaining half of the participants. Responses were coded so that higher values indicated a higher likelihood of belonging to a right-wing party. For each participant, four party assignment scores were calculated, one for right-facing male targets, one for left-facing male targets, one for right-facing females, and one for left-facing females, each varying from a minimum of 0 to a maximum of 4, with 2 representing chance.

Results

Group-based trait attribution. We first analyzed to what degree participants attributed Dynamism, Power, Warmth, and Competence to groups composed of a majority of left- vs. right-facing members. Responses ranged from 1 to 8 with higher values indicating that greater Dynamism, Power, Communion, or Competence were attributed to the right-facing rather than left-facing group. Using one-sample t-tests, we compared means with the scale midpoint of 4.5 representing chance level, hence indicative of absence of spatial bias. Results showed that, on the average, participants attributed greater agency (M=4.78), t(30) = 1.99 p = .055 and greater dominance (M=4.87), t(31) = 2.86, p = .008, to the right-facing group than would be expected by chance. In contrast, they attributed more warmth to the left-facing group than would be expected by chance (M=3.95), t(31) = - 2.95, p < . Competence ratings (M=4.63) did not differ from chance level. Thus, in line with our hypotheses, right facing targets were judged as more dominant and agentic, but less warm than left facing faces, but both were perceived as equally competent.

These results were not affected by the political opinion of the participants, as evidenced by non-significant correlations between political opinion and Dynamism, Power, Communion, and

Competence ratings (all p's > .22). We also controlled whether the trait ratings were influenced by any of the additional variables, using independent t-tests. None of the four subscales (Dynamism, Power, Communion, and Competence) was influenced by participant gender (all p's > .41) or by the color (green vs. blue) assigned to right- vs. left-facing group (all p's > .34). As far as original vs. mirror images were concerned, only Communion, but none of the remaining ratings, was influenced by this factor, with Communion ratings being higher for the original (M = 4.38) than for the mirror images (M = 3.52) t(30) = 2.52, p = .02. The reasons for this result remain unknown at this point, but a look at the means suggests that the difference between original and mirror images in triggering Communion judgments is only a matter of degree. Indeed, both values were below the scale midpoint suggesting that, as a tendency, left-oriented faces induce greater warmth ratings, regardless of whether they are original or mirror images.

Group-based party assignment. The second dependent variable consisted of the identification of likely party membership of the two groups, on a scale from 1 to 4 with higher values indicating that the predominantly right-facing group was associated with the right-wing group. A look at Figure 1 supports this idea, considering that there was a 59 : 41 percent chance that the predominantly right-(rather than left-) facing group was assigned to the right-wing party, but the distribution of responses was not found to differ from chance (chi2) nor were the participants' mean responses (M = 2.63) found to differ reliably from the scale midpoint of 2.5 (one-sample t-test). Thus, Hypothesis 2 was not supported. Also, group-based party assignment was unrelated to the participants' political orientation, r(32) = -.09, p = .62. The only trait attribution related with the bias was the attribution of power r(32)= -.36, p= .045. Contrary to our hypothesis, the more the rightward group was perceived as powerful, the less it is indicated as rightwing oriented. Interestingly, this effect is present only among rightwing participants (r(17)= -.642, p = .005) and not among leftwing participants (r (15)= .10, p=.71).

Individual party assignment. For each participant, we had calculated four scores referring to the average political party assignment (from 1 = definitively belonging to left-wing party to 4 = definitively belonging to right-wing party) for right-facing male targets, left-facing male targets, right-facing female targets, and left-facing female targets. A 2 (gender of participants) x 2 (gender of target) x 2 (orientation: right-facing vs. left-facing) ANOVA with repeated measures on the last two variables revealed three significant effects. First, on the average male targets (M = 2.17) were more often assigned to the right-wing party than female targets (M = 1.75), F(1,30) = 5.08, p = .03, η_p^2 = .15. Second, and most importantly, a strong and reliable main effect for facial orientation indicates that right-facing targets (M = 2.34) were more likely to be assigned to the right-wing party than left-facing targets (M = 1.58), F(1,30) = 24.29, p < .001, η_p^2 = .45. One-sample t-tests, comparing means to the scale midpoint, showed that right-facing targets (M = 2.34) were more likely to be assigned to the right-wing party than would be expected by chance (2), whereas left-

facing targets were more likely to be assigned to the left-wing party than would be expected by chance.

Finally, the direction effect was modified by gender of target, $F(1,30) = 4.74$, $p = .038$, $\eta_p^2 = .14$. For right-facing targets, there was no difference between males (M= 2.37) and females (M 2.31) in party assignment, $t(31) = -.26$, n.s.. In contrast, left-facing targets were much more likely to be assigned to the left-wing party when they were females (M = 1.19) rather than males (M = 1.97), $t(31) = -3.04$, $p = .005$. Also, the difference between right- and left-facing targets was stronger in the case of female targets (M = 2.31 vs. M = 1.19,), $t(31) = 5.64$, $p < .001$, than it was in the case of male targets (M = 2.38 vs. M = 1.97,), $t(31) = 1.60$, $p = .12$.

Discussion

Replicating the results of Study 6b, rightward target persons were more likely to be perceived as politically rightwing oriented than leftward target persons. More importantly, there is evidence for a direct relation between the direction of a social target and its perceived agency. In fact, a group whose members are mainly rightward oriented is perceived as more agentic than a group whose members are mainly leftward oriented. However, at group level the spatial bias - although in the predicted direction- failed to reach the standard level of statistical significance. Given that the task of political assignation to the group was done after the trait rating, it is possible that the delay between the presentation of the pictures and the task was too long and the direction of the group members was not salient anymore. An unexpected and puzzling negative correlation between power and rightwing attitudes attributions to the rightward group was found only among rightwing participants. This effect is contrary to our expectations and it is the only relation found between agency/communion attribution and stereotype-driven political spatial bias. The interpretation of this effect is not clear. However, given that the effect is present only with one dimension and only among rightwing participants we can hypothesize that it is not systematically related to the hypothesized process that relates agency attribution to spatial bias. In sum, this study confirmed the spatial political bias at the individual level leaving open to future research the investigation of the spatial bias at the group level. The challenge for future research is to find a methodology that stresses the group level allowing the emergence of the bias, but that simultaneously reduces the salience of participants' partisanship and the subsequent process of ingroup bias.

Conclusion

Right and left indicate both a spatial and a political position; they are therefore polysemous, namely words with more than one meaning. Specifically they are metonymically polysemous they share one part of their meaning, in fact, rightwing was used to identify those political figures that displayed their ideology through a spatial position, which in turn became the ideology itself: the left wing position became the leftwing political attitude and the right wing position became the rightwing political attitude. This class of words is thought to have an advantage in tasks such as word recognition because they activate multiple semantic representations (for a recent review on the advantage effect of polysemous words see Klepousniotou & Baum, 2007). If these words simultaneously activate all their meanings, it is possible that the relation between politics and space is the mere resultant of this multiple semantic activation. However, in the present set of studies we avoided to ever mention the two words right- and leftwing. The political positions were defined only by the content of their description. We can therefore claim that the relation between right/left in politics and spatial representations found in Study 7b and 7c is more likely to be due to the mental representation of the two concepts rather than due to pure polysemy. Our results are more consistent with the embodiment theory, according to which the association between right/left in space and politics is the effect of the embodied mental simulation of the political attitude. The origin of this simulation may be historical, linguistic, or metaphorical. A historical origin, namely the association between the position of politicians in the French parliament in 1789 and their political ideology is, in our opinion, very unlikely. In fact people hardly know about it and it has never been experienced. The linguistic origin consists in a chronic association between political and spatial features due the labels commonly used to indicate both positions. The association can be so deeply grounded to be present even when the labels right and left are not used. This origin is more plausible, however, it can hardly explain the use people made of space in Study 6a. In fact, space was used to favor the ingroup, associating it with the agentic spatial trajectory. Moreover a linguistic explanation does not clarify the relation between agency attribution and spatial bias. We can therefore either suggest that the ingroup-driven Spatial Bias that emerged in study 6a is something distinct from the stereotype-driven Spatial Bias, that emerged in study 6b and c, or we suggest the metaphorical explanation. According to Lakoff "we think by metaphors", even more "we live by metaphors" (Lakoff, 1986, 1992, 1995; Lakoff & Johnson, 1980). Similarly to the Embodiment Theory, the Theory of Metaphor suggests that we understand abstract concepts through metaphors typically taken from the concrete realm. This system of metaphorical concepts, connecting the abstract level with the physical or embodied level, is very pervasive in our cognition. Sometimes we are aware of our use of metaphors, sometimes we are not, but we systematically use

them to understand reality. The metaphor that Lakoff proposed to explain politics is based on different types of families. Simplifying we can say that one family is focused on the stereotypical role of the father and the other of the mother (Lakoff, 1995). In fact the characteristics that distinguish the two families are very similar to the characteristics that distinguish the stereotype content of males and females. Rightwing politics is therefore the strict, powerful, and dominant father. Leftwing politics is represented by the caring, supportive, and emotional mother. This use of the family metaphor simplifies political differences as differences in agency/communion that are associated to specific spatial representations. One may even wonder whether it was by pure chance that the conservatives sat on the right and liberals to the left. Maybe yes, but it may not be by chance that the point of view chosen to describe the spatial positions is the one of the king and not the one of an external observers!

To conclude, what ever its origin, the association between spatial and political position is relevant in terms of applied psychology, including specifically the field of political communication. In fact, if the signifier promotes a coherent and concrete spatial representation (left or right) of the abstract concept (leftwing or rightwing) it will be meaningful to consider this "natural" communication in term of political campaigns in order to avoid incongruent messages. Finally, in the present set of studies the spatial representation has been studied as a direction (rightward vs. leftward), however spatial positions are also relevant in political debates, specifically when two politicians are confronted. In situations such this, one politician is positioned to left and the other to right, both facing the audience. Relative positions could therefore be relevant in political debates as spatial positions can be interpreted as political positions, affecting the interpretation of the content of politicians' speeches. This hypothesis should be tested in future researc

Conclusions

In the present research project the Spatial Bias was analyzed for the first time from a social psychological perspective. In reference to Chatterjee (2002), we have proposed the existence of a SAB (Spatial Agency Bias) according to which, in left-to-right writing cultures, agentic targets are envisaged to the left of non-agentic counterparts, with the action evolving from left-to-right. Agency is defined in the model in terms of stereotype content; in fact it represents one of the basic constructs used to characterize social groups. The relation between the spatial dimension and stereotypes was overall confirmed, yet it was often of small magnitude. This is in line with other findings in this research area. For instance, gender biases in portrait orientation generally become visible only when analyzing very large samples of artworks. Throughout this project many factors have been individuated as possible moderators of the bias, namely stable factors such as culture (Study 1c and 5) and temporary factors, such as the exposure to predominantly right- vs. leftward oriented stimuli (Study 2d), to written vs. oral instructions (Study 5), the activation of culture-consistent vs. inconsistent directional motor actions (Study 4) or the exposure to alternative scanning habits in street crossing (Study 5), beliefs regarding gender roles (Study 2d and 4 and 6c) and agency (Study 2c and 6a), characteristics of the target such as its dynamism (Study 3b and c) or the type of behaviour performed by the target (Study 3a). This list of moderators, being by no mean exhaustive, illustrates the fragility of the bias and provides evidence for its malleability. This lack of strength, although annoying from a researcher's point of view, is reassuring from an applied perspective. As argued by Anjan Chatterjee (personal communication) it would be dysfunctional for survival if the human mind were rigidly programmed to only perceive actions with a specific trajectory or to systematically associate certain social groups with specific spatial positions. Given that our experience is constantly embedded in space, a stable and pervasive SAB would not allow us to interact flexibly with our physical and social environment. As a consequence, the subtlety of horizontal spatial bias is not only unsurprising, but also functional.

Brief discussion of the findings

As a first step, the symbolic representation of targets with socially relevant characteristics was explored at the encoding level in Chapter 1. In the first study of the chapter the analysis of symbolic representations of single targets confirmed the hypothesized spatial bias. Italian participants chose to represent targets described as agentic mainly with a rightward trajectory. This symbolic representation was confirmed in the second and third studies where Italian participants were asked to represent pairs of interacting persons and where agency was investigated in its sub-dimensions, power (e.g., strong vs. weak) and dynamism (e.g. fast vs. slow). In general, the highly agentic target was represented at the rear of the arrows symbolically indicating the origin of the action. This confirms the active role suggested by agency. Moreover, dynamic targets were associated to rightward arrows and powerful targets to downward arrows; communal and competent targets were associated to respectively horizontal and vertical arrows, but the direction was not consistent across the two studies. Altogether the three studies of Chapter 1 confirmed that stereotype contents are mapped onto spatial dimensions when participants are openly asked to do so.

The use of spatial features was further investigated in more spontaneous representations in Chapter 2. In the first two studies of Chapter 2 archival analyses of web images representing couples confirmed that the SAB is pervasive in the representation of gender. The couple Adam and Eve is represented with Adam to left of Eve in the 62% of the cases. This result is interpreted as the consequence of gender stereotypes, according to which the male, Adam, is the agentic partner of the couple. In order to rule out possible effects of naming order (*Adam and Eve* is much more common than *Eve and Adam*), couples identifiable with a single name were analyzed. Cartoons were the perfect candidates for this exploration, as famous couples are often referred to by the family name. We therefore analyzed the images representing The Simpsons, The Flinstones, and The Addams with a Google-Image research. Given the particular characterization of these families we pre-tested the difference in agency between the male and the female in each couple, hypothesizing that the SAB would only emerge for couples that match widely held stereotypes. In line with these predictions, the results confirmed the SAB, with the male being positioned to the left of the female partner, but only when the male was perceived as more agentic than the female (i.e. only for the Addams family… surely not for the Simpsons!). These archival investigations showed a spontaneous use of spatial information to represent social targets.

In order to further test the application of the bias to gender stereotypes, a different and more controlled methodology was implemented for Study 2c. Pairs of mirror images of male and female face profiles where presented to Italian participants who were asked to indicate which of the two mirror profiles of the pair was the original. The study confirmed the SAB, namely participants

generally indicated the rightward profile as the original one and this bias was stronger for male than for female targets. Moreover, the study ruled out the possibility of an effect of hemi-facial differences in expressivity in the spatial bias. In fact participants were not able to correctly individuate the original face profile. Although participants were not openly asked to do so, the use of spatial information was probably encouraged by the fact that spatial direction was the only characteristic that distinguished the two images. The task was possibly enhancing the bias in an artificial way, a limit that was overcome in the subsequent study.

Study 2d analyzed the use of spatial information in the categorization of male and female profiles, in a way that spatial information were completely irrelevant to the task. Nevertheless, Italian participants processed spatial features. In fact, gender categorization was facilitated for rightward profiles of males and for leftward profiles of females (Study 2d, control condition). This result is inline with the agency hypothesis and shows that the bias is present even when it is not useful for performing the task. Study 2d addressed two additional important issues. The first issue is represented by the consequences of the SAB. Specifically the effect of a biased performance was found to be related to both stereotyping and ambivalent attitudes toward males and females in general. The more Italian female participants associated male and females targets to respectively a rightward and leftward direction (what we define a stereotypic bias), the more they attributed power to males and communion to females and the more endorsed ambivalent attitudes on a subsequent questionnaire.

Importantly, in this study we had also varied the proportion of left- vs. right-oriented profiles participants were exposed to, finding that this reliably affected the performance in the categorization task. When mainly exposed to rightward male (and leftward female) profiles, participants displayed a stereotypic bias, that is a more accurate processing of rightward male and leftward female profiles. On the contrary, when mainly exposed to leftward male profile (and rightward female profiles), participants displayed a counter-stereotypic bias, that is a more accurate processing of leftward male and rightward female profiles. In other words, the exposure to unbalanced proportions of leftward and rightward oriented images of male and females targets affected participants' bias in the categorization task. This, in turn, affected stereotyping and ambivalent attitudes. To our knowledge, this is the first time that the social consequences of the spatial bias are investigated. These consequences are particularly pertinent in our society where the exposure to oriented images of women and men is all but equal. As shown in the art-history literature (see Introduction), men are more often represented showing a rightward profile compared to women. This unbalanced exposure has important implications for the maintenance of gender differences related to attribution of stereotypical characteristics. In line with this hypothesis is the result in the control condition, where participants' performance was characterized by a stereotypical bias although they were exposed to an equal number

of rightward and leftward profiles of male and female targets. Thus, in the control condition, the participants' responses reflect a pre-existing, not an experimentally induced bias.

The second issue addressed in the study regards the stability of the bias. The effect of exposure to an over-proportional number of images of rightward male or rightward female targets on the SAB suggests that it is susceptible to contextual variables. The stability of the bias was further challenged in Study 4, with an oriented writing exercise that was either in line with or opposite to normal scanning habits. Given that writing direction is one the causes of the bias indicated in the literature (see introduction for further details), we tested how persistent its influence was. Consistent with previous literature (Chokron & De Agostini, 2002), a directed motor activity affected the bias, such that rightward moving targets were selected as more masculine after a rightward writing exercise. After a leftward exercise (which went counter the habitual writing direction), participants' no longer displayed a spatial bias. Therefore motor activity can interfere with a pre-existing bias either reducing or strengthening it[6]. An interesting implication deriving from this study is that even subtle features of the experimental task may affect the magnitude of the SAB (and possibly other phenomena such as inhibition of return and representational momentum), such as whether instructions are given in a written or oral format or whether participants respond in handwriting or by pressing a computer key. In fact, if the momentary actions of writing or reading are able to activate the direction and therefore strengthen (if in the same direction) the bias, we would expect the bias to be stronger when participants a) read (e.g. the instructions to the task) and b) write something (e.g., their responses). Unfortunately, the role of visual scanning (reading) or motor action (writing) is confounded in Study 4 because participants could read while performing the writing exercise. Although preliminary evidence for the role of reading came from Study 5 in which Australian participants displayed a preference for rightward objects only after reading (vs. listening) the instructions to the task, a more systematic analyses should better investigate this issue, disentangling visual and motor habits.

The results concerning the cross-cultural comparisons confirmed the hypothesis of a moderating role of exposure to different writing/reading styles. In fact, the Arabic speakers who participated in our research, failed to show an opposite pattern (Study 1c), although their preference for rightward representations was definitely smaller compared to Italian (Study 1c and 5) and Australian (Study 5) participants. This is interpreted as resulting from exposure to both Arabic and Italian culture, given that Arabic readers were all immigrants currently living in Italy. Moreover, Arabic readers' preference for leftward moving objects was negatively related to the number of years they spent in Italy and positively related to the time they usually spent reading Arabic texts. These

[6] However it fair to note that the lack of a control group not performing any writing exercise reduces the validity of this interpretation.

results are in line with the effect of exposure found in Study 2d and in the previous literature (Maass & Russo, 2003; Padakannaya et al., 2002).

Further partial support for the importance of contextual factors emerged in the lack of spatial bias among Australians when evaluating cars. Although Australians displayed a weak preference for rightward motion when evaluating trains, this preference was completely absent when judging cars. This effect may derive from the exposure of Australians to an opposite scanning habit, namely the habit of scanning the street before crossing it. Before crossing, the wiser thing to do is to check first the closer lane and afterwards the farer lane. Given that in Australia cars are driven to the left of the street, in order to check the closer lane we have to turn right and than we move leftward to check the farer lane. This movement is hypothesized to create a leftward scanning habit opposite to the rightward one related to writing/reading. The presence of two opposite scanning habits may weaken the spatial bias in a similar way as the exposure to two writing systems weakens the bias among Arabic participants.

Taken together, these results sustain the hypothesis that behavioural habits promote spatial schemas coherent with the action, resulting in spatial biases. The embodied character of the bias is further analyzed in Chapter 3. In fact, if the bias is related to bodily actions, targets that are more strongly related to activity should enhance the use of the spatial schema. In Study 3a, this possibility is explored varying the type of action Italian participants were asked to categorize. Only when the action was communicating higher levels of activity (i.e. aggressive behaviour rather than friendly behaviour), the spatial schema was applied, and the image was processed with greater ease when the agent was positioned to the left of the recipient. Similarly, in Study 3b Italian participants preferred cartoons in which the agent was positioned to the left of the recipient only when the drawings were communicating dynamic actions (moving vs. still images). In this case, right (rather than left-) moving athletes were evaluated as more active. Surprisingly, they also evaluated left -(rather than right-) ward oriented athletes in a resting position as more dynamic. An unexpected result was also the easier categorization of leftward oriented athletes (independent of motion) found in Study 3d. These latter two results were puzzling and confirm the idea that the bias is fragile and susceptible to contextual causes often of difficult identification.

In the final set of studies, the SAB was applied to the field of politics, showing an association between spatial rightward (or leftward) and political rightwing (or leftwing). This association was very clear at the individual level, with rightward (vs. leftward) oriented targets being perceived as rightwing (vs. leftwing, see Study 6b and c). Consistently with the Agency Hypothesis, rightwing politicians are also perceived as overall more agentic than leftwing politicians (Study 6a). At a group level, the pattern is more complicated with the rightward direction being indicated as describing the political group matching participants' own political affiliation when group membership was stressed

in the introduction to the study (Study 6a). This ingroup-driven political spatial bias was related to the competence and dynamism ascribed to the ingroup, namely the more the political ingroup was perceived as dynamic and competent the more it was associated with the rightward representation. In Study 6c group membership salience was reduced as much as possible. Although rightward groups were perceived as more agentic, the agency-based political spatial bias was not statistically reliable. Additional research is therefore needed to further investigate the agency-driven political spatial bias at a group level.

Although the number of studies in the projects is too small to perform a meta-analysis, for descriptive purposes, Table 9 reports the major results of the studies of the present research project divided by type of instruction and response. Overall, the Spatial Bias was found in about half of the studies in which was tested (8 out of 16). For Spatial Bias, I mean the bias revealing an advantage of the rightward direction or left position (specified in the column Type of Bias of Table 9), independent of the characteristics of the target (e.g. the main effect of direction found in Study 2c in which rightward profiles were chosen more often than leftward profiles). With Spatial Agency Bias I mean the bias for targets defined by high agency (e.g. the interaction between direction and target gender found in Study 2c in which rightward profiles of male targets were chosen more often than rightward female profiles). The Spatial Agency Bias was found in the majority of the studies that tested it (14 out of 16) and always in concurrence with the Spatial Bias, confirming Chatterjee's hypothesis about a key role of agency in the Spatial Bias (2002). Table 9 also reports the type of instructions and responses. In line with the hypothesis that writing/reading action may work as a proximal cause of the bias (see Study 4 and Study 5), in 6 (out of 8, with one case involving Arabic participants) studies in which the bias was not fully confirmed either the instructions or the responses were not written. Naturally this hypothesis needs a more systematic analysis.

Study	Spatial Bias	Spatial Agency Bias	Type of Bias	Written Instructions	Written Responses
1a (Italians)	✓	✓	Direction	✓	✓
1b (Italians)	✓	✓	Direction & Position	✓	✓
1c (Italians)	✓	✓	Direction & Position	✓	✓
2a (web-sites)	–	✓	Position & Direction	–	–
2b (web-sites)	×	✓	Position & Direction	–	–
2c (Italians)	✓	✓	Direction	✓	✓
2d (Italians)	×	✓	Direction	✓	×
3a (Italians)	×	✓	Position & Direction	✓	×
3b (Italians)	×	✓	Position & Direction	✓	✓
3c (Italians)	×	✓	Direction	×	✓
3d (Italians)	×	×	Direction	✓	×
4 (Italians)	×	✓	Direction	✓	×
5 (Italians)	✓	–	Direction	✓	✓
5 (Australians)	✓	–	Direction	✓	✓
6a (Italians)	–	✓	Direction (ingroup bias)	✓	✓
6b (Italians)	–	✓	Direction (politcs)	✓	✓
6b (Italians)	–	✓	Direction (politcs)	✓	×
1c (Arabic)	×	×	×	✓	✓
5 (Arabics)	✓	–	Direction	✓	✓

Table 9: Spatial Bias and Spatial Agency Bias across the studies. The ✓ symbol means the presence and the × symbol means the absence of the effect.

Limits and Future directions

The present research project, although addressing many issues related to the SAB, can be considered as a first step in the understanding of the phenomenon from a social cognition perspective. Additional research is desirable to solve the many questions left unanswered by the presented studies. First of all, the role of cultural background should be investigated avoiding the participation of immigrants, whose cultural background is multiple. It would be desirable to conduct such studies in the country of origin of right-to-left writing individuals, preferably involving only participants who are unfamiliar with foreign languages written from left-to-right. Also studies involving pre-school children or illiterate participants could offer some answer to the role of writing/reading habits in the bias. Second, the bias as expression of position or direction should be disentangled. In many situations (e.g., interactive scenes), the two are intrinsically linked such that position often gives away information about the likely direction of the action. Third, the role of handedness was not addressed at all in the present project, in spite of its potential relevance because of the different motor actions while writing, with right-handed writers performing an outward and left-handed writers an inward movement. Given that outward movements are generally easier, the rightward direction matches the easier direction only in right-handed persons. This may lead to a stronger fluency effect in right-handers compared to lefthanders when performing a rightward action. In turn, this ease in the performance could influence the corresponding spatial bias. Fourth, the role of motor or visual activity should be disentangled. Fifth, the neuropsychological underpinnings of the bias (completely "neglected" in the present work) and its relation with the moderators identified in this project need a systematic investigation. Finally, the social consequences of the bias represent one of the most relevant findings of this project and open an entire new field of research, involving the analyses of personality characteristics related to stereotype endorsement (e.g. dogmatism, authoritarianism, open-mindedness), of situations that promote spatial bias (e.g., death salience) and of stereotyping of and attitudes toward both male and female participants that may derive from the systematic and repeated exposure to spatial bias.

Implications

In my opinion, the SAB may have a number of interesting implications. First of all, although the bias is of small magnitude, it may play a subtle role in different areas involving images, such as films or news reports. For example, Study 5 illustrates possible implications of spatial layout in advertising. Although we have no data to support this idea, it is possible that film or theatre directors inadvertently construct scenes so that the more active or stereotypically more agentic character is placed to the left of the receiving end of the action. Also, news reports may be biased so as to favor one of two opponents (for example in male-female interactions) in terms of implicit agency or to convey political affiliation through spatial features. As a case in point, there are historical documents that testify to the fact that German military reporters showed German soldiers almost exclusively with a LR trajectory, as ordered by the Ministry of Propaganda in Nazi Germany (reported in Reitz' famous historical TV serial "Heimat"; see Buchmann, 2006). Thus, it remains to be seen whether spatial arrangements in films, news reports etc. are systematically related to stereotypic beliefs or, possibly, to the intention to make one party or the other appear more active or more influential.

Second, artistic production may well reflect socially shared stereotypes with painters and photographers placing the more agentic person to the left. The idea that artwork reflects social beliefs is by no means new. Just like social psychologists, art historians often interpret religious iconography as reflecting longstanding stereotypes. Interestingly, art historians often acknowledge the fact that differences between social categories may be exaggerated for the sake of the composition. As a case in point, Clifton (1999) who has analyzed Masaccio's *Expulsion from the Garden of Eden* underlines the artists' use of the principle of *contrapposto* both in gesture and anatomy of the subjects that are part of the pictorial composition. This principle of *contrapposto* as evident in pictorial representations of Adam and Eve appears quite similar to the psychological opposition of agentic-instrumental vs. communal-expressive characteristics associated with males and females as originally proposed by Bakan (1966). In other words, pictorial representations such as Masaccio's and psychological theorizing such as Bakan's agree in assigning women characteristics such as passivity, modesty, and shame that are placed in opposition to the active and secure behaviors of males. Our research suggests that one subtle way to communicate differential agency in artwork lies in the spatial arrangement and that the exposure to such subtle communications may have important consequences in term of stereotyping and self-stereotyping.

Third, given the effects of self-stereotyping, one may hypothesize that self-presentations are not immune to the SAB. For example, it is conceivable that individuals with highly agentic self-concepts choose to present themselves to the left, facing right. First evidence comes from a study by Nicholls, Clode, Wood and Wood (1999) in which participants, regardless of gender, presented their

left cheek when asked to pose for a family portrait and their right cheek when posing as scientists. It is therefore plausible that actors engage in particular spatial positioning in line with their self-stereotyping. Although we are not aware of any study investigating spatial arrangements of more than one person, it is conceivable that similar left-right symmetries may occur, with people preferring to be presented to the left of others if they want to display a high degree of agency.

At this point, one may wonder whether spatial arrangements such as those reported here really matter. Are observers sensitive to variations in R vs. L positioning? As far as portrait direction is concerned (see Nicholls et al., 1999) there is tentative evidence that observers form impressions that are in line with the (presumed) sitters' intention, considering that right-oriented portraits are rated as more "scientific" (and presumably less emotional) than left-oriented ones (ten Cate, 2002, Study 2). Another research that speaks more directly to the implicit agency of L vs. R-oriented action, has recently been conducted by Maass, Pagani, and Berta (2007). These authors found that Italian speakers perceived the same athletic performance (a soccer goal) as stronger, faster, and more beautiful if presented with a LR rather than RL trajectory. Participants also interpreted aggressive film scenes as more violent and more harmful to the victim when shown with a left-to-right trajectory. In Study 2d the consequences of the SAB were directly analyzed for the first time bringing providing first evidence for critical implications for social cognition. Thus, there is first evidence that observers may not only be sensitive to but also influenced by the implicit meaning of different spatial arrangements.

Overall we can conclude that the SAB is subtle but persistent and that people should mind the direction they take!

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Appendix 1: Differential semantic scale of agency/communion used in Study 1b, 1c, 2d, 6a, and 6c.

Twenty-two couples of adjectives were selected from the sample of adjectives reported in Suitner and Maass (2008). The selected couples were rated as the most agentic and most communal and were semantically opposite of each other, with valence controlled across couples. The 22 couples were arranged in a semantic differential and pre-tested, with 40 participants each evaluating 11 pictures (e.g. a train, a face, a sportsman) on the semantic differential. A factorial analysis over the 440 judgments showed that the adjective pairs formed three main factors, explaining 55,68% of the total variance. The three factors are interpreted as power, dynamism, and communion. The first 4 couples of each sub-dimension were finally used in the questionnaire. The sub-dimension of competence did not emerge in the among the factors. However, given that the material was built after a study (Suitner and Maass, 2008) focusing on a theoretical model in which competence was not included (Abele, 2003; J.T. Spence et al., 1974), we decided to add 4 pairs of adjectives in order to cover the fourth dimension, namely competence. The resulting set of adjectives are:

- debole-forte (weak-strong), possente-fragile (powerfull-fragile, recoded), sottomesso-dominante (submissive-pushy), invulnerabile-vulnerabile (unbeatable- vulnerable, recoded) for the dimension of power;
- statico-dinamico (static-dynamic), frenetico-fermo (energetic-quiet, recoded), passivo-attivo (passive-active), veloce-lento (fast-slow, recoded), for the dimension of dynamism;
- caldo-freddo (warm-cold, recoded); scorbutico-espansivo (detached-convivial), aggressivo-dolce (aggressive-friendly), estroverso-scontroso (outgoing-introverted recoded), for the dimension of communion;
- intelligente-stupido (smart-stupid, recoded), incapace-capace (unskilled-skilled), incompetente-competente (incompetent-competent), for the dimension of competence.

Appendix 2: Responses to the agency/communion, Ami and ASI scales of Study d, Chapter 2.

TARGET	Dimension	Alpha T1	Alpha T2	Mean T1	St. Dev. T1	Mean T2	St. Dev. T2
MALES	Power	α= .60	α= .54	4.73	0.90	4.11	0.97
	Dynamism	α= .57	α= .67	4.46	0.75	5.04	1.11
	Warmth	α= .68	α= .47	4.06	0.61	3.96	0.60
	Competence	α= .79	α= .81	4.55	0.72	5.25	1.28
FEMALES	Power	α= .59	α= .34	3.52	0.88	3.32	0.51
	Dynamism	α= .44	α= .62	5.01	0.82	5.29	1.10
	Warmth	α= .61	α= .67	5.01	0.80	4.82	0.89
	Competence	α= .83	α= .85	5.29	0.89	5.57	1.19
SELF	Power	α= .75	α= .40	3.86	0.81	3.75	1.04
	Dynamism	α= .77	α= .65	5.12	0.87	5.11	0.99
	Warmth	α= .70	α= .65	5.30	0.76	4.93	1.11
	Competence	α= .13	α= .79	5.48	0.80	5.64	0.86
	Hostile Sexism	α= .85	α=.85	3.01	1.07	3.13	0.96
	Benevolent Sexism	α= .76	α=.74	3.75	0.85	3.72	0.88
	Hostile Ambivalence	α= .78	α=. 63	4.09	0.87	4.08	0.89
	Benevolent Ambivalence	α= .70	α=.70	3.32	0.87	3.30	0.87

Chronbach's alpha, means and standard deviations of the subscales measuring stereotype endorsement.

Brief Comment

Congruently with gender stereotypes, participants attributed more power, paired samples t (53)=6.31, *p* =.001, and less communion to males than females (paired samples t (53)=-4.90, *p* =.001). Participants also attributed less dynamism (paired samples t (53)=-3.36, *p* =.001) and competence (paired samples t (53)=-7.29, *p* =.001) to males than to females. Participants also attributed more dynamism (paired samples t (53)=4.57, *p* =.001), competence (paired samples t (53)=6.16, *p* =.001), and communion (paired samples t (53)=10.53, *p* =.001), but less power (paired samples t (53)=-4.43, *p* =.001), to themselves than to males. The patterns described until-now are very similar among male and female participants. On the contrary, the comparison between females and the self are moderated by participant gender, with female participants attributing all the characteristics but dynamism (t<1) more to themselves than to females in general, t_s (46)>1 and p_s<.05. Whereas male participants attribute the characteristics to a similar extent to themselves and to females in general, t_s(6)<1. However given the small number of male participants (i.e., six) comparisons between genders are not reliable.

Appendix 3: Direction activation exercise used in Study 4.

Vocal Instructions: Please, copy the letter you find to the side of the line throughout the whole line moving in a rightward (leftward) direction.

In Table below are reported examples of letters to be reproduced in a leftward direction (to the left) or in a rightward direction (to the right).