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The influence of a verticality metaphor in the processing of happy and sad faces

L'influence de la métaphore de verticalité sur le traitement des émotions faciales de gaieté et de tristesse

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Abstract

The present research focuses on the verticality metaphor that distinguishes happy and sad emotional concepts in mental representation, and its influence on the recognition of facial expressions for these emotions. Study 1 showed that people represent happiness and sadness concepts higher and lower in space, respectively. Study 2 extended these findings to the spatial representation of facial expressions of emotions. Given the prominence of this conceptual mapping, a congruent spatial positioning was predicted to facilitate the recognition of mild facial expressions of happiness and sadness. As predicted, Study 3 found reduced recognition times for spatially congruent presenta-

Résumé

Notre recherche s'intéresse à la métaphore de verticalité qui distingue les concepts émotionnels de gaieté et de tristesse à travers leur représentation mentale et à la reconnaissance de leur expression faciale. L'étude 1 montre que l'on représente la gaieté et la tristesse comme étant situées plus haut et plus bas dans l'espace, respectivement. L'étude 2 étend ces résultats à la représentation des expressions faciales. En raison de l'importance de cette métaphore, nous nous attendions à ce qu'un positionnement vertical congruent facilite la reconnaissance des expressions faciales (modérées) de gaieté et de tristesse. Appuyant cette hypothèse, l'étude 3 montre une réduction du temps de reconnaissance

Key-words
Metaphorical thinking, grounded cognition, facial emotions, gender

Mots-clés
Pensée métaphorique, cognition incarnée, émotions faciales, genre

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tions of these facial expressions. However, the effect was present for female participants only. Study 4, a replication of the second study, showed that women but not men display the happy-sad vertical positioning. The contribution of the present findings is discussed in the context of gender difference, simulation theory, and polarity argument.

des expressions faciales émotionnelles en position congruente. En revanche, l'effet n'apparaît que chez les femmes ayant participé à l'étude. L'étude 4, similaire à la deuxième étude, révèle que les femmes, mais pas les hommes, manifestent le positionnement vertical attendu de la gaieté et de la tristesse. Les résultats obtenus dans nos études sont discutés à la lumière des différences de genre, de la théorie de la simulation et de l'argument de polarité.

How do people mentally represent emotional experiences? This question is far from trivial because concepts are used in most acts of cognition, from thinking and reasoning to perceiving objects (Niedenthal, 2008). Traditionally, that is, for semantic network theories, appraisals theories or prototypes theories, emotional knowledge is assumed to be represented in some abstract form. According to this amodal perspective, bodily experiences of emotional states are transduced into amodal symbols representing emotional knowledge (Niedenthal, Winkielman, Mondillon, & Vermeulen, 2009). Over the last decade, however, a growing number of researchers have challenged the traditional view. These scholars stress the embodied nature of (emotional) knowledge and, more generally, hold that cognitive processes are rooted in bodily interactions with the world. This new perspective has been called grounded cognition or embodied cognition.

The embodied perspective of emotions

The embodied cognition is a heterogeneous research program in cognitive science. It posits that the body plays a central role in shaping the mind (Wilson, 2002). Although this perspective comprises a number of theories, two of them prevail in the field of social cognition and emotions, namely, Barsalou's (1999, 2008)

simulation theory and Lakoff and Johnson's (1980) conceptual metaphor theory.

Simulation theory is grounded in a neuropsychological background and holds that concept representation involves simulation (a partial reactivation at neuronal and physiological levels) of modality-specific states acquired during experience (e.g., the yellow colour or the sweet taste of a banana). With regard to emotions, emotional modality-specific states such as posture, gesture or sensation would represent the content of emotional concepts and cognitive processing about emotions would involve a partial reactivation of these states (Niedenthal, 2008). Several findings support this view. For instance, generating words related to pride or disappointment can induce congruent bodily posture (Oosterwijk, Rotteveel, Fischer, & Hess, 2009). Another example is that people tend to mimic automatically others' facial emotions (see Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005). As a matter of fact, preventing participants from engaging specific facial muscles can impair the processing of facial emotions involving these muscles (Niedenthal, Brauer, Halberstadt, & Innes-Ker, 2001; Oberman, Winkielman, & Ramachandran, 2007).

Conceptual metaphor theory is rooted in cognitive linguistics and holds that abstract knowledge is structured and understood through metaphorical mappings involving experiential concepts (concepts emerging directly out of experience). Metaphorical mappings (i.e., the so-called conceptual metaphors) can operate on-line to influence cognitive and affective processes. For instance, thinking about time often involves spatial experience (time is space, e.g., "this is *behind* us" or "we attended a *long* concert") and changing the way we grasp space can influence the way we grasp time (see, for instance, Boroditsky, 2000).

This metaphorical perspective seems most suitable for emotions because emotional concepts are abstract and elusive (Crawford, 2009) and the language of emotions is replete with metonymies and metaphors (e.g., "I'm in a *dark* mood"; see Kövecses, 2000; Ortony, 1988; Ortony & Fainsilber, 1989). According to Lakoff (2012), emotion conceptual metaphors mainly arise from physical correlates of emotions. For instance, skin temperature and blood pressure increase in angry people and these bodily experi-

ences are the basis for the emergence of an "anger is heat" metaphor. Supporting this view, Wilkowski, Meier, Robinson, Carter and Feltman (2009) found that the processing of anger cues is facilitated when the concept of heat is primed by related words or pictures.

As it appears, simulation theory and conceptual metaphor theory share roughly the same idea: (emotional) knowledge is grounded in bodily experiences. However, two differences deserve to be noted (Landau, Meier, & Keefer, 2010; Winkielman & Kavanagh, 2013). Firstly, simulation theory describes an intraconceptual mechanism (e.g., a specific interoception of heat for representing anger) whereas conceptual metaphor theory suggests an interconceptual mechanism (e.g., anger and heat are two different concepts linked by a metaphorical mapping). Secondly, metaphorical effects are thought to be unidirectional (an experiential concept is relevant for understanding an abstract concept, not the reverse) whereas simulation effects may be bidirectional (but see Eskine, 2013; Turner & Fauconnier, 1995).

Aim of the present research

Our research aimed to test the conceptual vertical mapping of happiness and sadness for emotional representation and facial emotions processing. We chose to mostly rely on the metaphorical rather than simulation view. This is because we were not directly interested in testing bodily simulation assumptions posited by the simulation approach. Rather, our goal was to examine the existence of a mapping of the happy and sad emotions onto a verticality dimension. When people ordinarily talk about happiness and sadness, they often mention vertical cues, e.g., "I'm feeling down/up", "he was over the moon", or "I'm on the top of the world" (Kövecses, 2000). According to Lakoff and Johnson (1980), verticality underlies the differential representation of happiness and sadness by way of a spatial mapping: "happy is up" as opposed to "sad is down". This conceptual mapping presumably arises from physical correlates of happy and sad emotional states (Lakoff, 2012). It is likely grounded in bodily experiences such as a straight versus dropping posture or a higher versus lower visual attention (e.g.,

LaFrance & Mayo, 1978; Meier & Robinson, 2006; Niedenthal, 2007).

This kind of vertical representation was examined in the past for the concept of valence/affect ("positive/I like is up" versus "negative/I don't like is down"). For instance, Meier and Robinson (2004) found that congruent locations facilitate the evaluation of valenced words. More recently, Ansorge, Khalid and König (2013) found that subliminal space prime words (e.g., up or down) facilitate the evaluation of valenced words.

Surprisingly, however, no research to date has provided experimental evidence revealing the influence of *vertical metaphors* on how people think about and process *happy and sad* emotional concepts and, further, recognize facial expressions. Of importance, although emotion recognition is an automatic, efficient, and fast process (Tracy & Robins, 2008), it is likely to be influenced by several top-down factors such as prior knowledge (e.g., Bijlstra, Holland, & Wigboldus, 2010). More generally, recent research also shows that top-down processes may impact on the perceptual integration of facial features (Hugenberg & Corneille, 2009; Michel, Corneille, & Rossion, 2007, 2010). Based on this prior literature, we deemed it reasonable to hypothesize that such top-down effects may also result from the metaphorical representation of happiness and sadness (e.g., for a related demonstration on anger and heat, see Wilkowski et al., 2009).

Studies overview

We first sought to examine the existence of a verticality metaphor in the *mental representation* of happiness and sadness as communicated in both lexical (Study 1) and configural (Study 2) emotional materials. Then, we predicted that this metaphor would influence the speeded *recognition* of happy and sad facial expressions (Study 3). Finally, we examined the role of gender as potential moderator for the spatial-emotional representation (Study 4).

Study 1

No experimental research to date has confirmed the vertical mental representation of happy and sad emotional concepts. Therefore, Study 1 sought to secure experimental evidence for the existence of a happy/sad vertical mapping by means of a written representation task. Participants were given two terms denoting these emotions and asked to write/draw them and, inevitably, locate them on a sheet of paper. In order to prevent any bias related to the alphabetical order of the terms, we created two versions of the study, a first one with the terms "happiness" and "sadness" ("gaieté" and "tristesse" in French) and a second one with the terms "happiness" and "grief" ("gaieté" and "chagrin" in French). We expected to observe a congruent positioning of happiness and sadness/grief written words.

Method

Participants and design

Fifty-seven (eight men) psychology students from the Catholic University of Louvain (UCL), aged 18 to 22, took part in the study. The study relied on a 2 (version: happiness/sadness or happiness/grief) x 2 (emotional word: happiness or sadness/grief) x 2 (order of the emotional words in instructions: happiness and sadness/grief or the reverse) mixed design with repeated measures on the second factor. The version and order factors were not associated with any main or moderating effects in our analysis and will not be discussed further.

Materials

Participants were handed a sheet of paper. On the first side of the sheet were the instructions and on the other side was a frame (13.90 x 13.90 cm).

Procedure

Participants were told that the study examined creativity. They were randomly assigned to the different conditions (from 12 to 16 participants per condition). Participants were instructed to write the happiness and the sadness/grief words within the

frame, trying to highlight their respective meaning and their mutual relation. After reporting their gender and age, participants were debriefed.

Results and discussion

The dependent measure was the distance (cm) between the middle of the written word and the lower side of the frame. Four participants did not follow the instructions (they wrote a text, or wrote the words out of the frame, or wrote the words more than once) and were excluded from the analysis. A one-way ANOVA testing the effect of emotional word on the distance revealed a significant difference, $F(1,49) = 204.99$, $p < .001$, showing that happiness was written higher ($M = 10.06$ cm, $SD = 2.03$) than sadness/grief ($M = 2.92$ cm, $SD = 2.50$). The effect size was large, partial $\eta^2 = 0.81$, Cohen's d corrected for dependence between means = 2.86 (Cohen, 1977; Wolf, 1986). Moreover, happiness was positioned significantly higher than the middle of the frame, $t(52) = 11.16$, $p < .001$, Cohen's $d = 1.53$, whereas sadness was placed significantly below the middle of the frame, $t(52) = -11.74$, $p < .001$, Cohen's $d = 1.61$. Complementary analyses revealed that the font size difference was also significant: happiness was written bigger than sadness, $p < .001$, partial $\eta^2 = 0.34$, Cohen's d corrected = 0.76.

This initial study reveals that people use verticality in order to represent and differentiate emotional concepts. Specifically, happiness was located higher than sadness. Less than 10 percent of participants failed to match the predicted pattern.

Study 2

In Study 2, we extended our empirical investigation to the case of facial emotions. In a face-positioning task, we predicted that participants would preferentially stick happy and sad faces on headless bodies placed in the upper and the lower portions of a sheet, respectively.

Method

Participants and design

Study 2 involved 29 students (five men), aged 18 to 24. They were assigned to a 2 (facial emotion: happy or sad) x 2 (gender of expressers pair: male or female) x 2 (identity of the expresser: man 1 or woman 1 for happiness and man 2 or woman 2 for sadness, or the reverse) mixed design, with the two last factors varying between participants. The expresser-related factors were not associated with any significant main or moderating effects in our analysis and will not be discussed further.

Materials

A pair of male expressers (Man 1 and Man 2) and a pair of female expressers (Woman 1 and Woman 2) were selected from the Warsaw Set of Emotional Facial Expression Pictures (Olzanowslei, Pochwatko, Kukliński, Ścibor-Rylski, & Ohme, 2008). We only took their happy and sad photographs. The selection of these expressers was based on their good pretested emotional intensity score and on their categorical similarities (in their twenties, good-looking), as reported by Olszanowski and colleagues. Each face was cropped so that only the facial area from the chin to the forehead remained and was reproduced on a 2x2 cm sticker. Finally, we prepared two sets of materials for each couple of faces: Man 1 or Woman 1 expressing happiness and Man 2 or Woman 2 expressing sadness, or the reverse. Expresser gender was not manipulated within participants so as to prevent potential effects of dominance. As a matter of fact, dominance and submission are related to up and down locations, respectively (Schubert, 2005), and men and women may be related to up and down locations too because of their respective levels of dominance – high for men and low for women (as formulated by Meier & Dionne, 2009).

Procedure

Participants were led to believe that the study was concerned with "the impact of spatial manipulation tasks on well-being". They were randomly assigned to the different conditions (Ns held constant across conditions, after removing one participant

– see below). They received two stickers (faces) and a sheet of paper showing two printed schematic headless human bodies located in the upper and the lower portion of the sheet, respectively. Participants were instructed to try the two face-body combinations, and then to choose (and stick) the faces on the bodies so as to come up with the most satisfactory display. In addition, they were asked to identify both emotions. After reporting their gender and age, participants were debriefed.

Results and discussion

One participant did not fill in the questionnaire and was excluded from the analysis. All other participants correctly identified the emotions. As predicted, participants positioned the happy and the sad faces more often on the upper and the lower bodies respectively ($n = 22$) than the other way around ($n = 6$), $X^2(1) = 9.14$, $p < .003$ - the odds of congruent positioning was 3.67.

These results confirm that the vertical representation also applies to the "embodiment" of emotions. Specifically, people preferentially match a happy (sad) face with an upper (lower) position.

Study 3

The results from Study 1 and Study 2 confirm the existence of an emotional vertical mapping, "happy is up" vs. "sad is down". In brief, people preferentially match the happy (sad) concept or face with an upper (lower) position. Building on these findings, we felt confident proceeding to the test of our next hypothesis, that is, that verticality operates on-line in the recognition of sad and happy emotions. Study 3 made use of a facial emotion recognition task for faces displaying mild emotions. According to Keefer and colleagues (Keefer, Landau, Sullivan, & Rothschild, 2011), people are particularly likely to rely on metaphors when they experience uncertainty. This is because reliance on metaphors is precisely aimed at facilitating judgments in complex and uncertain situations. Building on this line of reasoning, we only focused on mild emotions in Study 3. We hypothesized that spatially congruent presentations would facilitate the recognition of facial emotions possessing mild emotional cues.

Method

Participants and Design

Participants were 90 students (thirty-two men), aged 18 to 23. The experiment relied on a 2 (expresser's emotion: happy or sad) x 2 (expresser's location: up or down) x 2 (expresser's gender: male or female) x 2 (response keys: "s" for happy and "l" for sad, or the other way around) mixed design with the last factor varying between participants. We also controlled for the effect of participant's gender.

Stimuli

The photographs of 24 mild and 8 intense emotional faces, equally distributed between gender and emotion, were used in our study.

The 8 intense emotional faces (4 expressers) were borrowed from the validated Radboud Faces Database (Langner et al., 2010) (after erasing the neck of the expressers). The inclusion of this small number of intense expressers was simply aimed at stressing the relative mildness of the 24 target facial emotions. These 24 mild emotional faces were obtained following a multi-stages process. The photographs of 12 expressers in their happy, sad, and neutral versions were chosen from the Radboud Faces Database (again, we erased the neck of the expressers). Based on these photographs, 24 morphing continua ranging from neutral to emotional expression (happy or sad) were created (using Sqirlz Morph Software; Xiberpix, 2002). Each neutral-emotional continuum included 50 frames (for each expresser, there were 50 frames going from a neutral to either a happy or sad emotion). Twelve subjects watched these frames and were instructed to report the first frame that allowed them to perceive a happy or a sad emotional expression. We averaged across participants' individual decisions so as to identify the "mild facial emotion" that would be used for the experiment proper. In short, these mild facial emotions presented barely enough emotional cues so as to recognize the emotion.

Procedure

Participants arrived at the laboratory and were seated in individual cubicles. They were randomly assigned to one of the two response key conditions (Ns were held constant across conditions). They learned that the study examined emotions recognition abilities. The experimental session started with the computer task, using the E-prime 2.0 software. Subjects sat at a distance of 40 cm from the screen on an adjustable chair so as to adjust their gaze to the center of the screen. The screen size was 30x38 cm (15x12 inches, the screen was 90° rotated). Participants learned that a series of faces would appear on two different screen areas and that their task was to identify as quickly as possible whether the expresser was happy or sad pushing the "l" or the "s" key (using an AZERTY keyboard).

A trial started with a blank screen for 1500 ms, followed by a 500 ms fixation cue at the center of the screen. Another 500 ms fixation cue indicated where the face would appear, directly followed by the presentation of the face. The faces were displayed using an 8 cm by 13 cm format, and presented about 2 cm away (on a vertical axis) from the center and from the upper or lower border of the screen. Participants were given 800 ms to identify the emotion. The next trial started after this duration or after the "s" or "l" key had been pressed. There were 20 mild facial emotions equally distributed between gender and emotion, presented twice at both locations, resulting in 40 trials. Intermixed with these 40 trials, there were also 12 trials involving 6 intense facial emotions (presented at both locations). The latter 12 trials were considered as fillers and will not be analyzed. The presentation order of the 52 trials was randomized. Each experimental session was preceded by a short training session involving ten trials making use of mild and intense facial emotions from other individuals.

Following the computer task, participants were debriefed, thanked, and dismissed[1].

1. The Personal Need for Structure scale (PNS; Thompson, Naccarato, Parker, & Moskowitz, 2001) was also administered to participants. Along with Landau and colleagues (2010) and based upon some preliminary results, we reasoned that, considering the structural function of metaphors, people with a higher dispositional preference for structured knowledge might be more prone to think metaphorically and, then, to show a spatial-emotional congruent effect. However, results did not show any effect of PNS.

Results

Data preparation

Response times (in milliseconds) associated with incorrect decisions (n = 347, 9.6%) were excluded from the analysis. Response times were log-transformed so as to normalize their distribution (Ratcliff, 1993). Response times falling more than three standard deviations around the global mean (Bargh & Chartrand, 2000) were considered outliers (n = 2) and replaced by cutoff scores.

Multilevel analysis

We submitted the data to a SAS Proc Mixed analysis. This statistical method is well suited for response times (Hoffman & Rovine, 2007) and compensates for the use of a limited number of observations (Farrell & Ludwig, 2008). The independent variables in our model were emotion (happy, sad), location (down, up), expresser's gender (female, male), response keys (l-s or s-l for happy and sad emotions), participant's gender (female, male) (these variables were contrast-coded) and their interaction. There was a random intercept for each subject. The total number of observations was 3251.

The predicted emotion by location interaction was not significant, $F < 2$, *ns*. However, the emotion by location by participant's gender interaction was significant, $F(1,3133) = 4.58$, $p < .033$. This interaction was not qualified by a higher order interaction. To probe this three-way interaction, we analyzed the location by emotion interaction as a function of participant's gender. For male participants, there was no effect, $F < 1$, *ns* (see Figure 1b). In contrast, for female participants, the location by emotion interaction was significant, $F(1,3133) = 8.70$, $p < .004$ (see Figure 1a). The means showed the expected location-emotion congruent pattern in that sad faces were recognized faster when presented lower ($M = 494$ ms, $SD = 97.95$) than higher ($M = 504$ ms, $SD = 96.41$) whereas mild happy faces were recognized faster when presented higher ($M = 492$ ms, $SD = 101.37$) than lower in space ($M = 505$ ms, $SD = 106.08$). Simple effects analyses of location confirmed this difference for happy faces, $F(1,3133) = 5.63$, $p < .018$, but the difference was only marginal for sad faces, $F(1,3133) = 3.24$, $p = .072$. Moreover, higher faces were recog-

nized faster with happiness than sadness, $F(1,3133) = 6.58$, $p < .011$, whereas lower faces were recognized faster with sadness than happiness, although the latter effect was not significant, $F(1,3133) = 2.58$, $p = .108$.

No other effect was significant or of interest[2].

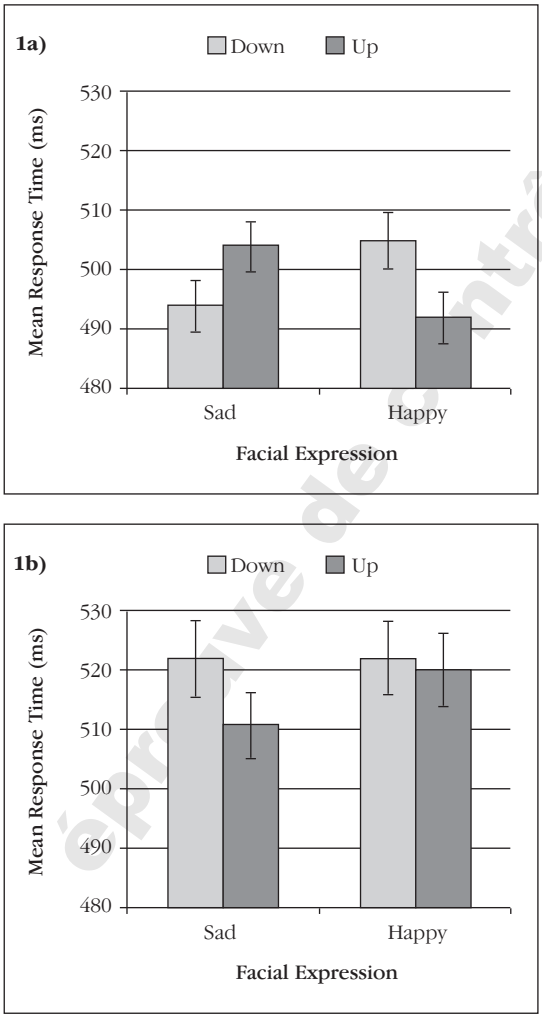

FIGURE 1:
Response times as a function of face's location and emotion for female participants (top panel, 1a) and for male ones (bottom panel, 1b). Error bars show the standard error of means.

2. There were two three-way significant ($p < .05$) interactions (participant's gender by emotion by expresser's gender interaction, $F(1,3133) = 10.25$, $p < .01$; participant's gender by response keys by expresser's gender interaction, $F(1,3133) = 5.69$, $p < .05$).

Discussion

These results confirm that the vertical happy-sad mapping can influence the speeded recognition of mild facial emotions. To our knowledge, only one study has examined the influence of metaphors in the processing of emotional cues or facial expressions (the heat representation of anger; Wilkowski, et al., 2009). Therefore, our results constitute the first evidence for the verticality metaphor impacting the processing of facial emotions.

Importantly, however, the predicted effect only emerged for female participants. Specifically, women recognized happiness and sadness faster when located higher and lower, respectively. This is an important finding which points to gender as a possible boundary condition of the happy-sad vertical metaphor. The question then arises as to why gender would moderate the spatial congruent effect in the recognition of sad and happy facial emotions. One reason for this might be that the happy-sad vertical representation is less effective or relevant for men. Because of the low number of male participants (a recurring problem in psychology), this post-hoc hypothesis could not be examined in Study 1 and 2. Therefore, we decided to replicate Study 2 but this time we took care to involve as many male as female participants.

Study 4

In this study, we tested the effect of participant's gender on the happy-sad vertical representation using the face-positioning task from Study 2.

Method

This study involved 87 students (forty-one men) from the Catholic University of Louvain (UCL), aged 18 to 27. The experiment relied on a 2 (facial emotion: happy or sad) x 2 (participant's gender: male or female) x 2 (gender of expressers pair: male or female) x 2 (identity of the expresser: man 1 or woman 1 for happiness and man 2 or woman 2 for sadness, or the reverse) mixed design with the last three factors varying between partici-

pants. The expresser-related factors were not associated with any significant main or moderating effects in our analysis and will not be discussed further.

We used the same procedure and materials as in Study 2. An almost equal number of male and female participants were randomly assigned to the different conditions.

Results

Eight participants (two men) who did not follow the instructions (i.e. they did not stick the faces) or did not correctly identify the emotions were excluded from the analysis.

In order to examine the gender-differential responses pattern, we first submitted the data to a Fisher exact test (correcting the Chi-square test for small sample size) by crossing gender and response. Results showed a significant relation between participant's gender and the positioning, $p < .046$ (1-sided) - the odds ratio comparing the two groups was 2.41. Then, we ran two Chi-square tests for both genders. As expected, female participants positioned the happy and the sad faces more often on the upper and the lower bodies respectively ($n = 27$) than the other way around ($n = 13$), $X^2(1) = 4.9, p < .028$. This was not the case for male participants ($n = 18$ vs. $n = 21$), *ns*.

Discussion

This study supports the hypothesis that women but not men preferentially match a happy (sad) face with an upper (lower) position. It further suggests that the vertical representation of these emotions would not be equally relevant or in use for both genders. As such, these results could explain why, in Study 3, there was a spatial-emotional congruent effect qualified by gender.

General Discussion

Summary of findings

This series of studies reveals the existence of a vertical mapping of sad and happy emotions and its impact on tasks involving lexical (Study 1) and configural (Studies 2 and 4) emotional materials, and on the speeded recognition of facial expressions (Study 3). As mentioned in the introduction, no research to date has examined the impact of a verticality metaphor on the spatial representation and recognition of facial expressions. These are important insights, which support the embodied cognition view for emotional concepts and offer additional support to the sensitivity of emotional processing to contextual effects (see also Corneille, Hugenberg, & Potter, 2007; Leppänen & Hietanen, 2003; Masuda et al., 2008; Smith & Schyns, 2009; Wilkowski et al., 2009).

Our findings also reveal that emotional metaphorical mappings may depend on individual differences such as gender. Study 3 showed a spatial-emotional congruent effect for women only. Study 4 further showed that women but not men link happy and sad faces with upper and lower location, respectively.

Individual differences as moderator

A handful of studies in the literature showed that individual differences can influence metaphorical mappings. For instance, attachment style (secure vs. insecure) moderate the effect of warmth on affection/affiliation (affection is warmth, Fay & Maner, 2012; Ijzerman, Karremans, Thomsen, & Schubert, 2013). More directly related to our research, Meier, Sellbom and Wygant (2007) found that high and low positioning facilitate the processing of moral-related and immoral-related concepts respectively (moral is up vs. immoral is down) but not for participants scoring higher in psychopathy. According to the authors, individuals having little concern for the morality domain would be less prone to use morality-related metaphors (for understanding and structuring this concept) and, therefore, less likely to show a spatial congruent effect.

Returning to the happy and sad vertical mapping, our findings could be possibly explained by taking into account the importance of the emotional domain for women. According to gender stereotypes, women compared to men are more emotionally expressive (at least for several emotions), more communicative on emotions, more sensitive to emotions, more emotionally skilled (the "emotional intelligence") and more interested in emotions (Oatley, 2004). These beliefs are partially supported by empirical studies on gender differences[3] (see for instance Balswick, 1988; Fischer, 2000; Grossman & Wood, 1993; Newman, Groom, Handelman, & Pennebaker, 2008; Palomares, 2008; Robinson & Johnson, 1997; Salguero, Extremera, & Fernandez-Berrocal, 2012). Building on these findings, it may be that women represent (and use conceptual metaphors for) emotional concepts to a greater extent because this matter is more central to them. Therefore, women would be more prone to use verticality for representing and distinguishing happy from sad concepts. In support for this hypothesis, Charteris-Black (2012) found greater evidence of (conceptual) metaphors with women (vs. men) talking about emotional distress and depression. Along similar lines, one could point the gender-differentiated bodily roots of emotions. As a matter of fact, women tend to express (bodily) their emotions more, in particular for sadness (e.g., Vingerhoets & Scheirs, 2000) but also for happiness (e.g., Lafrance & Hecht, 2000). Based on the idea that the happy-sad vertical metaphor is grounded in bodily experiences such as bodily expressions (e.g., jump for happiness, Lakoff, 2012), women, more than men, may represent happiness and sadness upon a vertical axis.

Our findings also draw attention to the importance of taking into account fundamental individual differences such as gender in metaphorical research. To the best of our knowledge, there is no prior research examining metaphorical effects as a function of gender. One may observe that experimental evidence is lacking regarding the moderating role of individual differences in people's tendency to think about concepts metaphorically.

3. Research also draws attention to the role of culture, socialization and displays rules on this matter (Brody, 2000; Grossman & Wood, 1993).

Interestingly, several authors (e.g., Landau et al., 2010; Meier, Schnall, Schwarz, & Bargh, 2012) suggested that research should now go beyond merely illustrating metaphorical or embodied effects and attempt to examine their moderators. According to these authors, such findings could afford significant contributions to the comprehension of the mechanisms underlying metaphorical thinking.

Conceptual metaphor and simulation

In our research, we favoured a conceptual metaphor theoretical background. One may also want to call upon a (bodily) simulation interpretation of our results. As a matter of fact, the studies reported here involved some bodily aspects such as hand gestures or eyes movement, allowing the actual effects to be due to specific (emotional related) bodily states rather than a more general conceptual mapping (e.g., looking up/down would be associated with happy/sad emotional states, Meier & Robinson, 2006). Moreover, some findings from the simulation perspective could also afford an alternative explanation for the role of gender. Stel and van Knippenberg (2008) predicted and found that preventing women (but not man) to mimic an emotional expression impair recognizing the affective valence of these expressions. According to these authors, women are more emotionally expressive and therefore rely more on emotional facial feedbacks to process emotional expressions. Building on this consideration, it could be that female participants in our studies showed a spatial-emotional congruent effect because of their high sensitiveness to facial feedback (upward or downward eyes movement). Having said this, and as Landau and colleagues (2010) pointed out, identifying what counts as evidence for conceptual metaphor independently from bodily simulation still represents a true challenge for future research in psychology. As a matter of fact, some authors have recently proposed to merge the two approaches (e.g., Gibbs, 2006; Ritchie, 2008, 2009). Another theoretical option, put forward by Gibbs (2011), also invites to extend the metaphor theory to a dynamical system approach. According to this view, conceptual metaphors consist of dynamical processes emerging from a self-organised system of activity (interaction of brain, body, and context, Gibbs, 2011). This dynamic approach

may prove very fruitful in better understanding how conceptual metaphors emerge in specific contexts.

Metaphorical effects and the polarity argument

Finally, our findings also allow us to examine a polarity argument, which is often presented as an alternative account to simulation or metaphor effects on response times. The polarity argument holds that conceptual or perceptual dimensions (good-bad, up-down) are mentally structured as having a +polar endpoint (good/up), which is generally used to refer to the dimension, and a –polar endpoint (bad/down) (Lakoff, 1987). Priming a polar endpoint of any dimension may therefore speed up decisions on stimuli related to another dimension but located on the same polar endpoint (Lakens, 2012; in our case, up for happiness and down for sadness). The polarity argument may well apply to Study 3 but it is more alien to the findings obtained in Studies 1-2-4. This is because these studies involved no response times yet clearly supported our current representational hypotheses. We think that this feature is an additional asset of the present set of findings and contributes in useful ways to the ongoing debate on embodiment and metaphors.

Perspectives for future research

Our studies provide initial experimental evidence supporting the existence and the effect of the happy-sad vertical representation and the potential moderator role of gender in emotional metaphors. To be sure, there is still plenty of room for future work.

For instance, the impact of the happy-sad vertical mapping could be tested by presenting either one or both emotions in the same task. According to Lakoff and Johnson (1980) or Kövecses (2000), the vertical mapping of happiness and sadness is contrast-based (happiness is up vs. sadness is down). One may then pose the question of the occurrence of the effect in a non-contrasted situation. Would we still observe a vertical effect if one were to present only one emotion (happy or sad vs. neutral for instance) rather than both emotions in the same task? A similar question was actually addressed by Lakens, Semin and Foroni (2011, 2012) for the vertical representation of powerful vs. powerless and for

the brightness representation of positive vs. negative valence. Their results showed that a contrasted situation facilitates or may even be required for obtaining metaphorical effects. Therefore, we may observe smaller effects than the ones observed in our current studies if we were to present happy or sad cues independently from each other. More research is necessary to examine this question.

Another issue for future consideration concerns gender effects. We suggested that, through socialization, the domain of emotion might become more personally relevant for women relative to men. As a result, women would be prone to relying on conceptual metaphors in order to represent and process emotional concepts. This greater reliance on metaphorical representations on the part of women should not be generalized to all emotion concepts, though. For instance, gender effects obtained here for sad and happy emotions may not generalize to other emotional concepts, such as pride or anger, which are more stereotypical of men (Brody, 2000). Specifically, women may display greater metaphorical effects than men for happiness and sadness but smaller metaphorical effects than men for anger. Future studies should thus definitely address the fascinating question of how gender potentially shapes emotional and non-emotional metaphorical effects.

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