Connecting minds and sharing emotions through human mimicry

Prochazkova, E.

Author: Prochazkova, E.
Title: Connecting minds and sharing emotions through human mimicry
Issue Date: 2021-03-04

Appendices

Appendix A

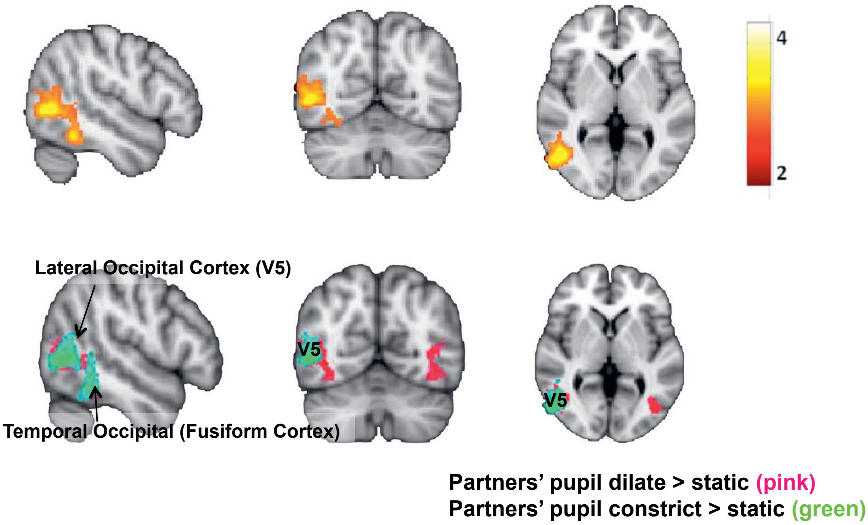
Supplementary Material for Chapter 4

This file includes:

Figure S1

Tables S1 to S12

Partners' pupil moving > static



Supplementary Figure 1I Neural correlates of partners' pupil change. Top figure: The whole-brain analysis contrast compares partner's moving (dilating & constricting) versus static pupils (thresholded at $P < 0.05$ (cluster-level FWE correction with multiple comparisons at 2.3. (n=34)). For the visualization threshold was set at $z = 2 – 4$. Bottom figure: shows the overlap between partner's dilating and partner's constricting pupils.

Neural correlates of partners' pupil change. To determine the effect of pupillary signals on the brain, irrespective of whether subjects mimicked or not, we evaluated the fMRI data acquired during the encoding of partner pupils: constricting, static and dilating conditions. We created the following contrasts: constrict versus static, dilate versus static, and changing versus static (combination of partner dilating and constricting conditions). This analysis revealed that compared to static pupils both partner pupil dilation and constriction were associated with enhanced activity in spatially overlapping right lateral occipital gyrus [50, -62, 2] and temporal occipital fusiform gyrus [52, -44, -6]. The contrast between dilating versus constricting pupils did not result in significant differences. This analysis depicts that processing of partner's dilating and constricting pupil movements share common neural underpinnings in lateral occipital and temporal areas.

Table S1. The effect of partner's pupil on participants' trust

Fixed Factors*	F	Df1	Df2	*p*-value
Corrected Model	38	2	5,933	0.000
Pupil Partner	38	2	5.213	0.000

Random Factors	Estimate	SE	Z	*p*-value
Variance	2.955	0.055	53.93	0.000
Var(intercept)	1.048	0.244	4.288	0.000

Table S2: The effect of partner's pupil on participants' pupil size

Fixed Factors	F	Df1	Df2	*p*-value
Intercept	14.201	11	153,986	0.000
Pupil Partner	1,274	2	153,986	0.280
lin	19,504	1	153,986	0.000
quadr	82,079	1	153,986	0.000
cub	15,234	1	153,986	0.000
Pupil Partner * lin	8,276	2	153,986	0.000
Pupil Partner * quadr	1,923	2	153,986	0.146
Pupil Partner * cub	15,783	2	153,986	0.000

Random Factors	Res. Eff.	Est.	SE	Z	p-value	95% Confidence Interval	
						Lower	Upper
Repeated Measures	AR1	0.255	0.004	64.219	0.000	0.247	0.263
Intercept	Variance	0.015	0.004	3.906	0.000	0.009	0.0026

A

Table S3: The effect of partner's pupil on participants' trust

Fixed Factors				**F**	**Df1**	**Df2**	***p*-value**
Intercept				15.229	5	5,750	0.000
Pupil Partner				32	2	5,750	0.000
Mimicry (yes/no)				19,504	1	5,750	0.312
Pupil Partner*Mimicry				6	2	5,750	0.003
						95% Confidence Interval	
Random Factors	**Res. Eff.**	**Estimat**	**SE**	**Z**	**p-value**	**Lower**	**Upper**
Intercept	Variance	2.954	0.056	53.099	0.000	2.847	3.066
Int. [subject=ID*Run]	Variance	0.0054	0.001	3.297	0.001	0.0029	0.0098

Table S4. Mimicry > no mimicry

Region	**BA**	**Side**	**Cluster size**	**x**	**y**	**z**	**Z-Max**
1. Occipital pole	18	L	39834	-6	-92	14	5.32
1. Middle Temporal Cortex	37	L		-58	-54	0	5.14
1. Supramarginal Gyrus (TPJp)	39	L		-54	-44	36	5.13
1. Lateral Occipital Cortex	19	L		-38	-74	26	5.13
1. Occipital pole	18	L		-10	-90	16	5.09
1. Lingual Gyrus	18	L		-8	-76	-6	5.08
2. Angular Gyrus (TPJp)	39	R	1184	54	-48	32	5.07
2. Middle Temporal Gyrus	22	R		64	-26	-4	4.86
2. Angular Gyrus (TPJp)	39	R		50	-48	28	4.81
2. Angular Gyrus (TPJp)	39	R		56	-48	26	4.75
2. Parietal Operculum (TPJa)	22	R		52	-34	20	4.74
2. Superior Temporal Gyrus (STS)	22	R		48	-30	-2	4.67

The activation survives whole-brain correction ($p < 0.05$) for multiple comparisons at the cluster level 2.3. (N=34). Locations coordinates are in stereotactic MNI space with 2x2x2 voxel size. The source of anatomical labels: FSL Atlas tools. Subpeaks of the clusters= Z-score; R= right; L = left; BA = Brodmann area.

Table S5. Regions that show heightened activation for mimicry with constricting pupils

Region	BA	Side	Cluster Size	x	y	z	Z-Max
1. Lateral Occipital Gyrus – V5	19	L	13971	-36	-82	-10	6.46
1. Precentral Gyrus	4	L		-34	-18	56	5.74
1. Lateral Occipital Sulcus–V5	19	L		-38	-78	-10	5.62
1. Lateral Occipital Gyrus-V5	19	L		-42	-80	-4	5.59
2. Lateral Occipital Gyrus-V5	19	R	7948	36	-84	-2	6.4
2. Lateral Occipital gyrus	19	R		36	-66	62	6.4
2. Fusiform Gyrus	20	R		40	-38	-22	5.69
3. Precentral Gyrus	44	R	3020	44	8	30	5.76
3. a. Insula	47	R		32	28	0	5.76
3. Precentral Gyrus	44	R		44	10	30	5.57
3. Middle Frontal Sulcus	6	R		32	-2	50	4.62
4. Insula	48	L	768	-36	18	2	5.71
4. a. Insula	47	L		-32	26	-2	5.12

The activation survives whole-brain correction (p 0.05) for multiple comparisons at the cluster level 2.3. (n=34). Locations coordinates are in stereotactic MNI space with 2x2x2 voxel size. The source of anatomical labels: FSL Atlas tools. Subpeaks of the clusters= Z-score; R= right; L = left; BA = Brodmann area.

A

Table S6. Regions that show heightened activation for mimicry with dilating pupils

Region	BA	Side	Cluster Size	x	y	z	Z-Max
1. Occipital temporal Gyrus	37	R	763	50	-62	-14	6.46
1. Lateral Occipital Gyrus–V5	19	R		46	-76	-2	5.74
1. Lateral Occipital Gyrus–V5	19	R		44	-82	-14	5.62
1. Precentral Gyrus	3	L		-36	-18	62	5.59
1. Paracingulate Gyrus	32	R		8	26	36	6.4

The activation survives whole-brain correction (p 0.05) for multiple comparisons at the cluster level 2.3. (n=34). Locations coordinates are in stereotactic MNI space with 2x2x2 voxel size. The source of anatomical labels : FSL Atlas tools. Subpeaks of the clusters= Z-score; R= right; L = left; BA = Brodmann area.

Table S7: TOM and Threat Masks' links for download

Network	Studies	Date of Download	Link to download
TOM	140	10/03/2015	http://neurosynth.org/analyses/terms/theory%20mind
Threat	170	15/03/2015	http://neurosynth.org/analyses/terms/threat/

Table S8. Partners' Pupils Constricting > Static

Region	BA	Side	Cluster Size	x	y	z	Z-Max
1. Lateral Occipital Gyrus –V5	37	R	868	50	-62	2	4.56
1. Lateral Occipital Gyrus –V5	37	R		52	-70	0	4.12
1. Lateral Occipital Gyrus –V5	37	R		58	-70	0	4.1
1. Inferior Temoral Gyrus (ITG)	37	R		48	-46	-18	3.65
1. Middle Temoral Gyrus	37	R		52	-44	-6	3.26
1. Middle Temoral Gyrus	37	R		46	-60	14	3.17

The activation survives whole-brain correction ($p < 0.05$) for multiple comparisons at the cluster level 2.3. (n=34). Locations coordinates are in stereotactic MNI space with 2x2x2 voxel size. The source of anatomical labels: FSL Atlas tools. Subpeaks of the clusters= Z-score; R= right; L = left; BA = Brodmann area.

Table S9. Partners' Pupils Dilating > Static

Region	BA	Side	Cluster Size	x	y	z	Z-Max
1. Lateral Occipital Gyrus –V5	37	R	1152	50	-62	2	2
1. Lateral Occipital Gyrus –V5	37	R		52	-70	0	-16
1. Lateral Occipital Gyrus –V5	37	R		58	-70	0	8
1. Lateral Occipital Gyrus –V5	37	R		48	-46	-18	12
1. Lateral Occipital Gyrus –V5	37	R		52	-44	-6	2
2. Temporal occipital (Fusiform Gyrus)	37	L	556	42	-50	-14	-14
2. Lateral occipital sulcus	19	L		-40	-68	8	3.68
2. Lateral Occipital Gyrus –V5	19	L		-40	-70	-6	3.16
2. Lateral Occipital Gyrus –V5	19	L		-42	-58	8	3.15
2. Lateral Occipital Gyrus –V5	19	L		-52	-66	12	2.89
2. Lateral Occipital Gyrus –V5	37	L		-44	-62	-10	2.88

The activation survives whole-brain correction ($p< 0.05$) for multiple comparisons at the cluster level 2.3. (n=34). Locations coordinates are in stereotactic MNI space with 2x2x2 voxel size. The source of anatomical labels: FSL Atlas tools. Subpeaks of the clusters= Z-score; R= right; L = left; BA = Brodmann area.

Table S10. Partners' Pupil Changing > Static

Region	BA	Side	Cluster Size	x	y	z	Z-Max
1. Lateral Occipital Gyrus –V5	37	R	1419	50	-62	2	4.75
1. Inferior Temoral Gyrus (ITG)	37	R		48	-46	-18	4.22
1. Lateral Occipital Cortex	37	R		60	-70	0	3.99
1. Lateral Occipital Gyrus –V5	39	R		46	-60	14	3.63
1. Temporal Occipital (Fusiform Gyrus)	37	R		42	-50	-14	3.54
1. Middle Temoral Gyrus	37	R		52	-44	-6	3.36

*The activation survives whole-brain correction ($p< 0.05$) for multiple comparisons at the cluster level 2.3. (n=34). Locations coordinates are in stereotactic MNI space with 2x2x2 voxel size. The source of anatomical labels: FSL Atlas tools. Subpeaks of the clusters= Z-score; R= right; L = left; BA = Brodmann area.

Table S11: The subjects' sex, age and questionnaire scores

Participants'	N	Min	Max	Mean	Std.
BDI	36	0	18	4,08	3,988
State	27	36	57	46,30	4,445
Trait	35	43	56	48,66	3,412
EC	40	0	6,57	4,686	1,275
PT	40	0	6,71	4,814	1,203
LSAS Fear	40	0	1,42	0,519	0,334
LSAS Avoid	40	0	1,25	0,486	0,308

Characteristics of subjects. The average score of the BDI questionnaire was 4, 08 which means that the group has minimal depression (Beck, Guth, Steer, & Ball, 1997). The average STAI score was 46,30 and 48,6 while the cut-off score for anxiety is 54-55 (Kvaal, Ulstein, Nordhus, & Engedal, 2005), therefore, we can conclude that the group is not anxious. For the Interpersonal Reactivity Index (IRI), the average score per question is among 3.5 (the half of the seven subscales). This group has an average of 4.68 per empathic concern (EC) and 4,8 for perspective taking (PT), suggesting that participants were empathetic towards other people. The average score for the LSAS is 0.5, concluding that the group does not have any fear or avoidance. BDI = Beck Depression Inventory, State & Trait = two subscales of State-Trait Anxiety Inventory, LSAS = Liebowitz Social Anxiety Scale.

Table S12. Localizers

TOM-Localizer		Threat-Localizer	
1. TOM story	**1. Photography story**	**1. Threatening story**	**1.Non-threatening story**
Larry chose a debated topic for his class paper due on Friday. The news on Thursday indicated that the debate had been solved but Larry never read it.	A large oak tree stood in front of City Hall from the time the building was built. Last year the tree fell down and was replaced by a stone fountain.	Imagine the following situation: At night on the way home, you decide to take a shortcut through the dark park. From the middle of the park, a man with a knife approaches you. You run for your life.	Imagine the following situation: You are watching an animal documentary on TV. The doorbell rings. Your neighbour is at the door and asks whether you have some sugar for her. You go to kitchen to get it for her.
2. Question	**2. Question**	**2. Question**	**2. Question**
When Larry writes his paper he thinks the debate has been solved.	An antique drawing of City Hall shows a fountain in front.	The situation is threatening	The situation is threatening
3. Answer	**3. Answer**	**3. Answer**	**3. Answer**
True/False	True/False	True/False	True/False

Localizer tasks. Two localizer tasks were performed to map TOM and threat-related networks. The inclusion masks derived from the localizers consisted thus of voxels that showed a significant difference between conditions where participants had to use TOM or had to think about a threatening event as compared to a control condition. Scan settings was the same as for the trust-game task **(Methods, fMRI data acquisition)**. The threat and TOM localizers were matched in terms of the number of words they contained. Both localizers lasted 8 minutes and their order was counter-balanced across participants.

Appendix B

Supplementary Material for Chapter 5

This file includes:

Figure S1 to S3

Tables S1 to S10

Quantification of physiological synchrony

Figure S1 shows that while in real couples we found significant associations in expressions between male and female participants, in randomly paired couples, significant associations were only formed within subjects.

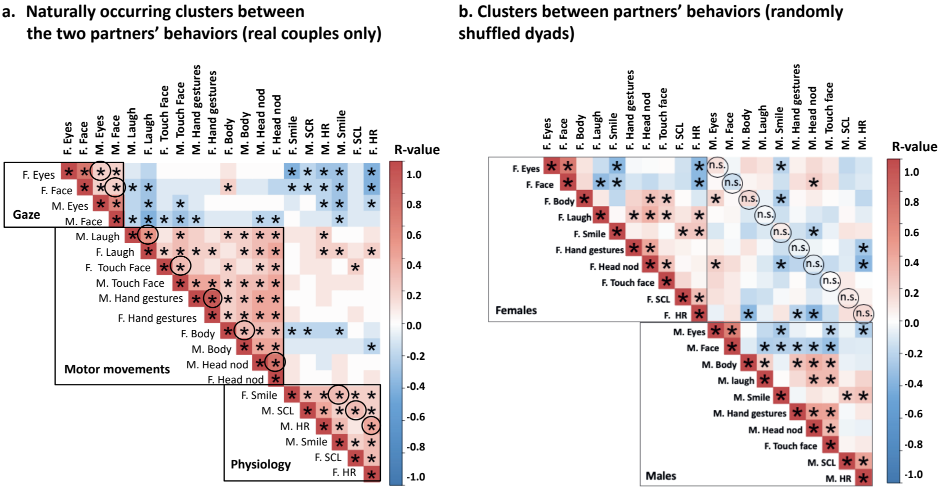


Figure S1. Correlation tables summarizing the associations between males and females and within-subject correlations in participants' expressions, fixations and physiology for three interaction time periods (based on Spearman's rank – order correlations, $N = 162$). The columns of the correlation matrix are placed according to the hierarchical clustering with similar values near each other. F = females, M = males. HR = heart rate, SCL = skin conductance level. **(a) Real couples:** The black boxes framed around naturally occurring clusters demonstrate that synchrony occurred on all three levels of expressions including males' and females' gaze reciprocity, expression mimicry and physiological synchrony. The circles represent ten types of synchrony including: smiles, laughs, head nods, hand gestures, face touching, eye contact, face-to-face gaze, body gaze, heart rate, and skin conductance level (all $\rho > 0.28$, $p < 0.05$). **(b) Randomly matched couples:** The heat map shows that in randomly paired couples the significant associations were almost exclusively formed within subjects, while in real couples the behavior clustered also between male and female participants, we used the FDR Benjamini-Hochberg's p-value < 0.05 to define significance (Benjamini and Hochberg, 1995).

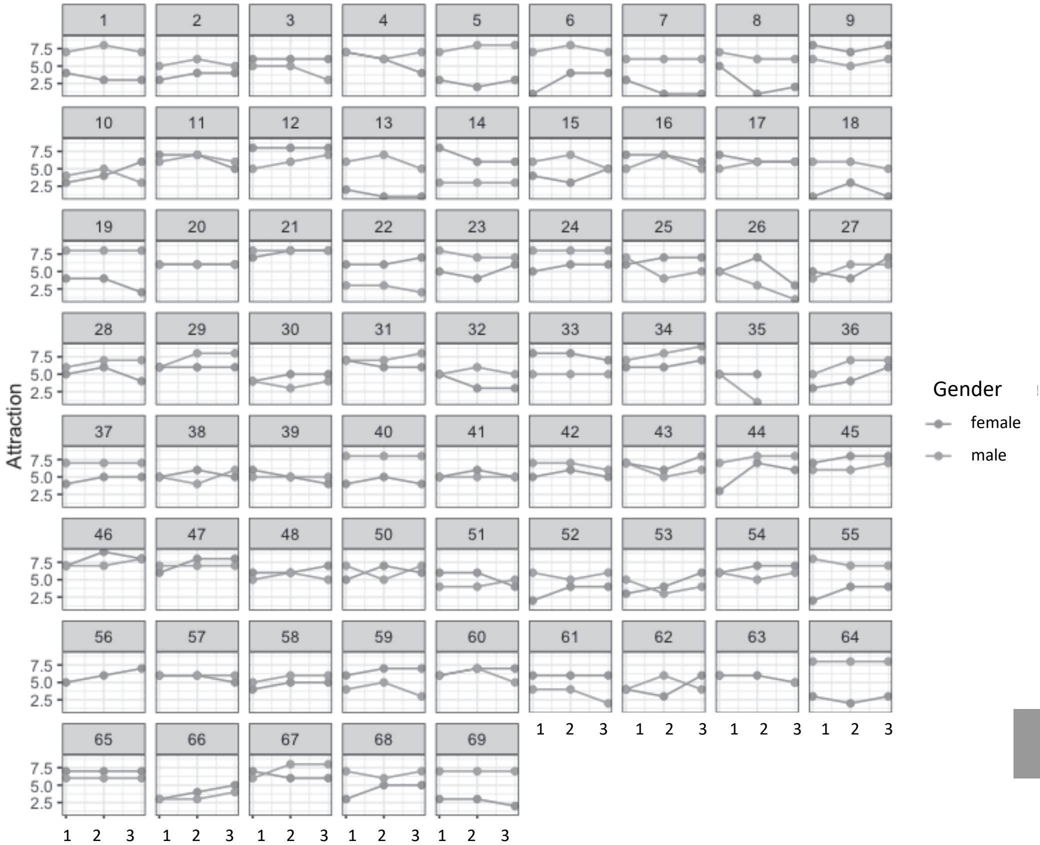


Figure S2. These line graphs provide an example of how attraction changed over time. Time: 1 = first impression, 2 = second interaction, 3 = third interaction. The rating scale was 0 – 9.

B

Individuals' expressions

During couples' dating interactions, we observed gender differences in naturally occurring expressions. Specifically, the results obtained from a Multivariate Multilevel linear mixed model (F (11, 98) = 4.06, p < 0.0001; Pillai's Trace = 0.34, Partial Eta = 0.34) indicated that females were significantly more expressive than males: females smiled, nodded and touched their face more frequently than males did (all *p*s < 0.01, **Figure S2**). Males, on the other hand, stared at their female partner more; they fixated at the female's head and eyes significantly longer than females looked at them (all *p*s < 0.01), while females had a tendency to look around and fixate longer at the background than males did ($p = 0.025$). Additionally, females' heart rate (F (1, 108) = 5.39, $p = 0.002$) and skin conductance level (F (1, 108) = 9.68, $p < 0.0001$) were higher than males' (Fig. 2) and females also reported to feel more "aroused" and less self-confident than men (all *p*s < 0.01). Together these data suggest that during a date, males' and females' behavior and physiology differs.

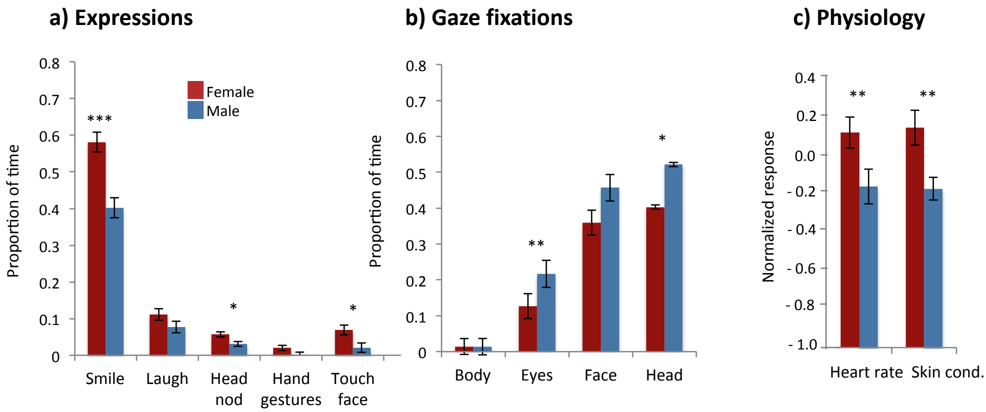


Figure S3. Bar graphs represent gender differences in the proportion of time males and females displayed specific **(a)** expressions, **(b)** gazed at specific areas of interest and **(c)** average heart rate (HR) and skin conductance responses (SCR) across the three interaction types; physiological responses were normalized by baseline correction and z-transformation. Significance was defined using FDR 0.05. All *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, N = 54 couples, error bars: ± SE.

Table S1 shows synchrony associations (focusing on the circles in Figure 1) within real dating partners compared to randomly matched pairs. Significant evidence was found for seven types of synchrony in: smiles, laughs, head nods, hand gestures, face-to-face gaze, heart rate, and skin conductance. There is no significant difference in touching face, body gaze and eye contact fixations between true couples and randomly matched couples.

Table S1. Correlation comparisons between true couple and randomly matched couples

	True Male	Random Male	Fisher's Z	*p*
Female's Eyes	0.23	0.13	0.99	0.31
Female's Face	0.22	-0.14	3.26	**0.00**
Female's Body	0.28	0.15	1.24	0.21
Female's Laugh	0.50	-0.02	5.20	**0.00**
Female's Smile	0.31	0.07	2.23	**0.02**
Female's Hand gestures	0.87	-0.04	12.11	**0.00**
Female's Head nod	0.66	-0.07	7.71	**0.00**
Female's Touch Face	0.27	0.11	1.53	0.12
Female's Skin conductance	0.32	0.09	2.13	**0.03**
Female's Heart rate	0.36	0.16	2.01	**0.04**

B

Table S2 summarizes results of the Multilevel linear mixed models where we investigated how different types of interpersonal synchronies impact on participant's attraction ratings (0-9). The multilevel model had following structure: three time points (Level 1) nested in participants (Level 2). We included all 7 synchrony predictors including synchrony in (i) smiles, (ii) laughs, (iii) head nods, (iv) hand gestures, (v) face-to-face, (vi) heart rate, and (vii) skin conductance. The full model further included factors of gender, time **(first impression, first interaction, second interaction),** the type of interaction (first impression, verbal, nonverbal), the order of interaction (verbal/nonverbal first) and two-way interactions between the type of interaction * and the type of synchrony (smiles, laughs, head nods, hand gestures, eye-to-eye, heart rate, and skin conductance). The final model was selected with a backward stepwise selection of fixed effects. The VIF values of the full and final were all smaller than 4 showing that multicollinearity did not influence our results.

Table S2. The Summary of the Full Multilevel linear mixed model Predicting Attraction Based on Synchrony Measures, gender, time, the type of interaction, the order of interaction and interactions between the type of interaction * synchrony

	Attraction			
Predictors	F	df1	df2	*p*
Intercept	1.616	19	285	**.055**
Gender (0 = female, 1 = male)	8.365	1	285	**.004**
Time	2.477	2	285	.086
Interaction type (0 = nonverbal/ 1 = verbal)	.330	1	285	.566
Verbal interaction first (0 = no, 1 = yes)	.563	1	285	.454
SCL synchrony	8.045	1	285	**.005**
HR synchrony	3.889	1	285	**.050**
Face-to-face contact	.411	1	285	.522
Smile mimicry	.322	1	285	.571
Laugh mimicry	.066	1	285	.797
Nodding mimicry	.252	1	285	.616
Gestures mimicry	.001	1	285	.978
Interaction type * SCL synchrony	1.189	1	285	.276
Interaction type * HR synchrony	.320	1	285	.572
Interaction type * Face-to-face contact	.304	1	285	.582
Interaction type * Smile mimicry	.006	1	285	.939
Interaction type * Laugh mimicry	.271	1	285	.603
Interaction type * Nodding mimicry	.078	1	285	.780
Interaction type * Gestures mimicry	.001	1	305	.987
Residual Effect	Estimate	Std. Error	Z	*p*
Variance	.759	.075	10.150	**.000**
Var (Intercept) Participant	2.142	.333	6.427	**.000**

Note: Time had three time points: first impression, first interaction, second interaction.

Table S3. The Summary of the Final Multilevel linear mixed model Predicting Attraction Based on Synchrony Measures

	Attraction			
Predictors	F	df1	df2	*p*
Intercept	4.954	5	298	**.000**
Gender	8.389	1	298	**.004**
Time	4.330	2	298	**.014**
SCL synchrony	7.332	1	298	**.007**
HR synchrony	5.498	1	298	**.020**
Random Effect	Estimate	Std. Error	Z	*p*
Variance	.745	.072	10.304	**.000**
Var (Intercept) Participant	2.154	.331	6.510	**.000**

Note: Time had three time points: first impression, first interaction, second interaction.

Control analysis – Does within or between dyad synchrony predict attraction?

In the previously described model, the variables for heart rate and skin conductance level synchrony included within- and between-dyad level variation in synchrony. It is therefore unclear whether couples that are highly attracted to each other synchronize more than those who are not (i.e., between-dyad effect), or whether changes in physiological synchrony over time predict attraction changes (i.e., within-dyad effect). To disentangle the two types of variations, we computed two variables: (1) Between-dyad SCL synchrony: the averaged synchrony level across time points per dyad, and (2) Within-dyad SCL synchrony: the deviation in synchrony level (per time point) from the dyad's averaged synchrony level (within-dyad centering). Both variables were included in a Multilevel linear mixed model with a two-level structure (three-time points (Level 1), nested in participants (Level 2). We also included a random intercept effect (across participants) and a random slope for Time, but not allowing a correlation between both random effects. Time variable was specified on continuous scale (as participants displayed (more or less) linear trajectories over time in attraction. The slope for time indicated the evolution of attraction over time.

B

Table S4. The Summary of the <u>Final</u> Multilevel linear mixed model Predicting Attraction Based on Synchrony Measures reflecting between-dyad variations (dyad's overall level of synchrony), and within-dyad variation (changes in synchrony level over time within each dyad)

	Attraction			
Predictors	F	df1	df2	*p*
(Intercept)	3.523	7	296	**.001**
Gender	8.240	1	296	**.004**
Time	4.151	2	296	**.017**
Within-dyad SCL synchrony	6.236	1	296	**.013**
Between-dyad SCL synchrony	1.013	1	296	.315
Within-dyad HR synchrony	4.679	1	296	**.031**
Between-dyad HR synchrony	.824	1	296	.365
Random Effect	Estimate	Std. Error	Z	*p*
Variance	.762	.077	9.957	**.000**
Var (Intercept) Participant	2.178	.349	6.250	**.000**

Note: Time had three time points: first impression, first interaction, second interaction.

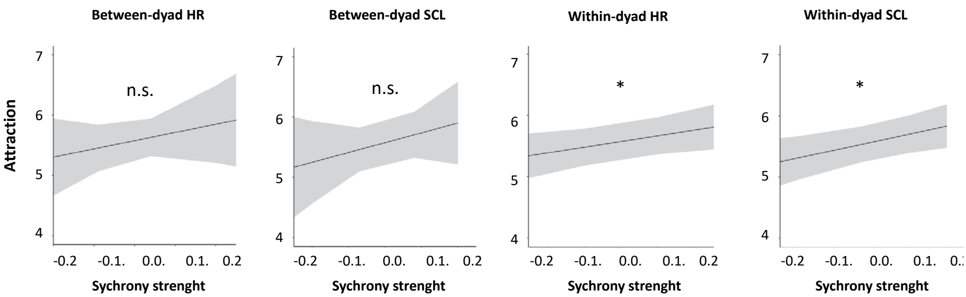


Figure S4: The line graphs represent slopes extracted from our Multilevel linear mixed model predicting attraction based on synchrony measures reflecting between-dyad variations and within-dyad variation (Table S4). The shaded areas represent 95% confidence intervals. Attraction based on Between-dyad HR synchrony [β = 1.34, SE = 1.47, CI (-1.56, 4.25), p = 0.365] and Between-dyad SCL synchrony [β = 1.63, SE = 1.62, CI (-0.56, 4.83), p = 0.315], Within-dyad HR synchrony [β = 0.96, SE = 0.44, CI (0.08, 1.83), p = 0.031] and Within-dyad SCL synchrony [β = 1.41, SE = 0.56, (CI 0.30, 2.53), p = 0.013]. The shaded areas represent 95% confidence intervals.

Control analysis – does arousal predict attraction?

In the current study we observed that synchrony in skin conductance level and heart rate could predict attraction. One possible confound is that it is not the synchrony on the dyadic level, but the arousal responses of the two individuals that drive these findings. For example, skin conductance levels might rise if a participant feels attracted to his/her partner. Consequently, the responses of the two participants would highly correlate reflecting the individuals' decisions rather than an interpersonal process. To test this, we conducted a control analysis where attraction was regressed against the participants' skin conductance (baseline corrected) heart rate and skin conductance levels for each interaction. For the skin conductance level, we first standardized the responses per participant and then computed the mean skin conductance and heart rate level per each interaction (first impression, verbal, nonverbal). Consistent with the model of the main analysis, we included gender and time as a control variable including individual as a random intercept effect. The model summary is shown in Table S4 which shows that attraction could not be predicted by the arousal responses of the two individuals.

Table S5. Summary of Multilevel linear mixed model with the Heart Rate (HR) and Skin Conductance Level (SCL) Predicting Participants' Attraction Ratings

	Attraction			
Predictors	F	df1	df2	*p*
Intercept	2.383	5	298	.039
Gender	8.269	1	298	**.004**
Time	1.637	2	298	.196
SCL level	.036	1	298	.850
HR level	.003	1	298	.955
Random Effect	Estimate	Std. Error	Z	*p*
Variance	.802	.081	9.951	**.000**
Var (Intercept) Participant	2.173	.347	6.258	**.000**

Note. SC = Skin Conductance; HR = Heart Rate.

Control analysis – is attraction a valid outcome variable?

One may wonder whether we really measured attraction in this study or possibly something else. To control for this possibility, throughout the experiment we also collected other ratings including trust, liking, feeling of connection and click. We also asked whether subjects felt awkward or anxious **(Table S3)**. Theses scores were then compared with attraction ratings **(Part 1)** and participants choice to go for another date (yes/not) with the partner **(Part 2)**.

B

Table S6a. Descriptive Statistics of Participants' Ratings

	N	Minimum	Maximum	Mean	Std. Dev.
	Self-ratings				
Valence	362	2	9	6.01	1.632
Arousal	362	1	9	5.94	1.757
Self-confident	397	1	9	5.65	1.467
Awkward	395	1	9	4.80	2.197
Shy	398	1	9	4.34	2.003
	Partner ratings				
Trustworthy	408	1	9	6.87	1.438
Intelligent	409	2	9	6.59	1.318
Funny	409	1	9	5.96	1.611
Attractive	408	1	9	5.57	1.711
	Self - Partner ratings				
Similar personality	408	1	8	4.86	1.712
Connection	411	1	8	4.48	1.838
Click	404	1	9	4.38	1.871
Sex. Attraction	410	1	9	3.83	1.945

The scale for all ratings ranged between 0 – 9, Descriptive statistics are based on 138 subjects ($N = 69$ dyads) rating their partner three times (after first impression, verbal and nonverbal interaction). Valence = higher number represents positive valence. Arousal = higher number represents more arousal levels.

Control analysis – is attraction a valid outcome variable? (Part 1)

To identify the common dimensions of ratings, we took all thirteen ratings and submitted them to a principal component analysis (PCA), using the Oblimin with Kaiser Normalization rotation method **Table S4)**. The first principal component (PC) accounted for 37.7% of the variance and the second PC accounted for 17.2% of the variance of the mean trait judgments. All positive judgments (e.g., attractive, funny, similar in personality, feeling of click, connection) had positive loadings, and all negative feelings (e.g., awkward, shy, low self-confidence) had negative loadings on the first PC (Table S4), suggesting that it can be interpreted as valence evaluation.

Table S6b. Principal Component Analysis: Loadings of Participants' Ratings

	Component 1 (Positive)	Component 2 (Negative)
Click	**.876**	-.035
Connection	**.861**	-.003
Sexual Attraction	**.826**	.070
Attractive	**.775**	.089
Funny	**.720**	.094
Similar personality	**.699**	.011
Intelligent	.562	.002
Trustworthy	.514	-.104
Valence	.483	-.285
Arousal	.235	.169
Awkward	-.049	**.880**
Shy	.183	**.851**
Self-confident	.092	**-.751**

Note. Self-confidence is negatively loaded to feelings of awkwardness and shyness because more confident people were less awkward and shy, they felt. The PCA was based on N = 344 valid cases.

B

Control analysis – is attraction valid outcome variable? (Part 2)

Multilevel binary logistic regression investigates how different types of ratings predict participants' choice to go for another date (yes/ no, coded 1 and 0 respectively). The multilevel model had the following structure: three time points (Level 1) nested in participants (Level 2). We included all 13 ratings (Table ST4) as predictors. The results showed that the model was highly predictive of participants' choice to date their partner again (Overall percentage reached 99.7% accuracy). Among all the ratings only positive affect and attraction predicted participants decisions significantly **(Table S5)**, whereas attraction ratings explained the most variance in participants' binary decision to date their partner (yes/no).

Table S7. Summary of Multilevel Binary Logistic Regression

	Date partner (yes/no)			
Predictors	F	df1	df2	*p*
Intercept	2.469	13	317	**.003**
Valence	3.936	1	317	**.048**
Arousal	.049	1	317	.825
Shy	.030	1	317	.863
Awkward	.207	1	317	.650
Self-confident	.964	1	317	.327
Attractive	6.331	1	317	**.012**
Funny	.096	1	317	.757
Intelligent	1.088	1	317	.298
Trustworthy	.565	1	317	.453
Similar personality	.025	1	317	.876
Connection	.536	1	317	.464
Sex. Attraction	.591	1	317	.443
Click	1.332	1	317	.249
Random Effect	Estimate	Std. Error	Z	*p*
Var (Intercept)	.117	.156	.749	.454

Control analysis – do partner's expressions predict attraction?

We conducted a follow-up control analyses to test whether specific behavior enacted by one individual promotes attraction in the other individual. In the Multilevel linear mixed model, we used five predictors. This time, instead of synchrony measures, we used the proportion of time a participant displayed specific expressions (smiling, laughing, head shaking, hand gestures) or gaze fixations (looking at partners' face) as predictors of partner's attraction ratings (0 - 9). The full model further included factors of gender, time **(first impression, first interaction, second interaction)** and the interaction between gender * expression as additional predictors. The multilevel model had following structure: three time points (Level 1) nested in participants (Level 2). The VIF values of the full and final were all smaller than 4 showing that multicollinearity did not influence our results. The results of Multilevel mixed effects models revealed that none of the directly visible signals such as participants' expressions and gaze fixations were significant predictors of male's or female's partner attraction scores.

Table 8. Summary of Multilevel linear mixed model with Participants' Visible Expressions Predicting Partners' Attraction Ratings

	Partners' Attraction			
Predictors	*F*	*df1*	*df2*	*p*
Intercept	1.523	13	310	.108
Gender	6.542	1	310	**.011**
Time	1.467	2	310	.232
Face-to-face contact	1.215	1	310	.271
Smile	.001	1	310	.980
Laugh	.337	1	310	.562
Nod	.030	1	310	.863
Gestures	.346	1	310	.557
Gender * Face-to-face contact	.506	1	310	.477
Gender * Smile	.507	1	310	.477
Gender * Laugh	1.365	1	310	.244
Gender * Nod	.014	1	310	.905
Gender * Gestures	.706	1	310	.402
Random Effect	Estimate	Std. Error	Z	*p*
Variance	2.106	.186	11.347	**.000**
Var (Intercept)	.865	.243	3.556	**.000**

B

Table S9. Participants' Demographics and Other Descriptive Statistics

	Female			Male			
Characteristics	N	M	SD	N	M	SD	*t*
Age	69.00	23.45	4.18	69.00	25.71	4.64	-2.96 **
Weight	68.00	65.84	10.34	67.00	78.06	8.70	-7.42 ***
Height	69.00	171.90	6.98	68.00	182.51	6.44	-9.24 ***
Number of alcohol drinks	68.00	0.01	0.55	68.00	0.58	0.55	-3.13 **
How much commitment (0-9)	64.00	5.92	1.64	65.00	5.72	1.43	0.73
Time single in months	62.00	38.69	65.31	59.00	37.03	65.45	0.14

	Average per cent	
Education	Female (N = 69)	Male (N = 69)
VMBO	0.02	0.00
HAVO	0.04	0.02
VWO	0.02	0.15
MBO	0.13	0.08
HBO	0.30	0.38
WO	0.47	0.38

Note: *** $p < .001$, VMBO: the lowest completed high-school level, WO: the highest level (scientific education, Bachelor or Master degree). How much commitment is on 0-9 scale.

Table S10. Comparisons (t-test) variables by sex: Liebowitz Social Anxiety Scale (LSAS), Positive and Negative Affect Schedule (Watson et al., 1988)(Watson et al., 1988)(Watson et al., 1988)(Watson et al., 1988) (PANAS) and Sexual Desire Inventory (SDI). The SDI is comprised of 11 items about various sexual behaviors, on a 5-point Likert scale. The total score on the SDI is the sum of all 11 items, with higher scores reflecting a higher sexual desire. The LSAS is comprised of two subscales: performance and social interaction. The 24 questions ultimately lead to six subscale scores: total fear, fear of social interaction, fear of performance, total avoidance, avoidance of social interaction and avoidance of performance. The statements had to be answered on a 4-point scale (0 = not at all, 4 = totally). The PANAS: consists of two 10-item mood scales, measuring positive affect (PA) and negative affect (NA). Participants are asked to rate their experience with a certain emotion on a 5-point scale (1 = very slightly or not at all, 5 = very much).

Table S10. Comparisons (t-test) variables by sex

	Female		Male			
Variable	M	SD	M	SD	*t*	*p*
SDI	4.25	1.47	4.68	0.93	-1.692	0.094
LSAS Fear	0.46	0.49	0.45	0.64	0.099	0.921
LSAS avoidance	0.77	0.67	0.81	0.69	-0.271	0.787
PANAS negative	1.69	0.45	1.72	.40	-.280	0.780
PANAS positive	3.20	0.56	3.41	.53	-1.853	0.067
Trust baseline	8.10	0.94	7.75	1.02	2.084	**0.039**
Trust overall	6.85	1.56	6.89	1.29	.186	0.817

Note: Trust baseline measures how trustworthy a potential partner should be, trust overall measures average trust across three interaction periods.

B

Quantifying expressive mimicry and eye fixation synchrony.

Mimicry is defined broadly as ‘doing what others are doing’. While some studies are very loose on their definition of mimicry; for instance, mimicry might be defined as any movement following the other person's movement (Fujiwara and Daibo, 2016; Tschacher et al., 2014). We adopt a stricter definition of mimicry where mimicry occurs when a person A directly does the same expression as person B (LaFrance, 1979; LaFrance and Broadbent, 1976). The advantage of this stricter definition is that in contrast to movement synchrony, it can be easily operationalized. Indeed, the observation of movement echo proved to be difficult to define and often leads to inconsistent results (Grammer et al., 1998). Motor movements (smiling, laughing, head nod, hand gestures, face touching) were coded by four independent raters (two raters for males and two for females). Eye fixations falling on pre-defined areas of interests were automatically recorded using Tobii Pro Glasses 2. Both emotional expression or eye fixation were classified per tenths of seconds as binary variable (1 for occurrence, 0 for no occurrence). We then quantified mimicry for each dyad and interaction by calculating the proportion of time both participants' directly reciprocated expressions (smiling, laughing, head nod, hand gestures, face touching) and gaze fixations (looking at partners' head, eyes, face, body). The proportion of mimicry was calculated for each condition (the first impression, verbal and nonverbal interaction) resulting in N dyads * 3 results * for mimicry in smiles, laughs, head nods, hand gestures, eye-to-eye fixations.

Quantification of physiological synchrony

Two methods that take non-stationarity into account are lagged windowed cross-correlation (Boker et al., 2002) and recurrence quantification analysis (Gates and Liu, 2016). The latter method is frequently used which has the advantage of having very few assumptions. However, the disadvantage is that it determines synchrony on a binary scale of moments being classified as either synchronized or not. The former method, albeit constraint by more assumptions, has the advantage of differentiating the degree of synchronization by quantifying it on a continuous (correlation) scale. Additionally, we feel that windowed cross-correlation is more intuitive to interpret. Consequently, we decided to apply this method which provides measures of the strength of synchrony. The objective of the lagged windows-cross correlations analysis (Boker et al., 2002) is to calculate the strength of association between two time series while taking into account the non-stationarity of the signals and the lag between responses, that is, to consider the dynamics of a dyadic interaction. Specifically, the time series are segmented into smaller intervals, calculating the cross-correlation for each segment. This allows the means and variances to differ between segments accounting for non-stationarity. This is important as the level of synchrony may change during the experiment, sometimes having moments of strong synchronization while during other times responding less strong to one another. Additionally, as the strength of association between two time points may differ depending on how far apart they are from each other, the segments are moved along the time series by an increment such that two adjacent segments overlap. Hence, segmenting the time series into smaller intervals and partially overlapping these intervals while moving along the time series provides a better estimate of the local strength of association between the physiological signals of two participants.

Besides the dynamics in the strength of synchronization during the course of the experiment, participants differ in how fast one might respond to a certain event or the other person. In other words, participants might not always be perfectly "in sync" whereby one participant might sometimes respond to the other person or vice versa introducing a delay between the responses of two individuals. To account for this, for each segment, the signals of the two participants are lagged in relation to one another. Specifically, the signal of participant 1 is kept constant while the signal of participant 2 is shifted more and more by a specified lag increment until a maximum lag is reached. Next, the same procedure is performed the other way around with participant 2 being kept constant. The maximum lag determines what is still considered synchrony. For example, if the maximum lag is four seconds, responses from two participants that are four seconds apart from each other are still considered synchronized. On the other hand, if one participant reacts to a certain event and the other participant shows a response 5 seconds later, it is not considered a response to the same event anymore and therefore does not count as synchrony. Based on this approach, there are four parameters that need to be determined: (1) the length of each segment, referred to the window size w_{max}; (2) the increment with which the segments are moved along the time series, the window increment w_{inc}; (3) the maximum with which two segments can be lagged from one another, the maximum lag τ_{max}; and (4) the increment with which two segments are lagged from each other, the lag increment τ_{inc}. We determined the parameters following an extensive process by comparing previous studies using similar statistical methods, by looking at what is physiologically plausible given the time course of the physiological signals and by employing a data-driven bottom-up approach where we investigated how changing the parameters affected the outcomes using a different dataset. As expected, the absolute values of the synchrony measures varied depending on the parameters, but as supported by (McAssey et al., 2013), the relative results were not affected (e.g. a dyadic manifesting relatively high synchrony showed such tendency for the different parameters). Based on these three factors, we set the parameters as follows: the window size was 8 seconds (160 samples), the window increment was 2 seconds (40 samples), the maximum lag was 4 seconds (80 samples) and the lag increment was 100ms (2 samples).

Calculating the cross correlations of each lag for each window segment generates a result matrix with each row representing one window segment and each column indicating a lag. The middle column represents the cross-correlation with a lag of zero, while the first and last column contain the cross-correlations for the maximum lag of participant 1 and 2. Hence, the number of columns in the result matrix is $(2^* \tau_{max} / \tau_{inc}) + 1$. The number of rows is given by $(N - w_{max} - \tau_{max})/ w_{inc}$, with N being the number of observations in the whole time series. Based on this result matrix, a so-called peak picking algorithm is applied. For each segment (i.e., each row in the matrix), the maximum cross-correlation across the lags is detected closest to the zero-lag (i.e., across all columns in a given row). If that maximum correlation is preceded and followed by smaller correlations, it is marked as a peak. For example, if participant 2 synchronizes with participant 1 with a lag of one second, the cross-correlations will become higher the closer the segments from the two participants are shifted towards the point where they are one second apart from each other. When the two signals are lagged by exactly one second the cross-correlation is highest (the peak). If the signals are lagged further away from each other, the cross-correlation decreases again. If, however, a peak cannot be detected, the algorithm assigns a missing value for that segment. This might be the case, for example, if people do not respond to an event or to each other (e.g., both participants wait and do nothing). The peak picking algorithm outputs a matrix with two columns, containing the value of the maximum cross-correlation (the peak) and the corresponding lag at which the peak cross-correlation is detected. The output has the same number of rows as the result matrix as it searches for a peak cross-correlation for each window segment. Both the windowed cross-correlations and the peak picking algorithm were conducted 6 times per dyad, once for the heart rate responses and once for the skin conductance responses for each condition (the first impression, verbal and nonverbal interaction) resulting in 54 dyads * 6 result and peak picking matrices. Finally, the mean cross-correlations of all window segments were calculated for both physiological measures for each condition per dyad.

Appendix C

Supplementary Material for Chapter 6

This file includes:

Figure S1 to S2

Tables S1 to S8

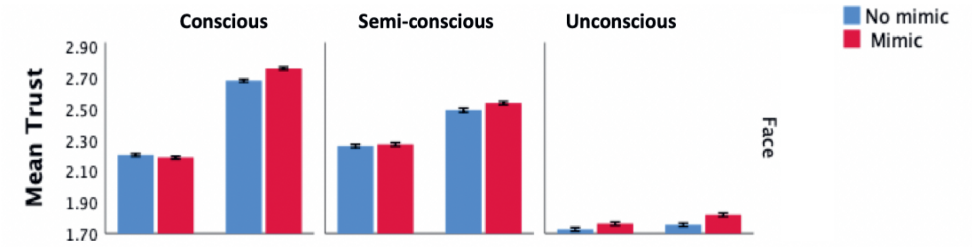


Figure S1: The effect of facial mimicry on trust. On average, the suppression broke in 25% of CFS trials (27% face trials and in 22% eyes condition trials). To test whether suppression breaks quicker for in response to negative emotions, we selected the trials in which suppression broke and checked whether suppression was modulated by the stimuli type (eyes/faces) and emotional expressions (positive, neutral, negative). In line with previous studies, Generalized linear model showed that emotional expressions ([$F(1, 2309) = 17.547$, $P < 0.0001$]) and the interaction between the stimuli type * emotional expressions had a main effect on reaction time within which the CFS broke ([$F(1, 2309) = 9.416$, $P < 0.0001$]). The pairwise comparison (Table S7) revealed that positive expressions broke the suppression quicker then negative ones. Table S8 demonstrates that this effect was driven mainly by eye stimuli, where dilated pupils broke the suppression quicker than static and constricted pupils. In faces, the happy facial expressions broke suppression quicker then neutral but not quicker than fearful faces.

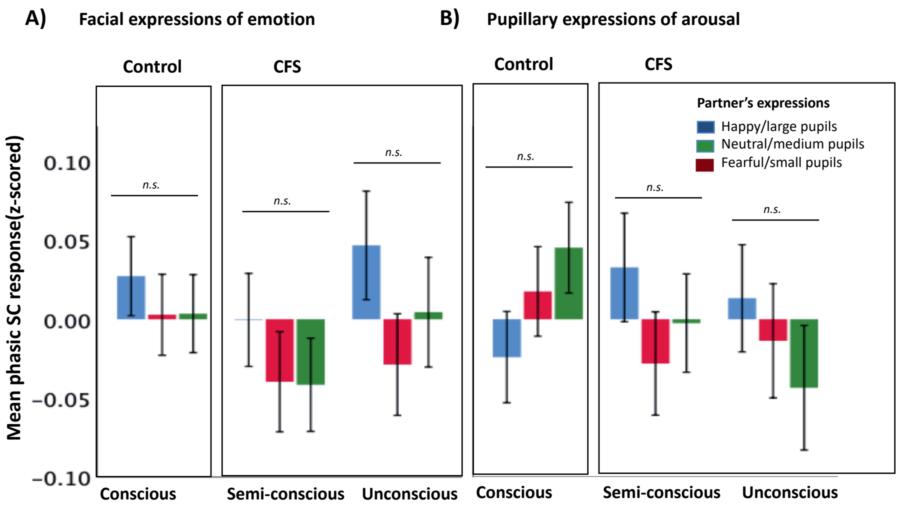


Figure S2: The phasic skin conductance measures did not differ across conditions.

Table S1. Summary of Generalized linear model predicting subjects' trust (investment as DV)

Fixed Effects	F	df1	df2	*p*
Intercept	121.011	17	17808	.000
Expression modality (Eyes/Face)	19.878	1	17808	.000
Emotion	79.913	2	17808	.000
Awareness level	770.611	2	17808	.000
Awareness level * Emotion	10.846	4	17808	.000
Awareness level * Expression modality	.805	2	17808	.447
Emotion * Expression modality	21.441	2	17808	.000
Awareness level * Emotion * Expression modality	24.019	4	17808	.000

C

Table S2. Frowning mimicry (CS signal as DV)

Fixed Effects	F	df1	df2	*p*
Intercept	3.501	17	163803	.000
Linear trend	.007	1	163803	.933
Cubic trend	.578	1	163803	.447
Quadratic trend	4.860	1	163803	.027
Emotion	9.935	2	163803	.000
Awareness level	6.355	2	163803	.002
Awareness level * Emotion	2.540	4	163803	.038
Emotion * Linear	.128	2	163803	.880
Emotion * Cubic	1.222	2	163803	.295
Emotion * Quadratic	.569	2	163803	.566

Table S3. Smiling mimicry (ZM signal as DV)

Fixed Effects	F	df1	df2	*p*
Intercept	3.312	17	163803	.000
Linear trend	.570	1	163803	.450
Cubic trend	.100	1	163803	.752
Quadratic trend	.081	1	163803	.775
Emotion	7.603	2	163803	.000
Awareness level	.273	2	163803	.761
Awareness level * Emotion	8.246	4	163803	.000
Emotion * Linear	.708	2	163803	.493
Emotion * Cubic	.291	2	163803	.747
Emotion * Quadratic	.895	2	163803	.408

Note: Emotion had 3 levels (Faces: happy, neutral, fearful/Pupils: large, medium, small), Awareness levels had 3 levels (conscious, semi-conscious, unconscious).

Table S4. Pupil mimicry (pupil size as a DV)

Fixed Effects	F	df1	df2	*p*
Intercept	21.185	17	136071	.000
Linear trend	209.712	1	136071	.000
Cubic trend	62.896	1	136071	.000
Quadratic trend	.850	1	136071	.357
Emotion	.276	2	136071	.759
Awareness level	8.961	2	136071	.000
Awareness level * Emotion	1.062	4	136071	.374
Emotion * Linear	.076	2	136071	.927
Emotion * Cubic	.215	2	136071	.806
Emotion * Quadratic	.153	2	136071	.858

Table S5. Facial Mimicry - Trust

Fixed Effects	F	df1	df2	*p*
Intercept	89.686	11	5911	.000
Awareness level	299.688	2	5911	.000
Emotion	167.514	1	5911	.000
Mimicry	.082	1	5911	.775
Emotion * Awareness level	51.489	2	5911	.000
Emotion * Mimicry	.921	1	5911	.337
Awareness level * Mimicry	.496	2	5911	.609
Emotion * Awareness level * Mimicry	.432	2	5911	.649

Table S7. RT b-CFS: Pairwise Contrasts

Expressions: Pairwise Contrasts	Contrast Estimate	Std. Error	t	df	*p*
negative - neutral	.012	.022	.546	2309	.585
negative - positive	.121	.022	5.466	2309	0,00
neutral - negative	-.012	.022	-.546	2309	.585
neutral - positive	.109	.023	4.821	2309	0,00

The least significant difference adjusted significance level is .05.

Table S6. RT b-CFS

Fixed Effects	F	df1	df2	*p*
Corrected Model	10.203	5	2309	.000
Emotion	17.547	2	2309	.000
Expression modality (Eyes/Face)	1.807	1	2309	.179
Expression modality * Emotion	9.416	2	2309	.000

The least significant difference adjusted significance level is .05.

Table S8. RT b-CFS: Pairwise Contrasts

Modality	Expression Pairwise Contrasts	Contrast Estimate	Std. Error	t	df	*p*
Face	negative - neutral	-.043	.031	-1.42	2309	.155
	negative - positive	.025	.030	.82	2309	.411
	neutral - negative	.043	.031	1.42	2309	.155
	neutral - positive	.068	.030	2.29	2309	.022
Eyes	negative - neutral	.067	.033	2.05	2309	.040
	negative - positive	.218	.032	6.72	2309	0,00
	neutral - negative	-.067	.033	-2.05	2309	.040
	neutral - positive	.150	.032	4.73	2309	0,00

The least significant difference adjusted significance level is .05.

Appendix D

Supplementary Material for Chapter 7

This file includes:

Figure S1

Tables S1 to S4

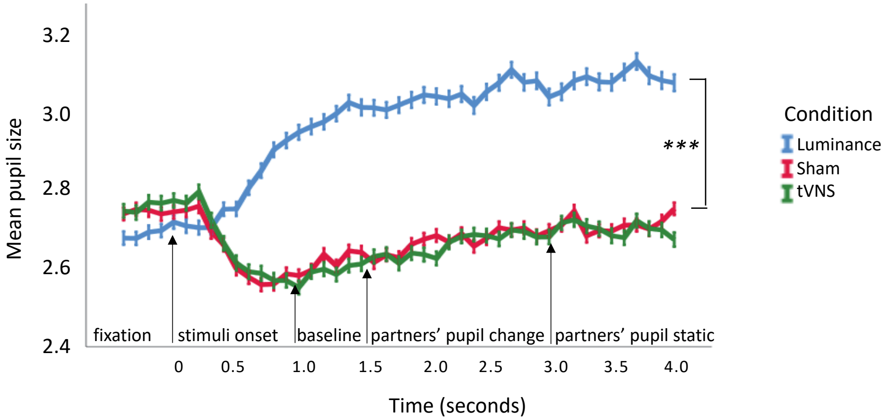


Figure 1. The effect of **condition** on participants' pupil size. The average pupil size of 500 ms of each participant and the trial (thus five values) before the partners' pupils started to change (1.000 ms-1.500 ms after stimulus onset) served as a baseline and was subtracted from all remaining pupil size values.

Table 1. The effect on participants' uncorrected pupil size (all participants)

	F	df1	df2	Sig.
Intercept	21.524	11	115248	.000
Condition	11.813	2	115248	.000
lin	185.531	1	115248	.000
quad	18.767	1	115248	.000
cub	1.158	1	115248	.282
Condition*lin	.206	2	115248	.814
Condition* quad	1.546	2	115248	.213
Condition* cub	2.423	2	115248	.089

Table 2. The effect on participants' corrected pupil size

	F	df1	df2	Sig.
Intercept	14.171	11	108997	.000
Partner Pupil Size	14.535	1	108997	.000
Condition	.368	2	108997	.692
lin	121.288	1	108997	.000
quad	13.501	1	108997	.000
cub	.346	1	108997	.556
Partner Pupil Size * lin	4.573	1	108997	.032
Partner Pupil Size * quad	.022	1	108997	.882
Partner Pupil Size * cub	.312	1	108997	.576
Condition * Partner Pupil Size	.519	2	108997	.595

Table 3. The effect on participants' investments (Trust)

	F	df1	df2	Sig.
Intercept	2.496	5	5280	.029
Partner Pupil Size	2.583	1	5280	.108
Condition	1.632	2	5280	.196
Partner Pupil Size* Condition	3.268	2	5280	.038

Table 4. The effect on participants' pupil contingent trust

	F	df1	df2	Sig.
Intercept	.780	5	138	.566
Condition	.456	2	138	.635
Subject Pupil Size	.178	1	138	.673
Condition * Subject Pupil Size	1.292	2	138	.278

References

Adolphs, R., 2001. The neurobiology of social cognition. Curr. Opin. Neurobiol. 11 (2), 231–239.

Adolphs, R., Gosselin, F., Buchanan, T.W., Tranel, D., Schyns, P., Damasio, A.R., 2005. A mechanism for impaired fear recognition after amygdala damage. Nature 433, 68–72. https://doi.org/10.1038/nature03086

Aktar, E., Raijmakers, M.E.J., Kret, M.E., 2020. Pupil mimicry in infants and parents. Cogn. Emot. 1–11. https://doi.org/10.1080/02699931.2020.1732875

Allman, J.M., Tetreault, N.A., Hakeem, A.Y., Manaye, K.F., Semendeferi, K., Erwin, J.M., Park, S., Goubert, V., Hof, P.R., 2010. The von Economo neurons in frontoinsular and anterior cingulate cortex in great apes and humans. Brain Struct. Funct. 214, 495–517. https://doi.org/10.1007/s00429-010-0254-0

Ambadar, Z., Schooler, J.W., Conn, J.F., 2005. Deciphering the enigmatic face the importance of facial dynamics in interpreting subtle facial expressions. Psychol. Sci. 16, 403–410. https://doi.org/10.1111/j.0956-7976.2005.01548.x.

Amemiya, S., Ohtomo, K., 2012. Effect of the observed pupil size on the amygdala of the beholders. Soc. Cogn. Affect. Neurosci. 7, 332–341. https://doi.org/10.1093/scan/nsr013

Amodio, D.M., Frith, C.D., 2006. Meeting of minds: the medial frontal cortex and social cognition. Nat. Rev. 7, 268–277. https://doi.org/10.1038/nrn1884

Anders, S., Birbaumer, N., Sadowski, B., Erb, M., Mader, I., Grodd, W., Lotze, M., 2004. Parietal somatosensory association cortex mediates affective blindsight. Nat. Neurosci. 7, 339–340. https://doi.org/10.1038/nn1213

Anders, S., Heinzle, J., Weiskopf, N., Ethofer, T., Haynes, J., 2011. Flow of affective information between communicating brains. Neuroimage 54 (1), 439–446.

Anderson, J.R., Myowa–Yamakoshi, M., Matsuzawa, T., 2004. Contagious yawning in chimpanzees. Proc. Roy. Soc. Lond.B: Biol. Sci. 271 (6), 468–470.

Anisfeld, M., 1996. Only tongue protrusion modeling is matched by neonates. Dev. Rev. 16 (2), 149–161.

Armony, J.L., Le Doux, J.E., 1997. How the brain processes emotional information. Ann. N. Y. Acad. Sci. 821 (1), 259–270.

Asada, M., 2015. Towards artificial empathy. Int. J. Soc. Robot. 7 (1), 19–33. Assogna, F., Pontieri, F.E., Caltagirone, C., Spalletta, G., 2008. The recognition of facial emotion expressions in Parkinson's disease. Eur. Neuropsychopharmacol. 18 (11), 835–848.

Asada, M., MacDorman, K.F., Ishiguro, H., Kuniyoshi, Y., 2001. Cognitive developmental robotics as a new paradigm for the design of humanoid robots. Robot. Autonomous Syst. 37 (1), 185–193.

Assenza, G., Campana, C., Colicchio, G., Tombini, M., Assenza, F., Di Pino, G., Di Lazzaro, V., 2017. Transcutaneous and invasive vagal nerve stimulations engage the same neural pathways: In-vivo human evidence. Brain Stimul. https://doi.org/10.1016/j.brs.2017.03.005

Astington, J.W., Jenkins, J.M., 1999. A longitudinal study of the relation between language and theory-of-mind development. Dev. Psychol. 35 (5), 1311.

Astington, J.W.E., Baird, J.A., 2005. Why language matters for theory of mind. In: Why Language Matters for Theory of Mind, Apr, 2002, University of Toronto, Toronto, ON, Canada; This volume originated from the aforementioned conference. Oxford University Press.

Aston-Jones, G., Chiang, C., Alexinsky, T., 1991. Discharge of noradrenergic locus coeruleus neurons in behaving rats and monkeys suggests a role in vigilance. Prog. Brain Res.

Aston-Jones, G., Cohen, J.D., 2005. An integrative theory of locus coeruleus-norepinephrine function: adaptive gain and optimal performance. Annu. Rev. Neurosci. 28, 403–450. https://doi.org/10.1146/annurev.neuro.28.061604.135709

Atkinson, A.P., Adolphs, R., 2005. Visual emotion perception. Emotion Consciousness 150–184. Augustine, J.R., 1996. Circuitry and functional aspects of the insular lobe in primates including humans. Brain Res. Rev. 22 (3), 229–244.

Bar-Gad, I., Morris, G., Bergman, H., 2003. Information processing, dimensionality reduction and reinforcement learning in the basal ganglia. Prog. Neurobiol. https://doi.org/10.1016/j.pneurobio.2003.12.001

Bar, M., Neta, M., Linz, H., 2006. Very first impressions. Emotion 6, 269–278. https://doi.org/10.1037/1528-3542.6.2.269

Baron-Cohen, S., Campbell, R., Karmiloff-Smith, A., Grant, J., 1995. Are children with autism blind to the mentalistic significance of the eyes? Br. J. Develop. Psychol. 13 (4), 379–398.

Baron-Cohen, S., Wheelwright, S., Hill, J., Raste, Y., Plumb, I., 2001. The “Reading the Mind in the Eyes” test revised version: a study with normal adults, and adults with Asperger syndrome or high-functioning autism. J. Child Psychol. Psychiatry 42 (2), 241–251.

Barrett, L.F., Simmons, W.K., 2015. Interoceptive predictions in the brain. Nat. Rev. Neurosci. 16 (7), 419–429.

Baumgartner, T., Heinrichs, M., Vonlanthen, A., Fischbacher, U., Fehr, E., 2008. Oxytocin Shapes the Neural Circuitry of Trust and Trust Adaptation in Humans. Neuron 58, 639–650. https://doi.org/10.1016/J.NEURON.2008.04.009

Ben-Menachem, E., Hamberger, A., Hedner, T., Hammond, E.J., Uthman, B.M., Slater, J., Treig, T., Stefan, H., Ramsay, R.E., Wernicke, J.F., Wilder, B.J., 1995. Effects of vagus nerve stimulation on amino acids and other metabolites in the CSF of patients with partial seizures. Epilepsy Res. 20, 221–227. https://doi.org/10.1016/0920-1211(94)00083-9

Benjamini, Y., Hochberg, Y., 1995. Controlling the false discovery rate: a practical and powerful approach to multiple testing. J. R. Stat. Soc. Ser. B 57, 289–300. https://doi.org/10.1111/j.2517-6161.1995.tb02031.x

Berscheid, E., Wastler, E., 1974. A little bit about love, in: Foundations of Interpersonal Attraction. pp. 356–381. https://doi.org/10.1016/b978-0-12-362950-0.50021-5

Bleske, B.E., Chung, H.S., DiMagno, M., Nicklas, J.M., 1999. Diurnal variation in plasma norepinephrine in patients with heart failure. Pharmacotherapy 19, 984–988.

Bloom, P. (2016). Against Empathy: The Case for Rational Compassion, Harper Collins, New York, New York.

Bogart, K., Matsumoto, D., 2010. Facial mimicry is not necessary to recognize emotion: facial expression recognition by people with Moebius syndrome. Soc. Neurosci. 5 (2), 241–251.

Boker, S.M., Xu, M., Rotondo, J.L., King, K., 2002. Windowed cross-correlation and peak picking for the analysis of variability in the association between behavioral time series. Psychol. Methods 7, 338–55. https://doi.org/10.1037/1082-989X.7.3.338

Borovikova, L. V., Ivanova, S., Zhang, M., Yang, H., Botchkina, G.I., Watkins, L.R., Wang, H., Abumrad, N., Eaton, J.W., Tracey, K.J., 2000. Vagus nerve stimulation attenuates the systemic inflammatory response to endotoxin. Nature 405, 458–462. https://doi.org/10.1038/35013070

Bradley, M.M., Miccoli, L., Escrig, M.A., Lang, P.J., 2008. The pupil as a measure of emotional arousal and autonomic activation. Psychophysiology 45, 602–607. https://doi.org/10.1111/j.1469-8986.2008.00654.x

Brascamp, J.W., Naber, M., 2017. Eye tracking under dichoptic viewing conditions: a practical solution. Behav. Res. Methods 49, 1303–1309. https://doi.org/10.3758/s13428-016-0805-2

Bryant, J., Miron, D., 2003. Excitation-transfer theory and three-factor theory of emotion, in: Communication and Emotion: Essays in Honor of Dolf Zillmann. Routledge, pp. 31–59. https://doi.org/10.4324/9781410607584

Buccino, G., Binkofski, F., Fink, G.R., Fadiga, L., Fogassi, L., Gallese, V., Freund, J., 2001. Action observation activates premotor and parietal areas in a somatotopic manner: an fMRI study. Eur. J. Neurosci. 13 (2), 400–404.

Buck, R., 1980. Nonverbal behavior and the theory of emotion: the facial feedback hypothesis. J. Pers. Soc. Psychol. 38 (5), 811.

Burger, A.M., Van der Does, W., Brosschot, J.F., Verkuil, B., 2020. From ear to eye? No effect of transcutaneous vagus nerve stimulation on human pupil dilation: A report of three studies. Biol. Psychol. 152, 107863. https://doi.org/10.1016/j.biopsycho.2020.107863

Cacioppo, J.T., Tassinary, L.G., Berntson, G.G., 2000. Psychophysiological science. Handbook of Psychophysiology. Cambridge University Press, pp. 3–23.

Capone, F., Assenza, G., Di Pino, G., Musumeci, G., Ranieri, F., Florio, L., Barbato, C., Di Lazzaro, V., 2015. The effect of transcutaneous vagus nerve stimulation on cortical excitability. J. Neural Transm. 122, 679–685. https://doi.org/10.1007/s00702-014-1299-7

Carlson, J.M., Reinke, K.S., 2008. Masked Fearful Faces Modulate the Orienting of Covert Spatial Attention. Emotion 8, 522–529. https://doi.org/10.1037/a0012653

Carr, L., Iacoboni, M., Dubeau, M.-C., Mazziotta, J.C., Lenzi, G.L., 2003. Neural mechanisms of empathy in humans: a relay from neural systems for imitation to limbic areas. Proc. Natl. Acad. Sci. U. S. A. 100, 5497–502. https://doi.org/10.1073/pnas.0935845100

Cashdan, E., 1998. Smiles, speech, and body posture: How women and men display sociometric status and power. J. Nonverbal Behav. 22, 209–228. https://doi.org/10.1023/A:1022967721884

Caspers, S., Zilles, K., Laird, A.R., Eickhoff, S.B., 2010. ALE meta-analysis of action observation and imitation in the human brain. Neuroimage 50, 1148–1167. https://doi.org/10.1016/j.neuroimage.2009.12.112

Catmur, C., Walsh, V., Heyes, C., 2007. Sensorimotor learning configures the human mirror system. Curr. Biol. 17, 1527–1531.

Cattaneo, L., Barchiesi, G., Tabarelli, D., Arfeller, C., Sato, M., Glenberg, A.M., 2010. One's motor performance predictably modulates the understanding of others' actions through adaptation of premotor visuo-motor neurons. Soc. Cognit. Affect. Neurosci. 6 (3), 301–310.

Chanes, L., Barrett, L.F., 2016. Redefining the role of limbic areas in cortical processing. Trends Cogn. Sci. 20 (2), 96–106.

Charman, T., Swettenham, J., Baron-Cohen, S., Cox, A., Baird, G., Drew, A., 1997. Infants with autism: an investigation of empathy, pretend play, joint attention, and imitation. Dev. Psychol. 33 (5), 781.

Charpak, N., Gabriel Ruiz, J., Zupan, J., Cattaneo, A., Figueroa, Z., Tessier, R., Mokhachane, M., 2005. Kangaroo mother care: 25 years after. Acta Paediatr. 94 (5), 514–522.

Chartrand, T.L., Bargh, J.A., 1999. The chameleon effect: the perception-behavior link and social interaction. J. Pers. Soc. Psychol. 76, 893–910. https://doi.org/10.1037/0022-3514.76.6.893

Chartrand, T.L., Dalton, A.N., 2009. Mimicry: its ubiquity, importance and functionality. Oxford Handbook of Human Action. pp. 458–483.

Chartrand, T.L., Lakin, J.L., 2013. The antecedents and consequences of human behavioral mimicry. Annu. Rev. Psychol. 64 (1), 285–308.

Chartrand, T.L., van Baaren, R., 2009. Human mimicry. Adv. Exp. Soc. Psychol. 41, 219–274. Chen, Q., Panksepp, J.B., Lahvis, G.P., 2009. Empathy is moderated by genetic background in mice. PLoS One 4 (2), e4387.

Chatel-Goldman, J., Congedo, M., Jutten, C., Schwartz, J.-L., 2014. Touch increases autonomic coupling between romantic partners. Front. Behav. Neurosci. 8. https://doi.org/10.3389/fnbeh.2014.00095

Chen, C.C., Williams, C.L., 2012. Interactions between epinephrine, ascending vagal fibers, and central noradrenergic systems in modulating memory for emotionally arousing events. Front. Behav. Neurosci. https://doi.org/10.3389/fnbeh.2012.00035

Clancy, J.A., Mary, D.A., Witte, K.K., Greenwood, J.P., Deuchars, S.A., Deuchars, J., 2014. Non-invasive Vagus nerve stimulation in healthy humans reduces sympathetic nerve activity. Brain Stimul. 7, 871–877. https://doi.org/10.1016/j.brs.2014.07.031

Cohen, B., Waugh, G., Place, K., 1989. At the movies: an unobtrusive study of arousal-attraction. J. Soc. Psychol. 129, 691–693. https://doi.org/10.1080/00224545.1989.9713786

Colzato, L.S., Sellaro, R., Beste, C., 2017. Darwin revisited: The vagus nerve is a causal element in controlling recognition of other's emotions. Cortex 92, 95–102. https://doi.org/10.1016/j.cortex.2017.03.017

Crabbe, J.C., Wahlsten, D., Dudek, B.C., 1999. Genetics of mouse behavior: interactions with laboratory environment. Science 284 (5420), 1670–1672.

Crane E., 2015. Revived by the power of love: Incredible moment "dead" premature baby came back to life after mother begged to cuddle him for a few last moments and ordered baby's dad to take off his shirt and help. Daily Mail Australia. Retrieved from http://www.dailymail.co.uk/news/article-2992862/The-miracle-baby-born-threemonths-early-written-doctors-brought-life-mother-s-touch-five-years-old-s-neversick.html.

Creaven, A.M., Skowron, E.A., Hughes, B.M., Howard, S., Loken, E., 2014. Dyadic concordance in mother and preschooler resting cardiovascular function varies by risk status. Dev. Psychobiol. 56 (1), 142–152.

Critchley, H., Daly, E., Phillips, M., Brammer, M., Bullmore, E., Williams, S., Van Amelsvoort, T., Robertson, D., David, A., Murphy, D., 2000. Explicit and implicit neural mechanisms for processing of social information from facial expressions: A functional magnetic resonance imaging study. Hum. Brain Mapp. 9, 93–105. https://doi.org/10.1002/(SICI)1097-0193(200002)9:2<93::AID-HBM4>3.0.CO;2-Z

Critchley, H.D., 2009. Psychophysiology of neural, cognitive and affective integration: fMRI and autonomic indicants. Int. J. Psychophysiol. 73, 88–94. https://doi.org/10.1016/j.ijpsycho.2009.01.012

Damasio, A.R., 1996. The somatic marker hypothesis and the possible functions of the prefrontal cortex. Philos. Trans. R. Soc. B Biol. Sci. 351, 1413–1420. https://doi.org/10.1098/rstb.1996.0125

Davis, M.H., 1983. A mulitdimensional approach to individual differences in empathy. J. Pers. Soc. Psychol. 44, 113–126. https://doi.org/10.1037/0022-3514.44.1.113

de Dreu, C.K., Greer, L.L., Handgraaf, M.J., Shalvi, S., Van Kleef, G.A., Baas, M., Feith, S.W., 2010. The neuropeptide oxytocin regulates parochial altruism in intergroup conflict among humans. Science 328 (5984), 1408–1411.

de Dreu, C.K., Gross, J., Méder, Z., Giffin, M., Procházková, E., Krikeb, J., Columbus, S., 2016. In-group defense, out-group aggression, and coordination failures in intergroup conflict. Proc. Natl. Acad. Sci. 10524–10529.

de Dreu, C.K.W., Giffin, M.R., 2017. Neuroendrocrine Pathways to In-Group Bounded Trust and Cooperation, in: Trust in Social Dilemmas. Oxford Scholarship Online. https://doi.org/10.1093/oso/9780190630782.001.0001

De Dreu, C.K.W., Gross, J., Méder, Z., Giffin, M., Procházková, E., Krikeb, J., Columbus, S., 2016. In-group defense, out-group aggression, and coordination failures in intergroup conflict. Proc. Natl. Acad. Sci. U. S. A. 113, 10524–9. https://doi.org/10.1073/pnas.1605115113

de Gelder, B., Snyder, J., Greve, D., Gerard, G., Hadjikhani, N., 2004. Fear fosters flight: a mechanism for fear contagion when perceiving emotion expressed by a whole body. Proc. Natl. Acad. Sci. U. S. A. 101 (47), 16701–16706.

de Kleijn, R., Kachergis, G., Hommel, B., 2015. Robotic action control: on the crossroads of cognitive psychology and cognitive robotics. In: Samani, H. (Ed.), Cognitive Robotics. CRC Press, London, pp. 171–187.

de Waal, F.B., Ferrari, P.F., 2010. Towards a bottom-up perspective on animal and human cognition. Trends Cognit. Sci. 14 (5), 201–207.

de Waal, F.B.M., Preston, S.D., 2017. Mammalian empathy: behavioural manifestations and neural basis. Nat. Rev. Neurosci. 18, 498–509. https://doi.org/10.1038/nrn.2017.72

Decety, J., 2010. To what extent is the experience of empathy mediated by shared neural circuits. Emotion Rev. 2 (3), 204–207.

Decety, J., 2011. Dissecting the neural mechanisms mediating empathy. Emotion Rev. 3 (1), 92–108.

Decety, J., Bartal, I.B.A., Uzefovsky, F., Knafo-Noam, A., 2016. Empathy as a driver of prosocial behaviour: highly conserved neurobehavioural mechanisms across species. Philos. Trans. Royal Soc. 371 (1686), 20150077.

Decety, J., Lamm, C., 2006. Human empathy through the lens of social neuroscience. Scientific World J. 6, 1146–1163.

Decety, J., Lamm, C., 2007. The role of the right temporoparietal junction in social interaction: how low-level computational processes contribute to meta-cognition. Neuroscientist 2 (91), 115–124.

Decety, J., Svetlova, M., 2012. Putting together phylogenetic and ontogenetic perspectives on empathy. Develop. Cognit. Neurosci. 2 (1), 1–24.

Dedovic, K.,Duchesne, A., Andrews, J., Engert, V., Pruessner, J.C., 2009. The brain and the stress axis: the neural correlates of cortisol regulation in response to stress. Neuroimage 47 (3), 864–871.

Demos, K E, Kelley, W.M., Ryan, S.L., Davis, F.C., Whalen, P.J., 2008. Human amygdala sensitivity to the pupil size of others. Cereb. Cortex 18, 2729–2734.

Di Pellegrino, G., Fadiga, L., Fogassi, L., Gallese, V., Rizzolatti, G., 1992. Understanding motor events: a neurophysiological study. Exp. Brain Res. 91 (1), 176–180.

Di, G., Fadiga, L., Fogassi, L., Gallese, V., Rizzolatti, G., 1992. Understanding motor events: a neurophysiological study. Exp. Brain Res. 91 (1), 176–180.

Diedenhofen, B., Musch, J., 2015. Cocor: A comprehensive solution for the statistical comparison of correlations. PLoS One 10, e0121945. https://doi.org/10.1371/journal.pone.0121945

Dietrich, S., Smith, J., Scherzinger, C., Hofmann-Preiß, K., Freitag, T., Eisenkolb, A., Ringler, R., 2008. A novel transcutaneous vagus nerve stimulation leads to brainstem and cerebral activations measured by functional MRI. Biomed. Tech. 53, 104–111. https://doi.org/10.1515/BMT.2008.022.

Dijk, C., Koenig, B., Ketelaar, T., de Jong, P.J., 2011. Saved by the blush: being trusted despite defecting. Emotion 11 (2), 313.

Dijk, C., Voncken, M.J., de Jong, P.J., 2009. I blush, therefore I will be judged negatively: influence of false blush feedback on anticipated others' judgments and facial coloration in high and low blushing-fearfuls. Behav. Res. Ther. 47 (7), 541–547.

Dimberg, U., Thunberg, M., 1998. Rapid facial reactions to emotional facial expressions. Scand. J. Psychol. 39 (1), 39–45. Dimberg, U., Thunberg, M., Elmehed, K., 2000. Unconscious facial reactions to emotional facial expressions. Psychol. Sci. 11 (1), 86–89.

Dinstein, I., Hasson, U., Rubin, N., Heeger, D.J., 2007. Brain areas selective for both observed and executed movements. J. Neurophysiol. 98 (3), 1415–1427.

Donner, T.H., Nieuwenhuis, S., 2013. Brain-wide gain modulation: The rich get richer. Nat. Neurosci. https://doi.org/10.1038/nn.3471

Dorr, A.E., Debonnel, G., 2006. Effect of vagus nerve stimulation on serotonergic and noradrenergic transmission. J. Pharmacol. Exp. Ther. 318, 890–898. https://doi.org/10.1124/jpet.106.104166

Driver, J., Noesselt, T., 2008. Multisensory interplay reveals crossmodal influences on 'sensory-specific' brain regions, neural responses, and judgments. Neuron 57 (1), 11–23.

Drummond, P.D., Bailey, T., 2013. Eye contact evokes blushing independently of negative affect. J. Nonverbal Behav. 37 (4), 207–216. Duffy, K.A., Chartrand, T.L., 2015. Mimicry: causes and consequences. Curr. Opin.Behav. Sci. 3, 112–116.

Drummond, P.D., Lazaroo, D., 2012. The effect of facial blood flow on ratings of blushing and negative affect during an embarrassing task: preliminary findings. J. Anxiety Disord. 26 (2), 305–310.

Dufour, N., Redcay, E., Young, L., Mavros, P.L., Moran, J.M., Triantafyllou, C., Gabrieli, J.D.E., Saxe, R., 2013. Similar brain activation during false belief tasks in a large sample of adults with and without autism. PLoS One 8, e75468. https://doi.org/10.1371/journal.pone.0075468

Eastwick, P.W., Finkel, E.J., 2008. Sex differences in mate preferences revisited: do people know what they initially desire in a romantic partner? J. Pers. Soc. Psychol. 94, 245–264. https://doi.org/10.1037/0022-3514.94.2.245

Eklund, A., Nichols, T., Knutsson, H., 2015. Can parametric statistical methods be trusted for fMRI based group studies? Proc. Natl. Acad. Sci. U. S. A. 113, 7900–5. https://doi.org/10.1073/pnas.1602413113

Ekman, P., Levenson, R.W.,Friesen, W.V., 1983. Autonomic nervous system activity distinguishes among emotions. Science 221 (4616), 1208–1210.

Eldar, E., Cohen, J.D., Niv, Y., 2013. The effects of neural gain on attention and learning. Nat. Neurosci. 16, 1146–1153. https://doi.org/10.1038/nn.3428

Elío Sjak-Shie, 2018. PhysioData Toolbox (Version 0.4) [Computer software].

Emonds, G., Declerck, C.H., Boone, C., Seurinck, R., Achten, R., 2014. Establishing cooperation in a mixed-motive social dilemma. An fMRI study investigating the role of social value orientation and dispositional trust. Soc. Neurosci. 9, 10–22. https://doi.org/10.1080/17470919.2013.858080

Estow, S., Jamieson, J.P., Yates, J.R., 2007. Self-monitoring and mimicry of positive and negative social behaviors. J. Res. Personal. 41 (2), 425–433.

Fan, Y., Duncan, N.W., de Greck, M., Northoff, G., 2011. Is there a core neural network in empathy? An fMRI based quantitative meta-analysis. Neurosci. Biobehav. Rev. 35 (3), 903–911.

Fan, Y., Duncan, N.W., de Greck, M., Northoff, G., 2011. Is there a core neural network in empathy? An fMRI based quantitative meta-analysis. Neurosci. Biobehav. Rev. https://doi.org/10.1016/j.neubiorev.2010.10.009

Farley, S.D., 2014. Nonverbal reactions to an attractive stranger: the role of mimicry in communicating preferred social distance. J. Nonverbal Behav. 38, 195–208. https://doi.org/10.1007/s10919-014-0174-4

Farroni, T., Csibra, G., Simion, F., Johnson, M.H., 2002. Eye contact detection in humans from birth. Proc. Natl. Acad. Sci. U. S. A. 99 (14), 9602–9605. Fawcett, C., Wesevich, V., Gredebäck, G., 2016. Pupillary contagion in infancy evidence for automatic transfer of arousal. Psychol. Sci 0956797616643924.

Fawcett, C., Arslan, M., Falck-Ytter, T., Roeyers, H., Gredebäck, G., 2017. Human eyes with dilated pupils induce pupillary contagion in infants. Sci. Rep. 7, 9601. https://doi.org/10.1038/s41598-017-08223-3

Fawcett, C., Wesevich, V., Gredebäck, G., 2016a. Pupillary contagion in infancy: evidence for spontaneous transfer of arousal. Psychol. Sci. 27, 997–1003. https://doi.org/10.1177/0956797616643924

Fehr, E., Gächter, S., 2002. Altruistic punishment in humans. Nature 415, 137–140. https://doi.org/10.1038/415137a

Feldman, R., 2012. Parent–infant synchrony: a biobehavioral model of mutual influences in the formation of affiliative bonds. Monogr. Soc. Res. Child Dev. 77 (2), 42–51.

Feldman, R., Magori-Cohen, R., Galili, G., Singer, M., Louzoun, Y., 2011. Mother and infant coordinate heart rhythms through episodes of interaction synchrony. Infant Behav. Develop. 34 (4), 569–577.

Feldman, R., Rosenthal, Z., Eidelman, A.I., 2014. Maternal-preterm skin-to-skin contact enhances child physiologic organization and cognitive control across the first 10 years of life. Biol. Psychiatry 75 (1), 56–64.

Ferrari, P.F., Rozzi, S., Fogassi, L., 2005. Mirror neurons responding to observation of actions made with tools in monkey ventral premotor cortex. J. Cogn. Neurosci. 17 (2), 212–226.

Field, T., Healy, B., LeBlanc, W.G., 1989. Sharing and synchrony of behavior states and heart rate in nondepressed versus depressed mother-infant interactions. Infant Behav. Dev. 12 (3), 357–376.

Field, T.M., Woodson, R., Greenberg, R., Cohen, D., 1982. Discrimination and imitation of facial expression by neonates. Science 218 (4568), 179–181.

Follesa, P., Biggio, F., Gorini, G., Caria, S., Talani, G., Dazzi, L., Puligheddu, M., Marrosu, F., Biggio, G., 2007. Vagus nerve stimulation increases norepinephrine concentration and the gene expression of BDNF and bFGF in the rat brain. Brain Res. 1179, 28–34. https://doi.org/10.1016/j.brainres.2007.08.045

Francis, D., Diorio, J., Liu, D., Meaney, M.J., 1999. Nongenomic transmission across generations of maternal behavior and stress responses in the rat. Science 286 (5442), 1155–1158.

Frangos, E., Ellrich, J., Komisaruk, B.R., 2015. Non-invasive access to the vagus nerve central projections via electrical stimulation of the external ear: FMRI evidence in humans. Brain Stimul. 8, 624–636. https://doi.org/10.1016/j.brs.2014.11.018

Frangos, E., Komisaruk, B.R., 2017. Access to Vagal Projections via Cutaneous Electrical Stimulation of the Neck: fMRI Evidence in Healthy Humans. Brain Stimul. 10, 19–27. https://doi.org/10.1016/j.brs.2016.10.008

Front. Hum. Neurosci. 6, 214. Lloyd, D., Di Pellegrino, G., Roberts, N., 2004. Vicarious responses to pain in anterior cingulate cortex: is empathy a multisensory issue? Cognit. Affect Behav. Neurosci. 4 (2), 270–278.

Fuente, L.A., Ierardi, H., Pilling, M., Crook, N.T., 2015. Influence of Upper Body Pose Mirroring in Human-robot Interaction. International Conference on Social Robotics. Springer International Publishing, pp. 214–223.

Fujiwara, K., Daibo, I., 2016. Evaluating interpersonal synchrony: Wavelet transform toward an unstructured conversation. Front. Psychol. 7, 516. https://doi.org/10.3389/fpsyg.2016.00516

Gallese, V., 2005. Embodied simulation: from neurons to phenomenal experience. Phenomenol. Cognit. Sci. 4 (1), 23–48.

Gallese, V., Goldman, A., 1998. Mirror neurons and the simulation theory of mindreading. Trends Cogn. Sci. 2 (12), 493–501.

Gallese, V., Keysers, C., Rizzolatti, G., 2004. A unifying view of the basis of social cognition. Trends Cogn. Sci. https://doi.org/10.1016/j.tics.2004.07.002

Gates, K.M., Liu, S., 2016. Methods for Quantifying Patterns of Dynamic Interactions in Dyads. Assessment 23, 459–471. https://doi.org/10.1177/1073191116641508

Gazzola, V., Aziz-Zadeh, L., Keysers, C., 2006. Empathy and the somatotopic auditory mirror system in humans. Curr. Biol. 16 (18), 1824–1829.

Geangu, E., Benga, O., Stahl, D., Striano, T., 2010. Contagious crying beyond the first days of life. Infant Behav. Develop. 33 (3), 279–288.

Givens, D.B., 1978. The nonverbal basis of attraction: flirtation, courtship, and seduction. Psychiatry 41, 346–359. https://doi.org/10.1080/00332747.1978.11023994

Goffman, E., 1977. The arrangement between the sexes. Theory Soc. 4, 301–331. https://doi.org/10.1007/BF00206983

Gogtay, N., Giedd, J.N., Lusk, L., Hayashi, K.M., Greenstein, D., Vaituzis, A.C., Rapoport, J.L., 2004. Dynamic mapping of human cortical development during childhood through early adulthood. Proc. Natl. Acad. Sci. U. S. A. 101 (21), 8174–8179.

Goldenthal, P., Johnston, R.E., Kraut, R.E., 1981. Smiling, appeasement, and the silent bared-teeth display. Ethol. Sociobiol. 2, 127–133. https://doi.org/10.1016/0162-3095(81)90025-X

Goldin-Meadow, S., Alibali, M.W., 2013. Gesture's role in speaking, learning, and creating language. Annu. Rev. Psychol. 64, 257–283.

Goldman, A.I., Sripada, C.S., 2005. Simulationist models of face-based emotion recognition. Cognition 94 (3), 193–213.

Gonzaga, G.C., Keltner, D., Londahl, E.A., Smith, M.D., 2001. Love and the commitment problem in romantic relations and friendship. J. Pers. Soc. Psychol. 81, 247–262. https://doi.org/10.1037/0022-3514.81.2.247

Gonzalez-Liencres, C., Juckel, G., Tas, C., Friebe, A., Brüne, M., 2014. Emotional contagion in mice: the role of familiarity. Behav. Brain Res. 263, 16–21.

Gothard, K.M., Battaglia, F.P., Erickson, C.A., Spitler, K.M., Amaral, D.G., 2007. Neural responses to facial expression and face identity in the monkey amygdala. J. Neurophysiol. 97 (2), 1671–1683.

Gould, R., 2010. A Modern Approach to Regression with R. J. Stat. Softw. 33. https://doi.org/10.18637/jss.v033.b03

Grafton, S.T., Arbib, M.A., Fadiga, L., Rizzolatti, G., 1996. Localization of grasp representations in humans by positron emission tomography. Exp. Brain Res. 112 (1), 103–111.

Grammer, K., 1990. Strangers meet: laughter and nonverbal signs of interest in opposite-sex encounters. J. Nonverbal Behav. 14, 209–236. https://doi.org/10.1007/BF00989317

Grammer, K., Kruck, K.B., Magnusson, M.S., 1998. The courtship dance: Patterns of nonverbal synchronization in opposite-sex encounters. J. Nonverbal Behav. 22, 1–27. https://doi.org/10.1023/A:1022986608835

Gray, L., Watt, L., Blass, E.M., 2000. Skin-to-skin contact is analgesic in healthy new-born. Pediatrics 105 (1), e14.

Gregory, S.W., Webster, S., 1996. A nonverbal signal in voices of interview partners effectively predicts communication accommodation and social status perceptions. J. Pers. Soc. Psychol. 70 (6), 1231–1240.

Groves, D.A., Bowman, E.M., Brown, V.J., 2005. Recordings from the rat locus coeruleus during acute vagal nerve stimulation in the anaesthetised rat. Neurosci. Lett. 379, 174–179. https://doi.org/10.1016/j.neulet.2004.12.055

Guéguen, N., 2009. Mimicry and seduction: an evaluation in a courtship context. Soc. Influ. 4, 249–255. https://doi.org/10.1080/15534510802628173

Hadjikhani, N., de Gelder, B., 2003. Seeing fearful body expressions activates the fusiform cortex and amygdala. Curr. Biol. 13 (24), 2201–2205.

Haith, M.M., Bergman, T., Moore, M.J., 1977. Eye contact and face scanning in early infancy. Science 198 (4319), 853–855.

Hall, J.A., Xing, C., 2015. The verbal and nonverbal correlates of the five flirting styles. J. Nonverbal Behav. 39, 41–68. https://doi.org/10.1007/s10919-014-0199-8

Harrison, N.A., Gray, M.A., Critchley, H.D., 2009. Dynamic pupillary exchange engages brain regions encoding social salience. Soc. Neurosci. 4, 233–243. https://doi.org/10.1080/17470910802553508

Harrison, N.A., Singer, T., Rotshtein, P., Dolan, R.J., Critchley, H.D., 2006. Pupillary contagion: central mechanisms engaged in sadness processing. Soc. Cogn. Affect. Neurosci. 1, 5–17. https://doi.org/10.1093/scan/nsl006

Harrison, N.A., Wilson, C.E., Critchley, H.D., 2007. Processing of observed pupil size modulates perception of sadness and predicts empathy. Emotion 7, 724–729. https://doi.org/10.1037/1528-3542.7.4.724

Hassert, D.L., Miyashita, T., Williams, C.L., 2004. The Effects of Peripheral Vagal Nerve Stimulation at a Memory-Modulating Intensity on Norepinephrine Output in the Basolateral Amygdala. Behav. Neurosci. 118, 79–88. https://doi.org/10.1037/0735-7044.118.1.79

Hassin, R.R., 2013. Yes It Can: On the Functional Abilities of the Human Unconscious. Perspect. Psychol. Sci. 8, 195–207. https://doi.org/10.1177/1745691612460684

Hasson, U., Ghazanfar, A.A., Galantucci, B., Garrod, S., Keysers, C., 2012. Brain-to-brain coupling: a mechanism for creating and sharing a social world. Trends Cogn. Sci. 16, 1–8. https://doi.org/10.1016/j.tics.2011.12.007

Hasson, U., Nir, Y., Levy, I., Fuhrmann, G., Malach, R., 2004. Intersubject synchronization of cortical activity during natural vision. Science 303 (5664), 1634–1640.

Hatfield, E., Cacioppo, J.T., Rapson, R.L., 1993. Emotional Contagion. Curr. Dir. Psychol. Sci. 2, 240.

Hatfield, E., Cacioppo, J.T., Rapson, R.L., 1994. Emotional Contagion. Cambridge University Press. Haxby, J.V.,

Hecht, M.A., LaFrance, M., 1998. License or obligation to smile: the effect of power and sex on amount and type of smiling. Personal. Soc. Psychol. Bull. 24, 1332–1342. https://doi.org/10.1177/01461672982412007

Hedger, N., Adams, W.J., Garner, M., 2015a. Fearful faces have a sensory advantage in the competition for awareness. J. Exp. Psychol. Hum. Percept. Perform. 41, 1748–1757. https://doi.org/10.1037/xhp0000127

Hedger, N., Gray, K.L.H., Garner, M., Adams, W.J., 2016. Are visual threats prioritized without awareness? A critical review and meta-analysis involving 3 behavioral paradigms and 2696 observers. Psychol. Bull. 142, 934–968. https://doi.org/10.1037/bul0000054

Heim, C., Newport, D.J., Mletzko, T., Miller, A.H., Nemeroff, C.B., 2008. The link between childhood trauma and depression: insights from HPA axis studies in humans. Psychoneuroendocrinology 6, 693–710.

Helm, J.L., Sbarra, D.A., Ferrer, E., 2014. Coregulation of respiratory sinus arrhythmia in adult romantic partners. Emotion 14, 522–531. https://doi.org/10.1037/a0035960

Helt, M.S., Eigsti, I.M., Snyder, P.J., Fein, D.A., 2010. Contagious yawning in autistic and typical development. Child Dev. 81 (5), 1620–1631.

Hennenlotter, A., Dresel, C., Castrop, F., Ceballos Baumann, A.O., Wohlschläger, A.M., Haslinger, B., 2009. The link between facial feedback and neural activity within central circuitries of emotion - New insights from botulinum toxin-induced denervation of frown muscles. Cereb. Cortex 19, 537–542. https://doi.org/10.1093/cercor/bhn104

Herman, J.P., Ostrander, M.M., Mueller, N.K., Figueiredo, H., 2005. Limbic system mechanisms of stress regulation: hypothalamo-pituitary-adrenocortical axis. Prog. Neuropsychopharmacol. Biol. Psychiatry 29 (8), 1201–1213.

Hess, E.H., 1975. The role of pupil size in communication. Sci. Am. 233 (5), 110–112.

Hess, E.H., Seltzer, A.L., Shlien, J.M., 1965. Pupil response of hetero-and homosexual males to pictures of men and women: a pilot study. J. Abnorm. Psychol. 70 (3), 165.

Hess, U., Fischer, A., 2013. Emotional mimicry as social regulation. Personal. Soc. Psychol. Rev. 17 (2), 142–157.
Heyes, C.M., 2005. Imitation by association. In: In: Hurley, S., Chater, N. (Eds.), Perspectives on Imitation: From Neuroscience to Social Science 1. MIT Press, Cambridge, MA, pp. 157–176.
Hickok, G., 2009. Eight problems for the mirror neuron theory of action understanding in monkeys and humans. J. Cogn. Neurosci. 21 (7), 1229–1243.
Hofer, M.A., 1987. Early social relationships: a psychobiologist's view. Child Dev. 58 (3), 633–647.
Hoffman, E.A., Gobbini, M.I., 2002. Human neural systems for face recognition and social communication. Biol. Psychiatry 51 (1), 59–67.
Hofree, G., Urgen, B.A., Winkielman, P., Saygin, A.P., 2015. Observation and imitation of actions performed by humans, androids, and robots: an EMG study. Front. Hum. Neurosci. 9 (1), 59–68.
https://doi.org/10.1177/0956797615588306
Hulsey, D.R., Riley, J.R., Loerwald, K.W., Rennaker, R.L., Kilgard, M.P., Hays, S.A., 2017. Parametric characterization of neural activity in the locus coeruleus in response to vagus nerve stimulation. Exp. Neurol. 289, 21–30. https://doi.org/10.1016/j.expneurol.2016.12.005
Iacoboni, M., 2009. Imitation, empathy, and mirror neurons. Annu. Rev. Psychol. 60 (1), 653–670.
Jackson, P.L., Brunet, E., Meltzoff, A.N., Decety, J., 2006a. Empathy examined through the neural mechanisms involved in imagining how I feel versus how you feel pain. Neuropsychologia 44 (5), 752–761.
Jackson, P.L., Meltzoff, A.N., Decety, J., 2005. How do we perceive the pain of others? A window into the neural processes involved in empathy. Neuroimage 24 (3), 771–779.
Jackson, P.L., Rainville, P., Decety, J., 2006b. To what extent do we share the pain of others? Insight from the neural bases of pain empathy. Pain 125 (1–2), 5–9.
Jacob, P., Jeannerod, M., 2005. The motor theory of social cognition: a critique. Trends Cogn. Sci. 9 (1), 21–25.
Jepma, M., Nieuwenhuis, S., 2011. Pupil Diameter Predicts Changes in the Exploration–Exploitation Trade-off: Evidence for the Adaptive Gain Theory. J. Cogn. Neurosci. 23, 1587–1596. https://doi.org/10.1162/jocn.2010.21548
Jiang, Y., He, S., 2006. Cortical Responses to Invisible Faces: Dissociating Subsystems for Facial-Information Processing. Curr. Biol. 16, 2023–2029. https://doi.org/10.1016/j.cub.2006.08.084

Jones, S.S., 2006. Exploration or imitation? The effect of music on 4-week-old infants' tongue protrusions. Infant Behav. Develop. 29 (1), 126–130.

Joshi, S., Li, Y., Kalwani, R. M. & Gold, J., 2016. Relationships between pupil diameter and neuronal activity in the locus coeruleus, colliculi, and cingulate cortex. Neuron 89, 221–234. https://doi.org/10.1016/J.NEURON.2015.11.028

Kanske, P., Böckler, A., Trautwein, F.M., Singer, T., 2015. Dissecting the social brain: Introducing the EmpaToM to reveal distinct neural networks and brain-behavior relations for empathy and Theory of Mind. Neuroimage 122, 6–19. https://doi.org/10.1016/j.neuroimage.2015.07.082

Keute, M., Demirezen, M., Graf, A., Mueller, N.G., Zaehle, T., 2019. No modulation of pupil size and event-related pupil response by transcutaneous auricular vagus nerve stimulation (taVNS). Sci. Rep. 9, 1–10. https://doi.org/10.1038/s41598-019-47961-4

Keysers, C., Gazzola, V., 2009. Expanding the mirror: vicarious activity for actions, emotions, and sensations. Curr. Opin. Neurobiol. 19 (6), 666–671.

Kilner, J.M., Friston, K.J., Frith, C.D., 2007. Predictive coding: an account of the mirror neuron system. Cognit. Process. 8 (3), 159–166.

Kleckner, I., Zhang, J., Touroutoglou, A., Chanes, L., Xia, C., Simmons, W.K., Barrett, L., 2017. Evidence for a large-Scale brain system supporting allostasis and interoception in humans. bioRxiv 098970. Kleinke, C.L., 1986. Gaze and eye contact: a research review. Psychol. Bull. 100 (1), 78.

Kleinke, C.L., 1986. Gaze and Eye Contact. A Research Review. Psychol. Bull. https://doi.org/10.1037/0033-2909.100.1.78

Kobayashi, H., Kohshima, S., 1997. Unique morphology of the human eye. Nature. https://doi.org/10.1038/42842

Kohavi, R., 1995. A study of cross-validation and bootstrap for accuracy estimation and model selection. Ijcai 14, 1137–1145. https://doi.org/10.1007/978-0-387-09608-7

Krach, S., Cohrs, J.C., de Echeverría Loebell, N.C., Kircher, T., Sommer, J., Jansen, A., Paulus, F.M., 2011. Your flaws are my pain: linking empathy to vicarious embarrassment. PLoS One 6 (4), e18675.

Kraus, T., Kiess, O., Hösl, K., Terekhin, P., Kornhuber, J., Forster, C., 2013. CNS BOLD fMRI effects of sham-controlled transcutaneous electrical nerve stimulation in the left outer auditory canal - A pilot study. Brain Stimul. 6, 798–804. https://doi.org/10.1016/j.brs.2013.01.011

Kret, M.E., 2015. Emotional expressions beyond facial muscle actions. A call for studying autonomic signals and their impact on social perception. Front. Psychol.

Kret, M.E., 2017. The role of pupil size in communication. Is there room for learning? Cogn. Emot. 5, 1–7. https://doi.org/10.1080/02699931.2017.1370417

Kret, M.E., De Dreu, C.K.W., 2017. Pupil-mimicry conditions trust in partners: moderation by oxytocin and group membership. Proc. R. Soc. London B 284, 1–10. https://doi.org/10.1098/rspb.2016.2554

Kret, M.E., Fischer, A.H., De Dreu, C.K., 2015. Pupil mimicry correlates with trust in ingroup partners with dilating pupils. Psychol. Sci. 26 (9), 1401–1410.

Kret, M.E., Ploeger, A., 2015. Emotion processing deficits: a liability spectrum providing insight into comorbidity of mental disorders. Neurosci. Biobehav. Rev. 52, 153–171.

Kret, M.E., Roelofs, K., Stekelenburg, J.J., de Gelder, B., 2013a. Emotional cues from faces, bodies and scenes influence observers' face expressions, fixations and pupil size. Front. Hum. Neurosci. 7 (810).

Kret, M.E., Sjak-Shie, E.E., 2019. Preprocessing pupil size data: Guidelines and code. Behav. Res. Methods 51, 1336–1342. https://doi.org/10.3758/s13428-018-1075-y

Kret, M.E., Stekelenburg, J.J., Roelofs, K., de Gelder, B., 2013b. Perception of face and body expressions using EMG and gaze measures. Front. Psychol. 4 (28).

Kret, M.E., Tomonaga, M., Matsuzawa, T., 2014. Chimpanzees and humans mimic pupil-size of conspecifics. PLoS One 9, e104886. https://doi.org/10.1371/journal.pone.0104886

Kreuzer, P.M., Landgrebe, M., Husser, O., Resch, M., Schecklmann, M., Geisreiter, F., Poeppl, T.B., Prasser, S.J., Hajak, G., Langguth, B., 2012. Transcutaneous Vagus Nerve Stimulation: Retrospective Assessment of Cardiac Safety in a Pilot Study. Front. Psychiatry 3. https://doi.org/10.3389/fpsyt.2012.00070

Krueger, F., McCabe, K., Moll, J., Kriegeskorte, N., Zahn, R., Strenziok, M., Heinecke, A., Grafman, J., 2007. Neural correlates of trust. Proc. Natl. Acad. Sci. 104, 20084–20089. https://doi.org/10.1073/pnas.0710103104

LaFrance, M., 1979. Nonverbal Synchrony and Rapport: Analysis by the Cross-Lag Panel Technique. Soc. Psychol. Q. 42, 66. https://doi.org/10.2307/3033875

LaFrance, M., Broadbent, M., 1976. Group Rapport: Posture Sharing as a Nonverbal Indicator. Gr. Organ. Manag. 1, 328–333. https://doi.org/10.1177/105960117600100307

Laird, J.D., 1974. Self-attribution of emotion: the effects of expressive behavior on the quality of emotional experience. J. Pers. Soc. Psychol. 29 (4), 475.

Lakin, J.L., Chartrand, T.L., 2003. Using nonconscious behavioral mimicry to create affiliation and rapport. Psychol. Sci. 14, 334–339. https://doi.org/10.1111/1467-9280.14481

Lakin, J.L., Jefferis, V.E., Cheng, C.M., Chartrand, T.L., 2003. The chameleon effect as social glue: evidence for the evolutionary significance of nonconscious mimicry. J. Nonverbal Behav. 27 (3), 145–162.

Lamm, C., Majdandžić, J., 2015. The role of shared neural activations, mirror neurons, and morality in empathy – a critical comment. Neurosci. Res. 90, 15–24.

Laurent, H.K., Ablow, J.C., Measelle, J., 2012. Taking stress response out of the box: stability, discontinuity, and temperament effects on HPA and SNS across social stressors in mother–infant dyads. Dev. Psychol. 48 (1), 35.

Lavín, C., Martín, R.S., Jubal, E.R., 2014. Pupil dilation signals uncertainty and surprise in a learning gambling task. Front. Behav. Neurosci. 7. https://doi.org/10.3389/fnbeh.2013.00218

Lawn, J.E., Mwansa-Kambafwile, J., Horta, B.L., Barros, F.C., Cousens, S., 2010. 'Kangaroo mother care' to prevent neonatal deaths due to preterm birth complications. Int. J. Epidemiol. 39 (1), 144–154.

Le Doux, J.E., 2012. Evolution of human emotion: a view through fear. Prog. Brain Res. 195, 431.

LeDoux, J., 2012. Evolution of human emotion: a view through fear. Prog. Brain Res.

Ledoux, J.E., 1996. The Emotional Brain: The Mysterious Underpinnings of Emotional Life - Joseph Ledoux - Google Books.

Lee, T.W., Josephs, O., Dolan, R.J., Critchley, H.D., 2006. Imitating expressions: emotionspecific neural substrates in facial mimicry. Soc. Cognit. Affect. Neurosci. 1 (2), 122–135.

Levenson, R.W., Gottman, J.M., 1983. Marital interaction: physiological linkage and affective exchange. J. Pers. Soc. Psychol. 45 (3), 587.

Levenson, R.W., Gottman, J.M., 1985. Physiological and affective predictors of change in relationship satisfaction. J. Pers. Soc. Psychol. 49, 85–94. https://doi.org/10.1037/0022-3514.49.1.85

Levenson, R.W., Ruef, A.M., 1992. Empathy: A Physiological Substrate. J. Pers. Soc. Psychol. 63, 234–246. https://doi.org/10.1037/0022-3514.63.2.234

Li, J., Chignell, M., 2011. Communication of emotion in social robots through simple head and arm movements. Int. J. Soc. Robot. 3 (2), 125–142.

Liebowitz, M.R., 1987. Social phobia. Mod. Probl. Pharmacopsychiatry 3, 141–173. https://doi.org/http://dx.doi.org/10.1159/000414022

Likowski, K.U., Mühlberger, A., Gerdes, A.B.M., Wieser, M.J., Pauli, P., Weyers, P., 2012. Facial mimicry and the mirror neuron system: simultaneous acquisition of facial electromyography and functional magnetic resonance imaging.

Mansoor Iqbal, 2019. Tinder revenue and usage statistics (2018) [WWW Document]. Bus. Apps. URL https://www.businessofapps.com/data/tinder-statistics/ (accessed 6.20.19).

Manta, S., El Mansari, M., Debonnel, G., Blier, P., 2013. Electrophysiological and neurochemical effects of long-term vagus nerve stimulation on the rat monoaminergic systems. Int. J. Neuropsychopharmacol. 16, 459–470. https://doi.org/10.1017/S1461145712000387

Martin, G.B., Clark, R.D., 1982. Distress crying in neonates: species and peer specificity. Dev. Psychol. 18 (1), 3.

Mayer, C., Sosnowski, S., Kühnlenz, K., Radig, B., 2010. Towards robotic facial mimicry: system development and evaluation. In: 19th International Symposium in Robot and Human Interactive Communication. IEEE. pp. 198–203.

Mayer, E.A., 2011. Gut feelings: The emerging biology of gut-"brain communication. Nat. Rev. Neurosci. https://doi.org/10.1038/nrn3071

McAssey, M.P., Helm, J., Hsieh, F., Sbarra, D.A., Ferrer, E., 2013. Methodological advances for detecting physiological synchrony during dyadic interactions. Methodology 9, 41–53. https://doi.org/10.1027/1614-2241/a000053

Meaney, M.J., 2001. Maternal care, gene expression, and the transmission of individual differences in stress reactivity across generations. Annu. Rev. Neurosci. 24 (1), 1161–1192.

Meltzoff, A.N., 2002. Imitation as a mechanism of social cognition: origins of empathy, theory of mind and the representation of action. In: Goswami, U. (Ed.), Blackwell Handbook of Childhood Cognitive Development. Blackwell Publishers Ltd, pp. 6–25.

Meltzoff, A.N., Decety, J., 2003a. What imitation tells us about social cognition: rapprochement between developmental psychology and cognitive neuroscience. Philos. Trans. Roy. Soc. B: Biol. Sci. 358, 491–500.

Meltzoff, A.N., Moore, M.K., 1983. Newborn infants imitate adult facial gestures. Child Dev. 702–709.

Meltzoff, A.N., Moore, M.K., 1997. Explaining facial imitation: a theoretical model. Early Dev. Parent. 6, 179–192.

Meston, C.M., Frohlich, P.F., 2003. Love at first fright: partner salience moderates roller-coaster-induced excitation transfer. Arch. Sex. Behav. 32, 537–544. https://doi.org/10.1023/A:1026037527455

Miller, M.L., Gallup, A.C., Vogel, A.R., Vicario, S.M., Clark, A.B., 2012. Evidence for contagious behaviors in budgerigars (Melopsittacus undulatus): an observational study of yawning and stretching. Behav. Process. 89 (3), 264–270.

Mitchell, R.L.C., Phillips, L.H., 2015. The overlapping relationship between emotion perception and theory of mind. Neuropsychologia 70, 1–10. https://doi.org/10.1016/j.neuropsychologia.2015.02.018

Mobbs, D., Yu, R., Meyer, M., Passamonti, L., Seymour, B., Calder, A.J., Dalgleish, T., 2009. A key role for similarity in vicarious reward. Science 324 (5929), 900.

Mogan, R., Fischer, R., Bulbulia, J.A., 2017. To be in synchrony or not? a meta-analysis of synchrony's effects on behavior, perception, cognition and affect. J. Exp. Soc. Psychol. 72, 13–20. https://doi.org/10.1016/j.jesp.2017.03.009

Montoya, R.M., Kershaw, C., Prosser, J.L., 2018. A meta-analytic investigation of the relation between interpersonal attraction and enacted behavior. Psychol. Bull. 144, 673–709. https://doi.org/10.1037/bul0000148

Moore, M.M., 1985. Nonverbal courtship patterns in women. context and consequences. Ethol. Sociobiol. 6, 237–247. https://doi.org/10.1016/0162-3095(85)90016-0

Morris, J.S., Öhman, A., Dolan, R.J., 1999. A subcortical pathway to the right amygdala mediating "unseen" fear. Proc. Natl. Acad. Sci. U. S. A. 96, 1680–1685. https://doi.org/10.1073/pnas.96.4.1680

Mutschler, I., Reinbold, C., Wankerl, J., Seifritz, E., Ball, T., 2013. Structural basis of empathy and the domain general region in the anterior insular cortex. Front. Hum. Neurosci. 7, 177.

Neal, D.T., Chartrand, T.L., 2011. Embodied emotion perception amplifying and dampening facial feedback modulates emotion perception accuracy. Soc. Psychol. Personal. Sci. 2 (6), 673–678.

Negative relations between pacifier use and emotional competence. Basic Appl. Soc. Psychol. 34 (5), 387–394.

Negro, E., D'Agata, F., Caroppo, P., Coriasco, M., Ferrio, F., Celeghin, A., Diano, M., Rubino, E., De Gelder, B., Rainero, I., Pinessi, L., Tamietto, M., 2015. Neurofunctional signature of hyperfamiliarity for unknown faces. PLoS One 10. https://doi.org/10.1371/journal.pone.0129970

Niedenthal, P.M., Augustinova, M., Rychlowska, M., Droit-Volet, S., Zinner, L., Knafo, A., Brauer, M., 2012.

Niedenthal, P.M., Brauer, M., Halberstadt, J.B., Innes-Ker, Å.H., 2001. When did her smile drop? Facial mimicry and the influences of emotional state on the detection of change in emotional expression. Cognit. Emotion 15 (6), 853–864.

Nummenmaa, L., Hirvonen, J., Parkkola, R., Hietanen, J.K., 2008. Is emotional contagion special? An fMRI study on neural systems for affective and cognitive empathy. Neuroimage 43 (3), 571–580.

Oberman, L.M., Winkielman, P., Ramachandran, V.S., 2007. Face to face: blocking facial mimicry can selectively impair recognition of emotional expressions. Soc. Neurosci. 2 (3–4), 167–178.

Öhman, A., Flykt, A., Esteves, F., 2001. Emotion drives attention: Detecting the snake in the grass. J. Exp. Psychol. Gen. 130, 466–478. https://doi.org/10.1037/0096-3445.130.3.466

Oliver, L.D., Mao, A., Mitchell, D.G.V., 2015. “Blindsight” and subjective awareness of fearful faces: Inversion reverses the deficits in fear perception associated with core psychopathic traits. Cogn. Emot. 29, 1256–1277. https://doi.org/10.1080/02699931.2014.976182

Olsson, A., Phelps, E.A., 2007. Social learning of fear. Nat. Neurosci. 10 (9), 1095–1102.

Oostenbroek, J., Suddendorf, T., Nielsen, M., Redshaw, J., Kennedy-Costantini, S., Davis, J., Slaughter, V., 2016. Comprehensive longitudinal study challenges the existence of neonatal imitation in humans. Curr. Biol. 26 (10), 1334–1338.

Palumbo, R. V., Marraccini, M.E., Weyandt, L.L., Wilder-Smith, O., McGee, H.A., Liu, S., Goodwin, M.S., 2017. Interpersonal autonomic physiology: a systematic review of the literature. Personal. Soc. Psychol. Rev. 21, 99–141. https://doi.org/10.1177/1088868316628405

Panksepp, J., 1998. Affective Neuroscience: The Foundations of Human and Animal Emotions. Oxford University Press.

Papp, L., Pendry, P., Adam, E., 2009. Mother-adolescent physiological synchrony in naturalistic settings: within-family cortisol associations and moderators. J. Family Psychol.

Papp, L.M., Pendry, P., Simon, C.D., Adam, E.K., 2013. Spouses’ Cortisol Associations and Moderators: Testing Physiological Synchrony and Connectedness in Everyday Life. Fam. Process 52, 284–298. https://doi.org/10.1111/j.1545-5300.2012.01413.x

Parr, L.A., Waller, B.M., 2006. Understanding chimpanzee facial expression: insights into the evolution of communication. Soc. Cognit. Affect. Neurosci. 1 (3), 221–228.

Partala, T., Surakka, V., 2003. Pupil size variation as an indication of affective processing. Int. J. Hum. Comput. Stud. 59, 185–198. https://doi.org/10.1016/S1071-5819(03)00017-X

Pasley, B.N., Mayes, L.C., Schultz, R.T., 2004. Subcortical discrimination of unperceived objects during binocular rivalry. Neuron 42, 163–172. https://doi.org/10.1016/S0896-6273(04)00155-2

Pawlby, S.J., 1977. Imitative interaction. In: Schaffer, H. (Ed.), Studies in Mother-Infant Interaction. Academic Press, New York, pp. 203–224.

Pelphrey, K.A., Morris, J.P., Michelich, C.R., Allison, T., McCarthy, G., 2005. Functional anatomy of biological motion perception in posterior temporal cortex: An fMRI study of eye, mouth and hand movements. Cereb. Cortex 15, 1866–1876. https://doi.org/10.1093/cercor/bhi064

Pessoa, L., Adolphs, R., 2010. Emotion processing and the amygdala: from a “low road” to “many roads” of evaluating biological significance. Nat. Rev. Neurosci. 11, 773–83. https://doi.org/10.1038/nrn2920

Peuker, E.T., Filler, T.J., 2002. The nerve supply of the human auricle. Clin. Anat. 15, 35–37. https://doi.org/10.1002/ca.1089

Phillips, R.G., Le Doux, J.E., 1992. Differential contribution of amygdala and hippocampus to cued and contextual fear conditioning. Behav. Neurosci. 106 (2), 274.

Prehn-Kristensen, A., Wiesner, C., Bergmann, T.O., Wolff, S., Jansen, O., Mehdorn, H.M., Pause, B.M., 2009. Induction of empathy by the smell of anxiety. PLoS One 4 (6), e5987.

Preston, S.D., de Waal, F.B., 2002. Empathy: its ultimate and proximate bases. Behav. Brain Sci. 25 (01), 1–20.

Procházková, E., Kret, M.E., 2017. Connecting minds and sharing emotions through mimicry: a neurocognitive model of emotional contagion. Neurosci. Biobehav. Rev. https://doi.org/10.1016/j.neubiorev.2017.05.013

Procházková, E., Procházková, L., Giffin, M.R., Scholte, H.S., De Dreu, C.K.W., Kret, M.E., 2018. Pupil mimicry promotes trust through the theory-of-mind network. Proc. Natl. Acad. Sci. 115, E7265–E7274. https://doi.org/10.1073/pnas.1803916115

Prochnow, D., Kossack, H., Brunheim, S., Müller, K., Wittsack, H.-J., Markowitsch, H.-J., Seitz, R.J., 2013. Processing of subliminal facial expressions of emotion: A behavioral and fMRI study. Soc. Neurosci. 8, 448–461. https://doi.org/10.1080/17470919.2013.812536

Quadt, L., D.Critchley, H., N.Garfinkel, S., 2018. Interoception and emotion: Shared mechanisms and clinical implications, in: The Interoceptive Mind: From Homeostasis to Awareness. pp. 123–143. https://doi.org/10.1093/oso/9780198811930.001.0001

Quintana, D.S., Guastella, A.J., Outhred, T., Hickie, I.B., Kemp, A.H., 2012. Heart rate variability is associated with emotion recognition: Direct evidence for a relationship between the autonomic nervous system and social cognition. Int. J. Psychophysiol. 86, 168–172. https://doi.org/10.1016/j.ijpsycho.2012.08.012

Raio, C.M., Carmel, D., Carrasco, M., Phelps, E.A., 2012. Nonconscious fear is quickly acquired but swiftly forgotten. Curr. Biol. 22, R477–R479. https://doi.org/10.1016/J.CUB.2012.04.023

Rand, D.G., Greene, J.D., Nowak, M.A., 2012. Spontaneous giving and calculated greed. Nature 489, 427–430. https://doi.org/10.1038/nature11467

Ray, E., Heyes, C., 2011. Imitation in infancy: the wealth of the stimulus. Develop. Sci. 14 (1), 92–105.

Reed, R.G., Randall, A.K., Post, J.H., Butler, E.A., 2013. Partner influence and in-phase versus anti-phase physiological linkage in romantic couples. Int. J. Psychophysiol. 88, 309–316. https://doi.org/10.1016/j.ijpsycho.2012.08.009

Reimer, J., McGinley, M.J., Liu, Y., Rodenkirch, C., Wang, Q., McCormick, D.A., Tolias, A.S., 2016. Pupil fluctuations track rapid changes in adrenergic and cholinergic activity in cortex. Nat. Commun. 7, 13289. https://doi.org/10.1038/ncomms13289

Rizzolatti, G., Craighero, L., 2004. The mirror-neuron system. Annu. Rev. Neurosci. 27, 169–192.

Rizzolatti, G., Fabbri-Destro, M., Cattaneo, L., 2009. Mirror neurons and their clinical relevance. Nat. Clin. Pract. Neurol. 5 (1), 24–34.

Rizzolatti, G., Fabbri-Destro, M., Cattaneo, L., 2009. Mirror neurons and their clinical relevance. Nat. Clin. Pract. ….

Rizzolatti, G., Fadiga, L., Gallese, V., Fogassi, L., 1996. Premotor cortex and the recognition of motor actions. Cognit. Brain Res. 3 (2), 131–141.

Rizzolatti, G., Fogassi, L., Gallese, V., 2001. Neurophysiological mechanisms underlying the understanding and imitation of action. Nat. Rev. Neurosci. 2 (9), 661–670.

Rochat, P., 1998. Self-perception and action in infancy. Exp. Brain Res. 123, 102–109.

Roosevelt, R.W., Smith, D.C., Clough, R.W., Jensen, R.A., Browning, R.A., 2006. Increased extracellular concentrations of norepinephrine in cortex and hippocampus following vagus nerve stimulation in the rat. Brain Res. 1119, 124–132. https://doi.org/10.1016/j.brainres.2006.08.048

Rossion, B., Caldara, R., Seghier, M., Schuller, A., Lazeyras, F., Mayer, E., 2003. A network of occipito-temporal face-sensitive areas besides the right middle fusiform gyrus is necessary for normal face processing. Brain 126, 2381–2395. https://doi.org/10.1093/brain/awg241

Russell, J.A., 1978. Evidence of convergent validity on the dimensions of affect. J. Pers. Soc. Psychol. 36 (10), 1152.

Samuels, E., Szabadi, E., 2008. Functional Neuroanatomy of the Noradrenergic Locus Coeruleus: Its Roles in the Regulation of Arousal and Autonomic Function Part I: Principles of Functional Organisation. Curr. Neuropharmacol. 6, 235–253. https://doi.org/10.2174/157015908785777229

Sara, S.J., Bouret, S., 2012. Orienting and Reorienting: The Locus Coeruleus Mediates Cognition through Arousal. Neuron. https://doi.org/10.1016/j.neuron.2012.09.011

Saxbe, D.E., Margolin, G., Spies Shapiro, L., Ramos, M., Rodriguez, A., Iturralde, E., 2014. Relative influences: patterns of HPA axis concordance during triadic family interaction. Health Psychol. 33 (3), 273.

Saxe, R., Wexler, A., 2005a. Making sense of another mind: The role of the right temporo-parietal junction. Neuropsychologia 43, 1391–1399. https://doi.org/10.1016/j.neuropsychologia.2005.02.013

Schaafsma, S.M., Pfaff, D.W., Spunt, R.P., Adolphs, R., 2015. Deconstructing and reconstructing theory of mind. Trends Cogn. Sci. 19, 65–72. https://doi.org/10.1016/j.tics.2014.11.007

Schlossmacher, I., Junghöfer, M., Straube, T., Bruchmann, M., 2017. No differential effects to facial expressions under continuous flash suppression: An event-related potentials study. Neuroimage 163, 276–285. https://doi.org/10.1016/j.neuroimage.2017.09.034

Schuler, M., Mohnke, S., Walter, H., 2016. The neurological basis of empathy and mimicry. In: Hess, U., Fischer, A. (Eds.), Emotional Mimicry in Social Context. Cambridge University Press, Cambridge, pp. 129–135.

Schulte-Rüther, M., Markowitsch, H.J., Fink, G.R., Piefke, M., 2007. Mirror neuron and theory of mind mechanisms involved in face-to-face interactions: A functional magnetic resonance imaging approach to empathy. J. Cogn. Neurosci. 19, 1354–1372.

Schurz, M., Radua, J., Aichhorn, M., Richlan, F., Perner, J., 2014. Fractionating theory of mind: A meta-analysis of functional brain imaging studies. Neurosci. Biobehav. Rev. 42, 9–34. https://doi.org/10.1016/j.neubiorev.2014.01.009

Sellaro, R., de Gelder, B., Finisguerra, A., Colzato, L.S., 2018. Transcutaneous vagus nerve stimulation (tVNS) enhances recognition of emotions in faces but not bodies. Cortex 99, 213–223. https://doi.org/10.1016/j.cortex.2017.11.007

Selman, R.L., 1971. Taking another's perspective: role-taking development in early childhood. Child Dev. 42 (6), 1721–1734.

Senju, A., Johnson, M.H., 2009. The eye contact effect: mechanisms and development. Trends Cogn. Sci. 13, 127–134. https://doi.org/10.1016/J.TICS.2008.11.009

Shamay-Tsoory, S.G., 2011. The neural bases for empathy. The Neuroscientist 17 (1), 18–24.

Shamay-Tsoory, S.G., Aharon-Peretz, J., Perry, D., 2009. Two systems for empathy: a double dissociation between emotional and cognitive empathy in inferior frontal gyrus versus ventromedial prefrontal lesions. Brain 132 (3), 617–627.

Shea, A., Walsh MacMillan, C.H., Steiner, M., 2005. Child maltreatment and HPA axis dysregulation: relationship to major depressive disorder and post traumatic stress disorder in females. Psychoneuroendocrinology 30 (2), 162–178.

Shearn, D., Bergman, E., Hill, K., Abel, A., Hinds, L., 1990. Facial coloration and temperature responses in blushing. Psychophysiology 27 (6), 687–693.

Simpson, E.A., Murray, L., Paukner, A., Ferrari, P.F., 2014. The mirror neuron system as revealed through neonatal imitation: presence from birth, predictive power and evidence of plasticity. Philos. Trans. Roy. Soc. 369 (1644), 20130289.

Singer, T., 2006. The neuronal basis and ontogeny of empathy and mind reading: Review of literature and implications for future research. Neurosci. Biobehav. Rev. https://doi.org/10.1016/j.neubiorev.2006.06.011

Singer, T., Lamm, C., 2009. The social neuroscience of empathy. Ann. N.Y. Acad. Sci. 1156 (1), 81–96.

Sivaselvachandran, S., Acland, E.L., Abdallah, S., Martin, L.J., 2016. Behavioral and mechanistic insight into rodent empathy. Neurosci. Biobehav. Rev.

Skuse, D., 2003. Fear Recognition and the Neural Basis of Social Cognition. Child Adolesc. Ment. Health 8, 50–60. https://doi.org/10.1111/1475-3588.00047

Smith, L.B., Thelen, E., Titzer, R., McLin, D., 1999. Knowing in the context of acting: the task dynamics of the A-not-B-error. Psychol. Rev. 106, 235–260.

Smith, S.M., Jenkinson, M., Woolrich, M.W., Beckmann, C.F., Behrens, T.E.J., Johansen-berg, H., Bannister, P.R., Luca, M. De, Drobnjak, I., Flitney, D.E., Niazy, R.K., Saunders, J., Vickers, J., Zhang, Y., Stefano, N. De, Brady, J.M., Matthews, P.M., 2004. Advances in functional and structural MR image analysis and implementation as FSL technical report. Neuroimage 23(S1), 208–219. https://doi.org/10.1016/j.neuroimage.2004.07.051

Smith, S.M., Nichols, T.E., 2009. Threshold-free cluster enhancement: Addressing problems of smoothing, threshold dependence and localisation in cluster inference. Neuroimage 44, 83–98. https://doi.org/10.1016/j.neuroimage.2008.03.061

Spector, I.P., Carey, M.P., Steinberg, L., 1996. The sexual desire inventory: development, factor structure, and evidence of reliability. J. Sex Marital Ther. 22, 175–190. https://doi.org/10.1080/00926239608414655

Spielberger, C.D., 2010. State-Trait Anxiety Inventory, in: The Corsini Encyclopedia of Psychology. John Wiley & Sons, Inc., Hoboken, NJ, USA, p. 1. https://doi.org/10.1002/9780470479216.corpsy0943

Stein, T., Hebart, M.N., Sterzer, P., 2011a. Breaking continuous flash suppression: A new measure of unconscious processing during interocular suppression? Front. Hum. Neurosci. 5, 167. https://doi.org/10.3389/fnhum.2011.00167

Stein, T., Senju, A., Peelen, M. V., Sterzer, P., 2011b. Eye contact facilitates awareness of faces during interocular suppression. Cognition 119, 307–311. https://doi.org/10.1016/j.cognition.2011.01.008

Stein, T., Sterzer, P., 2012. Not just another face in the crowd: Detecting emotional schematic faces during continuous flash suppression. Emotion 12, 988–996. https://doi.org/10.1037/a0026944

Stel, M., van Knippenberg, A., 2008. The role of facial mimicry in the recognition of affect. Psychol. Sci. 19 (10), 984–985.

Stel, M., Vonk, R., 2010. Mimicry in social interaction: benefits for mimickers, mimickees, and their interaction. Br. J. Psychol. 101, 311–323. https://doi.org/10.1348/000712609X465424

Stephens, G.J., Silbert, L.J., Hasson, U., 2010. Speaker-listener neural coupling underlies successful communication. Proc. Natl. Acad. Sci. 107 (32), 14425–14430.

Strack, F., Martin, L.L., Stepper, S., 1988. Inhibiting and facilitating conditions of the human smile: a nonobtrusive test of the facial feedback hypothesis. J. Pers. Soc. Psychol. 54 (5), 768.

Straube, T., Dietrich, C., Mothes-Lasch, M., Mentzel, H.J., Miltner, W.H.R., 2010. The volatility of the amygdala response to masked fearful eyes. Hum. Brain Mapp. 31, 1601–1608. https://doi.org/10.1002/hbm.20960

Tahhan, D.A., 2013. Touching at depth: The potential of feeling and connection. Emot. Sp. Soc. 7, 45–53. https://doi.org/10.1016/j.emospa.2012.03.004

Takahashi, H., Kato, M., Matsuura, M., Mobbs, D., Suhara, T., Okubo, Y., 2009. When your gain is my pain and your pain is my gain: neural correlates of envy and schadenfreude. Science 323 (5916), 937–939.

Tamietto, M., Castelli, L., Vighetti, S., Perozzo, P., Geminiani, G., Weiskrantz, L., de Gelder, B., 2009. Unseen facial and bodily expressions trigger fast emotional reactions. Proc. Natl. Acad. Sci. 106 (42), 17661–17666.

Tamietto, M., De Gelder, B., 2010. Neural bases of the non-conscious perception of emotional signals. Nat. Rev. Neurosci. https://doi.org/10.1038/nrn2889

Thelen, E., 2001. Dynamic mechanisms of change in early perceptual-motor development. In: McClelland, J., Siegler, R. (Eds.), Mechanisms of Cognitive Development: Behavioral and Neural Perspectives. Carnegie Mellon Symposia on Cognition. Erlbaum, Mahwah, N.J, pp. 161–184.

Thomsen, D.G., Gilbert, D.G., 1998. Factors characterizing marital conflict states and traits: physiological, affective, behavioral and neurotic variable contributions to marital conflict and satisfaction. Pers. Individ. Dif. 25, 833–855. https://doi.org/10.1016/S0191-8869(98)00064-6

Tia, B., Saimpont, A., Paizis, C., Mourey, F., Fadiga, L., Pozzo, T., 2011. Does observation of postural imbalance induce a postural reaction? PLoS One 6 (3), e17799.

Tickle-Degnen, L., Rosenthal, R., 1990. The nature of rapport and its nonverbal correlates. Psychol. Inq. 1, 285–293. https://doi.org/10.1207/s15327965pli0104_1

Tomasello, M., Carpenter, M., Call, J., Behne, T., Moll, H., 2005. Understanding and sharing intentions: the origins of cultural cognition. Behav. Brain Sci. 28 (05), 675–691.

Tschacher, W., Rees, G.M., Ramseyer, F., 2014. Nonverbal synchrony and affect in dyadic interactions. Front. Psychol. 5, 1323. https://doi.org/10.3389/fpsyg.2014.01323

Tsuchiya, N., Koch, C., 2005. Continuous flash suppression reduces negative afterimages. Nat. Neurosci. 8, 1096–1101. https://doi.org/10.1038/nn1500

Tylén, K., Allen, M., Hunter, B.K., Roepstorff, A., 2012. Interaction vs. observation: distinctive modes of social cognition in human brain and behavior? A combined fMRI and eye-tracking study. Front. Hum. Neurosci. 6, 331. https://doi.org/10.3389/fnhum.2012.00331

Uzgiris, I.C., Benson, J.B., Kruper, J.C., Vasek, M.E., 1989. Contextual influences on imitative interactions between mothers and infants. In: Lockman, J., Hazen, N. (Eds.), Action in Social Context: Perspectives on Early Development. Plenum Pres, New York, pp. 103–127.

van Baaren, R., Janssen, L., Chartrand, T.L., Dijksterhuis, A., 2009. Where is the love? the social aspects of mimicry. Philos. Trans. R. Soc. B Biol. Sci. 364, 2381–2389. https://doi.org/10.1098/rstb.2009.0057

van Breen, J.A., De Dreu, C.K.W., Kret, M.E., 2018. Pupil to pupil: The effect of a partner's pupil size on (dis)honest behavior. J. Exp. Soc. Psychol. 74, 231–245. https://doi.org/10.1016/j.jesp.2017.09.009

van den Bergh, B.R., Van Calster, B., Smits, T., Van Huffel, S., Lagae, L., 2008. Antenatal maternal anxiety is related to HPA-axis dysregulation and self-reported depressive symptoms in adolescence: a prospective study on the fetal origins of depressed mood. Neuropsychopharmacology 33 (3), 536–545.

van der Schalk, J., Hawk, S.T., Fischer, A.H., Doosje, B., 2011. Moving faces, looking places: Validation of the Amsterdam Dynamic Facial Expression Set (ADFES). Emotion 11, 907–920. https://doi.org/10.1037/a0023853

van Puyvelde, M., Loots, G., Meys, J., Neyt, X., Mairesse, O., Simcock, D., Pattyn, N., 2015. Whose clock makes yours tick? How maternal cardiorespiratory physiology influences new-born' heart rate variability. Biol. Psychol. 108 (1), 132–141.

Vick, S.J., Waller, B.M., Parr, L.A., Pasqualini, M.C.S., Bard, K.A., 2007. A cross-species comparison of facial morphology and movement in humans and chimpanzees using the facial action coding system (FACS). J. Nonverbal Behav. 31 (1), 1–20.

Vieira, J.B., Wen, S., Oliver, L.D., Mitchell, D.G.V., 2017. Enhanced conscious processing and blindsight-like detection of fear-conditioned stimuli under continuous flash suppression. Exp. Brain Res. 235, 3333–3344. https://doi.org/10.1007/s00221-017-5064-7

Vonck, K., Raedt, R., Naulaerts, J., De Vogelaere, F., Thiery, E., Van Roost, D., Aldenkamp, B., Miatton, M., Boon, P., 2014. Vagus nerve stimulation. . .25 years later! What do we know about the effects on cognition? Neurosci. Biobehav. Rev. https://doi.org/10.1016/j.neubiorev.2014.05.005

Wagenmakers, E.J., Beek, T., Dijkhoff, L., Gronau, Q.F., Acosta, A., Adams, R.B., Bulnes, L.C., 2016. Registered replication report strack, martin, & stepper (1988). Perspect. Psychol. Sci. 11 (6), 917–928.

Walker, L.J., 1980. Cognitive and perspective-taking prerequisites for moral development. Child Dev. 51 (1), 131–139.

Walster, E., Aronson, V., Abrahams, D., Rottman, L., 1966. Importance of physical attractiveness in dating behavior. J. Pers. Soc. Psychol. 4, 508–516. https://doi.org/10.1037/h0021188

Wang, Y., Newport, R., Hamilton, A.F., de, C., 2011. Eye contact enhances mimicry of intransitive hand movements. Biol. Lett. 7 (1), 7–10.

Warren, C.M., Tona, K.D., Ouwerkerk, L., van Paridon, J., Poletiek, F., van Steenbergen, H., Bosch, J.A., Nieuwenhuis, S., 2019. The neuromodulatory and hormonal effects of transcutaneous vagus nerve stimulation as evidenced by salivary alpha amylase, salivary cortisol, pupil diameter, and the P3 event-related potential. Brain Stimul. 12, 635–642. https://doi.org/10.1016/j.brs.2018.12.224

Watanabe, A., Ogino, M., Asada, M., 2007. Mapping facial expression to internal states based on intuitive parenting. J. Robot. Mehatronics 19 (3), 315.

Watson, D., Clark, L.A., Tellegen, A., 1988. Development and validation of brief measures of positive and negative affect: the PANAS scales. J. Pers. Soc. Psychol. 54, 1063–1070. https://doi.org/10.1037/0022-3514.54.6.1063

Webb, J.T., 1969. Subject speech rates as a function of interviewer behaviour. Lang. Speech 12 (1), 54–67. Weinstock, M., 2005. The potential influence of maternal stress hormones on development and mental health of the offspring. Brain Behav. Immun. 19 (4), 296–308.

Wehebrink, K.S., Koelkebeck, K., Piest, S., de Dreu, C.K.W., Kret, M.E., 2018. Pupil mimicry and trust – Implication for depression. J. Psychiatr. Res. 97, 70–76. https://doi.org/10.1016/j.jpsychires.2017.11.007

Wheatley, T., Kang, O., Parkinson, C., Looser, C.E., 2012. From mind perception to mental connection: synchrony as a mechanism for social understanding. Soc. Personal. Psychol. Compass 6, 589–606. https://doi.org/10.1111/j.1751-9004.2012.00450.x

Wicker, B., Keysers, C., Plailly, J., Royet, J.P., Gallese, V., Rizzolatti, G., 2003. Both of us disgusted in My insula: the common neural basis of seeing and feeling disgust. Neuron 40 (3), 655–664.

Williams, M.A., Morris, A.P., McGlone, F., Abbott, D.F., Mattingley, J.B., 2004. Amygdala Responses to Fearful and Happy Facial Expressions under Conditions of Binocular Suppression. J. Neurosci. 24, 2898–2904. https://doi.org/10.1523/JNEUROSCI.4977-03.2004