highest levels of synchrony, with respect to coherence, more mutuality in the lead-lag structure, and shorter time lags to synchrony. It has been suggested that synchrony builds on the infant's biological rhythms and extends it to social relatedness (Lester et al. 1985; Wolff 1967). Perhaps female newborns' higher social orientations, increased periods of eye contact, smiles, and rhythmical mouthing contrast with male newborns' frequent peaks of excitement, quicker rapidity of buildup, and higher reflex startling (Korner 1969; Osofsky 1976) to more easily match and build on similar parent interactions that tend to build on these innate dispositions.

Thus, mothers and fathers provide infants two modes of coregulation. As infants interact with mother and father, they learn that interpersonal intimacy may come in different forms; some relationships focus on subtle shifts in facial signals, whereas others are directed to exploring of the outside world; some are moderate in intensity, whereas others may be more arousing and exciting. Also, some are consistent with the individual's biological tendencies, while others may require some adjustment. As one might expect, it has been shown that mother-son dyads take longer to repair from mismatched to matched states (Weinberg et al. 1999), which may be explained by gender mismatching of dyadic interactions between mother and son. Such experiments explain the well-established link between early father absence and the development of externalizing disorders (Cabrera et al. 2000).

Since synchrony is central for the development of self-regulation, father absence and lack of sufficient and naturally more synchronous same-gender early interactions may disrupt the acquisition of self-regulatory skills and lead to conduct disorders in boys. This may also point to possible protective therapeutic interventions to maximize opposite-gender parent-infant interactions. These findings fit with psychoanalytic notions that early relational patterns construct person-specific internalized models (Stern 1985), perhaps through the development of specific emotion-regulation brain circuits (Leppanen & Nelson 2009), to serve as templates for intimate emotional interactions throughout life (Cassidy & Shaver 2008). Unique contributions from mother-child interaction (Moran et al. 2008) and father-child interaction (Boyce et al. 2006; Grossmann et al. 2002) to evolutionarily favorable sex-specific emotional expressions of the developing child may significantly constitute the mechanism through which sex differences cross generations.

These sex differences in emotional expression, manifested and perhaps transmitted through parent-infant interactions, are presumably based on sexual differences in parental brain structure and function across species (Bridges 2008) and in humans in particular (Swain & Lorberbaum 2008; Swain et al. 2007). Such studies also lie within the larger and growing field addressing sex differences in brain structure, function, and chemistry (Cosgrove et al. 2007). For example, neurochemical modulators such as oxytocin and vasopressin (Donaldson & Young 2008) are likely to be important determinants of emotion expression, as well as contribute to psychopathology risk.

Furthermore, brain networks that differ according to sex likely also vary according to the type of emotional stimuli (Hamann et al. 2004; Proverbio et al. 2009; Schirmer et al. 2004; Wager & Ochsner 2005), including the involvement of empathys (Schulte-Rüther et al. 2008). For example, considering parent-related stimuli, infant laughing, and crying stimuli versus a control sound, the amygdala and anterior cingulate of non-parent women were more active than those of men (Sander et al. 2007). Perhaps these gender-dependent correlates of neural activity reflect neural predispositions in mothers for responses to preverbal infant vocalizations. Direct contrast of men versus women in the first weeks postpartum indicated increased activity in mothers compared with fathers in response to baby cry (Swain et al. 2004) and picture (Swain et al. 2006) in limbic brain regions. This fits with findings that fathers experience more anxious emotional thoughts and engage in more compulsion-like behaviors to reduce their worry (Kim et al., submitted; Leckman et al. 1999; 2004; Swain et al. 2005). Taken together, this research suggests that networks of highly conserved hypothalamic-midbrain-limbic-paralimbic-cortical circuits act in concert to support aspects of parent response to infants, including the emotion-regulation circuits that vary according to gender. An integrated understanding of the brain basis of parenting according to gender has implications for long-term parent and infant emotional expression and mental health.

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## On the richness and limitations of dimensional models of social perception

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**Abstract:** The two-dimensional model of social relations outlined in the target article has striking convergence with empirically derived dimensional models of interpersonal perception, inter-group perception, and face evaluation. All these models posit two-dimensional structures related to perceptions of valence/affiliation and power/status. Although these models are parsimonious, they may be insufficient to account for behaviors in specific contexts.

In an ambitious treatment of gender differences in expressive behaviors, Vigil's target article outlines a two-dimensional model of social relationships according to which people evaluate their relationships on two fundamental dimensions: trustworthiness and capacity. These dimensions are related to inferring the intentions (e.g., potential harm) and the ability of the relationship partner to implement these intentions (e.g., means to inflict harm). This model converges with a number of dimensional models that have been empirically derived from the study of specific domains of social perception. These include Wiggins's model of interpersonal perception (Wiggins 1979; Wiggins et al. 1989), Fiske's model of inter-group perception (Fiske et al. 2007), and Todorov's model of evaluation of faces on social dimensions (Oosterhof & Todorov 2008; Todorov et al. 2008).

All these models use a similar data-driven approach. Groups, people, or faces are initially characterized on a number of specific attributes (e.g., trustworthiness, competence, aggressiveness), and then the judgments on these attributes are submitted to statistical analyses that identify and model the common variance among these judgments. The final objective is to identify a simple model that accounts for most of the variance in these judgments and, ultimately, provide an explanatory framework for the domain of study. Using this approach, Fiske et al. (2007) have argued that the primary dimensions of perceiving social groups are warmth and competence and that these dimensions are related to competition and status. Wiggins et al. (1989) have argued that the primary dimensions of perceiving other people are affiliation and dominance. Todorov et al. (2008) have argued that the primary dimensions of evaluating faces are valence/trustworthiness and power/dominance.

I use our own approach to illustrate the data-driven character of these methods. To outline the structure of perception of faces on social dimensions (Oosterhof & Todorov 2008; Todorov et al. 2008), we first identified trait attributes that are spontaneously

used to characterize unfamiliar faces. Then, we asked participants to rate faces on these attributes. Not surprisingly, judgments of these attributes were highly correlated with each other. In fact, it is almost impossible to find a social judgment that is uncorrelated with judgments of trustworthiness. A Principal Component Analysis of the trait judgments identified a simple two-dimensional solution that accounted for more than 80% of the variance of these judgments. The first dimension was interpreted as valence evaluation of faces and the second dimension as dominance evaluation. Trustworthiness judgments were the best approximation of valence evaluation, and dominance judgments were the best approximation of power evaluation.

Computer modeling of judgments of trustworthiness and dominance showed that whereas cues signaling correspondent approach/avoidance behaviors were important for the valence/trustworthiness dimension, cues signaling physical strength were important for the power/dominance evaluation. As shown in Figure 1, whereas faces on the extreme positive end of the trustworthiness dimension were perceived as happy and slightly surprised, faces on the extreme negative end were perceived as angry. Whereas extremely dominant faces were perceived as extremely masculine and mature faced, extremely submissive faces were perceived as extremely feminine and baby-faced (Fig. 1).

These findings converge nicely with the model proposed by Vigil: that relationship partners are evaluated on trustworthiness and capacity; that is, intentions and the ability to implement these intentions. Moreover, given the commonalities between these dimensions and the dimensions in the models of Fiske et al. (2007) and Wiggins et al. (1989), models that were empirically derived in different domains of social perception, it may be argued that these dimensions are universal dimensions of social perception (Fiske et al. 2007).

Yet, although these models can provide a powerful explanatory framework for a set of phenomena, their parsimony can come with a price. Specifically, these models may be insufficient to explain and predict social behaviors in specific contexts. In the data-driven methods, the general approach is to model common variance and discard variance that is unique to the specific input variables (e.g., non-error variance that is specific for trustworthiness per se and is not shared with general valence evaluation of faces). While this approach is justified to the extent that the objective is to arrive at a general framework that can account for a variety of specific effects, it may miss important effects that are not easily attributable to common variance. For example, perceptions of trustworthiness and dominance are sufficient to account for perceptions of threat (Oosterhof & Todorov 2008) but not perceptions of competence. In decision contexts (e.g., voting) where competence is the primary dimension of evaluation, cues specific to competence, and not trustworthiness or dominance, predict social decisions (Olivola & Todorov, in press; Todorov et al. 2005). The weight of attributes or importance of dimensions can also change as a function of the specific context. Whereas masculine-looking leaders, with the associated perceptions of leadership and dominance, are preferred in wartime, feminine-looking leaders, with the associated perceptions of trustworthiness and likeability, are preferred in peacetime (Little et al. 2007).

To what extent the socio-relational framework of expressive behaviors (SRFB) model would sacrifice specificity of prediction is an empirical question. As a general descriptive framework, this model is certainly supported by independent evidence from other dimensional approaches to social perception. Moreover, as outlined by Vigil, the descriptive framework of the model can be best understood in the context of social interaction. That is, displays of social cues are in the service of social interaction.

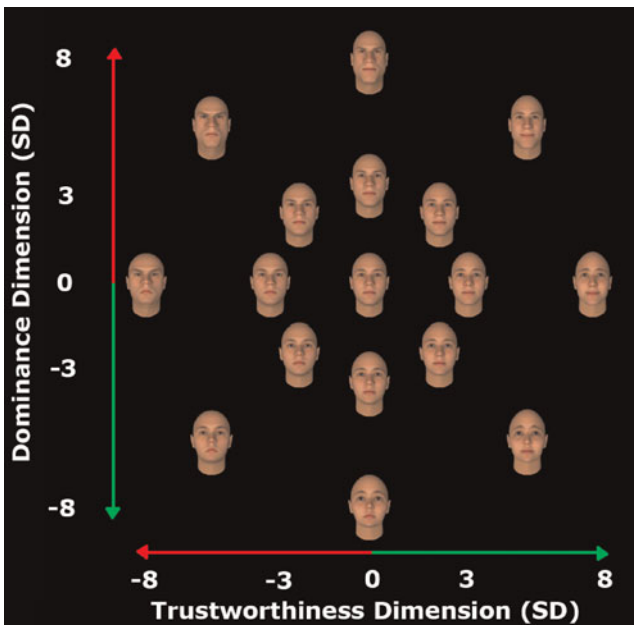


Figure 1 (Todorov). A data-driven computer model of variation of faces on the dimensions of valence/trustworthiness depicted on the *x*-axis and power/dominance depicted on *y*-axis. The variation of faces is in standard deviation units. The details of the modeling are described in Oosterhof and Todorov (2008).

## Smiling reflects different emotions in men and women

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**Abstract:** We present evidence that smiling is positively associated with positive affect in women and negatively associated with negative affect in men. In line with Vigil's model, we propose that, in women, smiling signals warmth (trustworthiness cues), which attracts fewer and more intimate relationships, whereas in men, smiling signals confidence and lack of self-doubt (capacity cues), which attracts numerous, less-intimate relationships.

Vigil proposes that "gender-specific emotive behaviors would have coevolved with these [social] constraints in order to regulate interpersonal dynamics to enhance social fitness" (target article, sect. 1, para. 3). Vigil's framework can be used to make sense of apparently contradictory findings in the literature regarding the relationship between smiling and affect; moreover, the framework is useful for understanding our own recent empirical findings concerning gender differences in emotional expression.

Previous empirical evidence regarding the relationship between smiling and positive affect is equivocal, with some