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A systemic approach to impression Formation: From verbal to multimodal processes

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A systemic approach to Impression Formation: From verbal to multimodal processes

Our views of how interpersonal relationships are forged and the factors that influence how we form impressions of others have always been a central chapter in social psychology. It was Salomon Asch who laid the foundations of what was to become social cognition with his classic studies on impression formation in 1946. He demonstrated that warm and cold as 'central traits' play a critical role in dramatically shaping impressions. The cognitive revolution was to tame this perspective into a representational paradigm that captured the imagination of researchers for an extended period emerging from person perception, and developing to person cognition, to person memory and social cognition (e.g., Ostrom, 1984).

Recent developments have questioned the central tenets of social cognition work inspired by cognitive psychology by drawing attention to the adaptive, embodied, and dynamic nature of social cognitive processes in a social and physical environment (cf. for a review Semin, Garrido, & Palma, 2011). This emerging perspective on human functioning, broadly referred to as *situated cognition* or *socially situated cognition* (Semin & Smith, 2002; Semin et al., 2011; Smith & Semin, 2004) introduces an embodied view of social cognitive processes inviting a consideration of how abstract concepts such as time, affection, power, and valence that we cannot experience with our sensorimotor devices are grounded by conceptual metaphors that involve action, space and bodily experiences (Lakoff & Johnson, 1980; 1999).

In this chapter, we return to the central concept that Asch introduced, namely warm and cold as central 'traits', except that our concern is driven by highlighting the type of bodily experiences that ground interpersonal affinity and how physical features of the environment that influence our bodily experiences contribute to the types of inferences we make about persons. It is temperature as a physical or environmental stimulus rather than its linguistic neighbors, 'warm' and 'cold', that interest us. How do differences in ambient temperature affect our inferences about persons and what is the relationship between physical and linguistic representations of temperature? Notably, bodily experiences that ground interpersonal affinity are not limited to temperature alone. As we shall argue below temperature is but one

modality that is a significant contributor shaping our perceptions of others. Two other modalities are wedded to temperature and jointly ground interpersonal affinity. These are the physical distance and smell. In the following we provide the background to the embodied grounding of intimate relationships and review the research, conducted by others (e.g., Williams & Bargh, 2008a, 2008b; Zhong & Leonardelli, 2008) and our research group (e.g., Garrido & Semin, 2011; Ijzerman & Semin, 2009; 2010) revealing the systematic relationship between different *thermal conditions* and how they influence the shape of impressions we form. We also present research evidence from our laboratory revealing the roles that *olfactory features* of the environment and *physical distance* play on how we form perceptions of interpersonal affinity (Garrido & Semin, 2011). In concluding the research overview we refer to our work that shows how these modalities interface with their linguistic neighbors (e.g., physical proximity - distance vs. close) along with investigations highlighting how differences in temperature influence patterns of language use in communication as well as perceptual processes. In concluding, we discuss this research field's contribution to social cognitive inferences in particular and to experimentation in general.

A multimodal view of social cognition and its implications for Interpersonal Proximity and Affiliation

Background

An emerging development in psychology is an increasingly systemic view of human functioning. This view derives from the realization of the interdependence between the material conditions of the environment, the human body, and psychological processes (e.g., Garrido & Semin, 2011; Ijzerman & Semin, 2009; 2010; Proffitt, 2006a, 2006b; Schnall, Harber, Stefanucci, et al., 2008; Schnall, Zadra, Proffitt, 2010; Williams & Bargh, 2008a; Zhong & Leonardelli, 2008) that are embedded in a social context in which such interdependencies have evolved (Semin & Smith, 2002; Smith & Semin, 2004). The question is not only how mind, brain, and body interact but also their relation to the physical and social environment.

A self-evident candidate for investigation from a systemic view is intimate interpersonal relationships in their diverse forms of expression from infancy to child- and adulthood. Close or intimate interpersonal relationships are manifested not only

in verbal utterances or representations about how we feel (e.g., I feel close, like, or love somebody). They also entail acts of bodily connection with hedonically charged physical experiences (i.e. changes in heart beat rate, body temperature, physical proximity, body odor, etc.). Such multimodal experiences, involving bodily connections, accompany us from birth to adulthood in diverse types of intimate relationships. Indeed, there is an abundant research literature on the significance of bodily connections in infancy.

The classic experiments by Harlow (e.g. 1962), on 'surrogate mothers' with primate infants revealed that warmth and comfort rather than food were more important in nurturing attachment. In the formation of attachment, *physical proximity*, *touch*, and *warmth* constitute some of the primary environmental factors affecting human comfort, a central tenet to Bowlby's work (1969, 1980). Other research has highlighted the significance of physical stimuli (e.g., touch, smell) in the context of their potential contributions to close interpersonal or affiliative relationships particularly in early childhood (e.g., Hofer, 1995; 2006; Polan & Hofer, 1999; Suomi, 1999). Similarly, the critical contribution of nutrient based *olfactory* factors (i.e. maternal breast odors) to attachment has been shown in studies with infants. Minutes after birth, maternal breast odors guide the infant to the nipple (for a review Porter & Winberg, 1999) and breast-fed infants recognize their mother's unique olfactory signature. Indeed, at a later age, pleasant or unpleasant scents influence how attractive or unattractive people judge neutral faces to be (e.g., Demattè, Österbauer, & Spence, 2007; Li, Moallem, Paller, & Gottfried, 2007). The nature of actions involving bodily connections between adults take different forms but in all their forms such bodily connections embrace the co-activation of thermal, olfactory and visual senses and involve hedonically charged stimulation. A further input to this line of research comes from A. P. Fiske's relational model (2004). Communal Sharing (CS), in his framework, refers to relationships that emphasize the common essence between people who are engaged in actions that connect their bodies, as is the case in intimate adults as well as caregiver infant relationships – to which A. P. Fiske (2004) refers to as 'common essence'. Such contacts contribute to a condition in which the boundaries between the self and other are suspended (Semin 2011; Chicago Social Brain Network, 2011) and a sense of 'oneness' emerges.

The general contention under examination is that these three modalities (over an extended period of repeated exposure and emotionally significant experiences) acquire a generalized form that has regulatory effects on later social interaction and perception. In other words, over time and repeated exposure, the systemic relationship between psychological states, bodily experiences and their *verbal expression* acquires *functional autonomy* (e.g., Allport, 1937) and generalizes by becoming independent of their origins. If, as the argument goes, hedonically charged *thermal*, *spatial*, and *olfactory* conditions are systematic concomitants of positive interpersonal representations that have acquired functional autonomy, then each and every one of these should separately have comparable consequences.

The proposed perspective on how person judgments are affected from a systemic *multimodal* perspective constitutes a novel integration. The one or the other modality has been subject to empirical examination, in particular the effects of variations in thermal stimuli has been of recent interest (Ijzerman & Semin, 2009; 2010; Williams & Bargh, 2008a; Zhong & Leonardelli, 2008). However, an investigation of all three modalities together has not been conducted and the interesting prediction from a systemic point of view would be that all three modalities in their respective 'pleasant' and 'unpleasant' conditions should induce respectively comparable inferences. There is nevertheless research speaking to each of these modalities that we shall review next before turning to the theoretical perspectives that are relevant to how interpersonal affection and relationships are grounded.

Thermal, Olfactory and Spatial Stimuli

The research evidence for each of the three physical stimuli is not balanced in part because some research questions for one modality or another turn out to be more difficult to address systematically. Nevertheless, there is research relevant to the potential formative shape that different modalities have for intimate interpersonal relationships which is reviewed here under three headings for the respective three modalities. While the recent interest in *thermal stimuli* has a somewhat richer literature on the subject, there is little research with olfactory stimuli in general given the elusive character of olfaction. The influence of spatial environmental conditions that are specifically related to the current research

question posed, namely how impression formation is shaped by conditions of physical contexts is also limited.

Thermal Stimuli and Their Impact

What evidence is there on how modality specific stimuli influence impression formation? The impact of thermal stimuli has been revealed in a set of recent studies opening a cross-modal window on the embodied grounding of complex social cognitive processes. Williams and Bargh (2008a) used the classic Asch (1946) impression formation paradigm in a study where participants were first asked to hold a coffee cup (hot versus iced) before receiving information about a hypothetical person described as skillful, industrious, determined, practical, and cautious. Subsequently, participants registered their personality impression of the target person on 10 bipolar traits half of which were semantically related to the warm-cold dimension. The other half of items on the list was unrelated to the warm-cold dimension. Their results revealed that holding a hot cup of coffee as compared to an iced cup of coffee led participants to judge third parties as warmer and friendlier.

More recently, Ijzerman and Semin (2009) showed in three experiments, that warmer conditions, compared with colder conditions, induced greater social proximity to a target person. Zhong and Leonardelli (2008) have taken the opposite implication seriously and have shown that social exclusion leads people to feel colder, namely, the recall or experience of social exclusion events led participants to perceive lower temperatures. That these associations have a neural basis is highlighted in an functional magnetic resonance (fMRI) study showing that pleasant temperatures activate brain regions not only related to thermal sensory functions but also affective – emotional awareness and processing (Sung, Yoo, Yoon, Oh, Han, & Park, 2007; see also Craig, Chen, Bandy & Reiman, 2000). These findings suggest that positive emotion related brain regions are activated by thermal stimulation. In particular, these studies demonstrate a strong activation of the insular cortex with warmth stimulation, responsible among other things for the processing of information about the internal states of the body, including individual subjective awareness of inner body feelings and emotions (Craig, 2002; 2009).

Significantly, the social implications of temperature are also anchored in language. Asch's (1946) paradigmatic study on impression formation, which shaped

the path that person perception took, has demonstrated that warm and cold as 'central traits' have a critical role in dramatically shaping impressions. This dimension (warm-cold) representing sociability (bad and good) is unrelated to other traits (intelligent, scientific, persistent, determined, skillful and industrious, and their antonyms or contraries), namely traits that have to do with the semantic domain of intelligence (e.g., Rosenberg, Nelson, & Vivekanathan, 1968; Zanna & Hamilton, 1972).

Recent research by Susan Fiske and her colleagues on the *stereotype content model* (SCM, e.g., Fiske, Cuddy, Glick, & Xu, 2002; Fiske, Xu, Cuddy, & Glick, 1999) has shown that warmth and competence constitute dimensions that underlie perceptions of others and play an important role in the regulation of behavior and emotional reactions. Moreover, Fiske and her colleagues have argued that these dimensions are universal (Cuddy et al., in press) because they represent inquiries about others that have an adaptive function (Cuddy, Fiske, & Glick, 2008).

Earlier research by Semin (1989) underlines how well the warm - cold dimension is anchored in language by revealing that Asch's findings are driven by well-established semantic conventions. Semin developed a dictionary based quantitative index of semantic associations between the traits terms that Asch (1946) used to describe a target person and the dependent variables to measure the impression of participants. The dictionary driven association index accounted for 79% to 92% of the variance for the data reported by Asch and a replication of the same experiment. This research underlines how strongly the warm - cold (but also blunt and polite) dimension and its interpersonal associations are consolidated in our 'documented' linguistic knowledge namely dictionaries.

Spatial Stimuli and Their Impact

Physical distance and proximity have adaptive significance and as we argued earlier physical proximity is one of the primary environmental factors affecting human comfort contributing to the formation of attachment. Proximity to caregivers is a source of safety, as is distance to potential predators. The relationship between attachment and spatial proximity is indicated by Kaitz, Bar-Haim, Lehrer, and Grossman (2004). These authors provide evidence of an association between adults' comfort with interpersonal emotional closeness or attachment style and their

comfort with and regulation of interpersonal physical closeness. Williams and Bargh (2008b) have shown that the mere activation of spatial representation of physical distance and closeness (by means of locating two coordinates in Cartesian space which were either close or distant to each other) was sufficient to shape subjective feelings and moderate reported emotional attachment to family members. Participants primed with spatially proximal coordinates reported stronger bonds to their siblings, their parents, and their hometown than those primed with distant coordinates.

While there is no research directly examining the interface between spatial distance and *impression formation*, there is a spate of research on spatial proximity and 'attraction'. This work has shown consistently that people who like each other are placed closer spatially than those who dislike each other (e.g., Allgeier, & Byrne, 1973; Mehrabian & Friar, 1969; King, 1964; Kleck, 1967; Little, 1965).

Olfactory Stimuli and Their Impact

If, as we argued earlier on, the associations one forms in the early stages of life influence the way we perceive and behave towards others, then scent should also play an important role in the regulation of interpersonal relationships. A variety of studies document the influence of scent upon behavior. For instance, scent has been shown to influence the amount of time spent in casinos (Hirsch, 1995); time spent to make decisions (Bone & Ellen, 1999; Mitchell, Kahn, & Knasko, 1995); the intention to visit a shop (Spangenberg, Crowley, & Henderson, 1996).

Despite the number and complexity of scents, the classification of a scent into pleasant or unpleasant is easy and appears to be largely learned. In fact, a variety of studies suggest that scent is dependent on experience and memory (cf. Case, Stevenson, & Dempsey, 2004; Rouby, Schaal, Dubois, Gervais, & Holley, 2002; Wilson, & Stevenson, 2003). For instance, pine tree scent has been shown to be associated with Christmas or the scent of citrus is associated with cleaning (Degel, Piper, & Köster, 2001; Stevenson & Boakes, 2003). Exposure to a cleaning scent makes the cleaning concept more accessible (Holland, Hendriks, & Aarts, 2005) and not only accelerates the reaction time to cleaning related words in lexical decision tasks but also guides expectation relative to future domestic activities and influences the actual cleaning behavior. More recent research suggests that scents affect people

even when they are asleep (Stuck, 2008) with exposure to a pleasant scent (roses) inducing more pleasant dreams than an unpleasant scent (rotten eggs).

There is some research showing that human odors affect social interaction including attraction to others (cf. Stockhorst & Pietrowsky, 2004). For instance, Baron (1977) has demonstrated that helping was more likely when pleasant fragrances were present relative to their absence. Two recent research reports illustrate the cross-modal influence of pleasant and unpleasant odors on judgments of facial attractiveness. Li, Moallem, Paller, and Gottfried (2007) have shown that participants were more likely to rate neutral faces as more likable after smelling pleasant odors relative to smelling unpleasant or neutral odors, but only when these odors were delivered below detection threshold. Independently, Demattè, Österbauer, and Spence (2007) revealed similar findings with female participants who rated male faces. They rated these faces as being significantly less attractive in the presence of an unpleasant odor than when the faces were presented together with a pleasant odor.

While, as we have discussed earlier linguistically available metaphors make good use of temperature *and* distance to ground interpersonal affection (e.g., 'she has warm feelings towards me'', 'keeping somebody at a distance', 'a close friend') the sense of smell occupies a somewhat poorer position in this regard and it is possible that concrete olfactory experiences are not reflected or anchored systematically in metaphorical expressions. The paucity of linguistically anchoring odor may be due to a number of reasons that may arise as a consequence of the distinctive nature of olfaction compared to the other senses. First, olfaction is elusive and shows rapid adaptation, meaning that the intensity of a constant odor decreases, as does sensitivity to the stimulus. Second, the difficulty to capture odors in language is also due to a problem common to the chemical senses (and in particular in the case of olfaction), namely the lack of a stimulus dimension. This gives rise to problems in defining the stimulus (Travers & Travers, 2009). While predictable variations within spectra of light, sound or pressure stimulate vision, hearing, and touch, odorant molecules show no obvious connections with each other except that they are odorous. Odor appears to be limited to molecules with a specific weight range and with a virtually *unlimited* number of molecules within that range. The

human ability to distinguish between the components of mixtures is limited to 3 or 4 components (Laing & Francis, 1989).

Finally, the anatomical structure of the olfactory system is also distinctive. Compared to other senses, that have structures in the neo-cortex, the higher brain, odor is processed by a system that is distributed over both the higher cortex and the limbic system, namely the older structures that are the seat of emotion and motivation (Warrick, Castle, & Pantelis, 2006) and the debate about how olfactory stimuli are coded in the nervous system still continues (Travers & Travers, 2009).

These factors appear to contribute to the elusive nature of olfaction and may have implications for the linguistic representation of scents. As Plato (Jowett, 1892) and Aristotle (Hammond, 1902) have long observed, olfactory stimuli appear to be most elusive and evade unambiguous linguistic representation, although we can immediately classify a scent as pleasant or repulsive. These considerations suggest that while temperature and distance are anchored in language this may not hold in the case of smell. In fact, the absence of such bidirectionality introduces an interesting case where a source (smell) grounds interpersonal affection without the apparent corresponding link to any available metaphor. This presents a rather interesting limiting case for conceptual metaphor theory, which we discuss below.

We now turn to the theoretical perspectives before reporting the research that adopts a systemic approach to how interpersonal affiliation is grounded.

Theoretical Perspectives

Currently, two complementary theoretical models compete for an informative account of the processes induced by multimodal influences on impression formation via the route of functionally autonomous consequences of multimodal sensory experiences accumulated by means of intimate interpersonal relationships. One is an *ahistorical* account, by Lakoff and Johnson (1980; 1999) who argue that the human conceptual system is largely metaphorical. The assumption is that thoughts about abstract concepts rely on metaphors in everyday language, which anchor abstract concepts in *image schemas* for space, action, forces, and other aspects of bodily experience. Thus, proximity and distance as well as warmth and coldness are terms that are often used to represent the quality of an interpersonal relationship. We use terms such as “They are very close”, or “We were tight as a

glove", "We were two peas in a pod", "They are inseparable", employing different spatial metaphors to mark the quality of a relationship. Similarly, temperature – or the warm-cold terminology is used to represent the very same quality as in "a warm and close person" or "giving the cold shoulder". The important assumption here is that while metaphors map across source domain (e.g., spatial distance, temperature) and entities in a target domain (e.g., affection), such mappings are *asymmetric* and partial. In this view, abstract concepts rest on more concrete concepts, and cannot be understood without them. Thus, while the *experience* of affection per se is possible, we cannot *think* about it without recruiting concepts of physical distance, warmth and other concrete dimensions. The asymmetry argument about source and target arises from these considerations. Lakoff and Johnson's argument suggests that a conception of 'affection' (for instance) would not be possible without the concrete sources of distance, temperature, etc. However, 'affection' does not contribute to our understanding of physical distance, temperature, etc. This is what is meant with 'asymmetry' in conceptual metaphor theory and there is empirical evidence supportive of this argument in the abstract domain of 'time' (e.g., Boroditsky & Casasanto, 2008). However, it is by no means clear if this is a general principle that applies across all abstract domains and the domain of affection presents an interesting test case, since the alternative theoretical perspective for grounding abstract concepts, discussed below tolerates a symmetry argument for concepts that emerge over repeated multimodal experiences and are captured in 'abstracted' concepts – as is the case of affection.

A second avenue to examine this integration is provided by Barsalou's model of Perceptual Symbol Systems (PSS, e.g., Barsalou, 1999, 2008a, 2008b), which permits a synchronic perspective on the emergence of experientially acquired abstract concepts. In line with this perspective, one can argue that multimodal stimuli (such as thermal, spatial, and olfactory stimuli) constitute *online* experiences that give rise to modal states in the somatosensory system, the visual system but also in affective systems. Notably, the multimodal experiences are also associated with language so that the *offline* experience of categories such as "a warm and close person" or "giving the cold shoulder" are represented as activations of the somatosensory system, the visual system, affective systems, etc. According to PSS, once established in the brain, knowledge about the categories, which are

represented by multimodal associative structures, can be used across a number of cognitive tasks, such as in the types of inferences involved in impression formation. Thus, one can argue with Barsalou's PPS model, that the representations that arise in dedicated input systems during sensation and motor action can be stored and used "offline" by means of mental simulations, namely by "the reenactment of perceptual, motor, and introspective states acquired during interaction with the world, body, and mind" (Barsalou, 2008a, p. 618). In the context of the current work, this means that early childhood as well as adult experiences give rise to the stimuli (i.e. thermal, olfactory, etc.) responsible for multimodal states that can be activated on- or offline during adulthood.

The possible association of multimodal experiences with language suggests a bidirectional relationship between the modality specific experiences and linguistic categories attached to these experiences. Thus, the physical features of an environment that simulate related modalities (e.g., thermal, olfactory stimuli) are likely to influence language driven processes representing the close social bonds between two persons and most probably influence person perception. The opposite direction, namely priming positively sociable features of a person are likely to lead to simulations of the modalities that were associated with the physical features that were present in such bonded relationships (e.g., pleasant temperatures and scents).

A systemic investigation of the multimodal grounding of interpersonal relationships

The systemic interdependence between temperature, distance, and scent was examined in a set of three experiments (Garrido & Semin, 2011). The experimental paradigm was identical across all three conditions and relied on a narrative about a target who was described neutrally on the intelligence/competence dimension. Each experiment controlled for the pleasant versus unpleasant conditions of the three critical variables (temperature: warm vs. cold; distance: close versus distant; and scent: pleasant versus unpleasant). The critical dependent variable was how these conditions would shape the impression participants would form of the target sociability (friendly - unfriendly, close – distant, etc.) a dimension on which they had no information and that was orthogonal to the information they received on the target, namely neutral information on the target's intelligence[1]. As can be seen from Table 1 the pattern of outcomes is identical across all three experiments on a

reliable scale that tapped sociability (i.e., warm, friendly, popular, extraverted, sociable). The pleasant modality condition – across all three modalities – leads participants to infer that the target person on whom they have no information aside from being neutral in terms of intelligence is a sociable one compared to the unpleasant modality condition. Moreover, there are no differences on judgments of the target's intelligence – meaning that the modality manipulation affects only sociability judgments.

Table 1: The Main Effects for the Three Modality Experiments

Experiment 1: Temperature Manipulation

	WARM	*COLD*	F(1,17)	η^2
Chinese Ideograms	*8.22*	*5.10*	*8.49*	*0.33*
Sociability T	4.22	3.61	3.64	0.18
Intelligence T	--	--	--	--
Sociability Experimenter	4.67	3.55	9.36	0.36

Experiment 2: Distance Manipulation

	CLOSE	*DISTANT*	F(1,32)	η^2
Chinese Ideograms	7.17	4.81	9.45	0.23
Sociability T	4.10	3.26	4.10	0.11
Intelligence T	--	--	--	--
Sociability Experimenter	4.39	3.39	2.79.	0.08

Experiment 3: Odor Manipulation

	PLEASANT	*UNPLEASENT*	F(1,18)	η^2
Chinese Ideograms	8.00	4.60	19.13	0.52
Sociability T	4.07	2.56	16.54	0.48
Intelligence T	--	--	--	--
Sociability Experimenter	4.20	3.40	3.60	0.17

The two additional measures were introduced to assess the generality of the effect induced by the physical stimuli. One examined, in an ostensibly unrelated task, whether a set of Chinese symbols were pleasant or unpleasant. The other was designed to assess participants' judgments of the sociability of the experimenter. The pattern underlines the functional autonomous effects of the modalities with the hedonic condition inducing inferences of pleasantness of the Chinese symbols and sociability of the experimenter, in contrast to the less pleasant condition of the three modalities. Additional measures of mood, participants' motivation, or effort induced by the experimental conditions were generally unrelated to these effects.

In short, the three experiments reveal (1) the functional autonomy of the three modalities; (2) the convergence of the effects across the three modalities; and (3) the generality of the effects across different judgmental stimuli.

So, is the grounding of affection symmetrical or asymmetrical?

As we argued earlier on the possible association of multimodal experiences with language suggests a bidirectional relationship between the modality specific experiences and linguistic categories attached to these experiences. This was investigated in a further experiment (Garrido & Semin, 2011) in which participants were supplied with a narrative describing a target person with behavioral items that indicated that the target person was either sociable or unsociable. The critical questions (interspersed in the context of an investigation of the experimental facilities in the lab) that constituted the dependent variables required the participants to report on the features of the experimental environment. The critical questions were whether the participants infer the temperature in the experimental room they are in (respectively warm versus cold), the social distance between themselves and a target (close versus distant), and the scent in the experimental room (pleasant vs. unpleasant).

Indeed, participants' judgments of the thermal conditions in the *sociability* condition induced the perception that the temperature in the experimental room was significantly warmer compared to the condition in which the profile of an unsociable person was given. Similarly, reading the profile of a sociable target induced participants to place the target person closer to himself or herself relative to reading the unsociable profile. However, there were no systematic effects for smell. This may not be entirely surprising since olfaction presents a rather complex

and unique sense (along with taste) compared to other senses. Olfactory stimuli lack a stimulus dimension and the complex anatomical nature of the olfactory system appears to present problems for linguistic representations. A comparison of the pattern of results from this experiment with the previous three experiments confirms the bidirectional nature of the physical temperature and 'sociability' relationship, as well as distance and sociability, but not the smell manipulation. At the same time, this finding suggests that while specific types of sensorimotor modalities that can be represented dimensionally (temperature, distance) are recruited to ground abstract concepts, other modalities which are equally basic while shaping our experiences remain just that – experiential and not accessed symbolically. In other words, olfactory modality, the oldest sense and a very important one, does not lend itself to ground the concept of affection and its absence. This poses an interesting problem for embodiment theories that do not make any differentiation between different modalities and their functions and how they contribute to experience and representation.

Recent research by Ijzerman and Semin (2010) has convergent implications for these findings. They reveal that participants feel socially closer to another person when physical proximity is induced but this also gives rise to a perception of higher temperature. Similarly, they also reveal that verbally induced social proximity induces the perception of higher temperature.

These findings suggest differentiated conclusions on symmetry versus asymmetry. First of all, and contrary to Lakoff and Johnson's (e.g., 1980) argument the metaphoric representation of affection is symmetrical when it comes to their grounding by proximity and temperature to an extent that the physical and social meanings of these terms seem to be interchangeably associated. This suggests that while the asymmetry argument may hold for abstract concepts that we cannot touch, see, taste or smell, such as time (e.g., Boroditsky & Casasanto, 2008) it does not apply to *abstract concepts that abstract from and subsume a wide range and variety of experiences*. Consequently, a better framework to understanding how concepts that are abstracted from multimodal and variegated experiences is probably perceptual symbol systems. We note guardedly 'framework' rather than theory, because PSS is a perspective rather than a systematic theory and is underspecified to make precise predictions in its current state.

The second point that the research suggests is that there are certain experiential modalities that are salient, adaptively important, and fundamental, such as olfactory modality, which defy being conceptually captured by either CMT or PSS.

Conclusions

The research we have reviewed highlights the significance of going beyond symbolic representations of social cognitive processes and examining cognitive processes as they are anchored in a dynamically changing social world, and grounded by the constraints of the human body and the environment. This invites a different perspective from the mainstream paradigm guiding social cognition research. The eventual shape that social cognition research took from its early origins on impression formation (Asch, 1946; Taguiri & Petrullo, 1958) was strongly influenced by cognitive psychology with a view that social cognition is best conceptualized in terms of abstract symbolic codes that are the result of an amodal transduction of experiences with the social world – namely symbolic representations that have an arbitrary relationship to the objects, events or concepts they represent (de Saussure, 1916; Kintsch, 1988; Newell & Simon, 1972, inter alia). The consequent modeling relied on a conception of social knowledge as represented in terms of a network of connected nodes in the form of amodal propositions (cf., Smith, 1998). Conceptualizing psychological functioning in terms of a closed loop of symbols or an internal model of the world implies that the meaning of each symbol is defined only by other symbols. As a situated view of social cognition suggests (e.g., Semin & Smith, 2002; Semin, et al., 2011; Smith & Semin, 2004) this view contains a number of problems. For instance, conceptualizing psychological functioning as consisting merely of symbolic processes leaves no room for adaptive action. As a consequence, such amodal views are not perceptually grounded and have difficulties in furnishing an informed answer to how adaptively successful interaction with other agents and the world emerges.

The research we reviewed here is an illustration of the importance of taking serious not only how mind, brain, and body interact but also their relation to the physical and social environment. These interactions reveal neglected inputs to human functioning in general and social cognitive processes in particular. Indeed, this research draws attention to the importance of taking the environmental context in

which we conduct our experiments. Activating different modalities like temperature, smell, or physical distance are likely to affect a range of processes that may yield different results. For instance, we know that a warm room induced the use of concrete language in describing and representing events compared to a cold room which induces the use of more abstract language (Ijzerman & Semin, 2009). What does this mean for research concerned with construal level theory (Trope, & Liberman, 2003)? But it is not only temperature or physical distance than can affect experimental outcomes. Recently, Meyers and Zhu (2007) show that ceiling height can influence language use and inferential processes as well. Rooms with a high ceiling induce more abstract language use relative to low ceiling rooms – thus, lab cubicles with their confined spaces are potentially likely to induce systematic differences in language use compared to more specious conditions. Consider for a moment what the implications of an fMRI environment are in terms of both temperature and spatial constraints and how much such environments are likely to influence the types of psychological processes that are examined. Indeed, this is an issue that appears to be evoking some interest in consumer psychology (e.g., Berger & Fitzsimons, 2008; 2009).

The implications of the research we reviewed here goes far beyond the immediate influence of environmental factors upon affection and its grounding and the suitability of the types of conceptual perspectives on how abstract concepts are grounded. Aside from these theoretical implications, this research highlights how taking environmental factors, in particular modalities that are rarely taken into consideration in standard research such as the chemosenses, or thermal sense can have very serious consequences upon the range of findings we obtain. These findings invite a more careful consideration of the experimental environment and its effects upon human functioning in general.

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[1] Note that across the first three experiments we do not include a control condition because there is no clear baseline for these manipulations. Given that the physical experience of intimate others can vary within a range of acceptable temperatures, distance and smells, it would be difficult to determine what a "neutral" temperature, physical distance or smell conditions would be like.