**Predicting Autism from Young Infants’ Empathic Responding:
A Prospective Study**

**Supplementary Material**

**Order of tasks in visits**

1. Consent form
2. Neutral tasks (2) a,b
3. Distress simulation – experimenter
4. Neutral task a,c
5. Laughing infant video
6. Additional tasks (2) a
7. Crying infant video
8. Additional task a,c
9. Mother-child interactions a
10. Experimenter-child interaction d
11. Distress simulation – mother
12. Laughing experimenter
13. Mother interview a
14. Questionnaires a

*Notes.* a Tasks not included in the current report.

b In the 9 and 12 months visits, only one neutral task was included.

c Only in the 6 months visit.

d Only in the 9 and 12 months visits.

| Table S1: Means (and SDs) of empathic concern and contagious happiness scores by diagnosis group |
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|  |  | *Non-ASD* | *Atypical Development* |
|  | *n* | LR 20 | HR-non11 | HR-mild17 | GDD 2 | Non-ASD totala50 | NRb48 | ASDa9 | AD totalb11 |
| *a. mean scores across simulations:* |  |  |  |  |
| 6m | EC | .83 (.44) | 1.02 (.38) | .83 (.35) | .25 (.35) | .85 (.41) | .87 (.39) | .48 (.44) | .44 (.42) |
| CH | .94 (.61) | 1.00 (.63) | 1.06 (.62) | 1.50 (.71) | 1.02 (.61) | .99 (.61) | 1.17 (.61) | 1.23 (.61) |
| 9m | EC | .93 (.46) | .75 (.73) | .79 (.49) | .58 (.12) | .83 (.53) | .84 (.54) | .47 (.35) | .49 (.32) |
| CH | .60 (.60) | .99 (.76) | .74 (.47) | .50 (.71) | .73 (.60) | .74 (.61) | .67 (.68) | .64 (.66) |
| 12m | EC | 1.08 (.41) | .95 (.52) | .79 (.39) | .50 (.24) | .93 (.44) | .95 (.44) | .50 (.36) | .50 (.33) |
| CH | .78 (.38) | .95 (.59) | .81 (.53) | 1.00 (.71) | .84 (.49) | .83 (.48) | .83 (.61) | .86 (.60) |
| *b. human simulation scores:* |  |  |  |  |
| 6m | EC | .86 (.53) | 1.07 (.34) | .88 (.43) | .25 (.35) | .89 (.47) | .92 (.46) | .56 (.45) | .50 (.43) |
| CH | .66 (.63) | 1.08 (.67) | .79 (.59) | 1.75 (.35) | .84 (.64) | .80 (.62) | 1.32 (.72) | 1.40 (.67) |
| 9m | EC | 1.13 (.52) | .91 (.81) | .95 (.60) | .63 (.18) | 1.00 (.61) | 1.01 (.62) | .39 (.40) | .43 (.37) |
| CH | .48 (.60) | .75 (.82) | .42 (.45) | .25 (.35) | .51 (.60) | .52 (.61) | .56 (.68) | .50 (.63) |
| 12m | EC | 1.25 (.44) | 1.02 (.68) | .94 (.47) | .63 (.53) | 1.07 (.52) | 1.09 (.52) | .56 (.43) | .57 (.42) |
| CH | .50 (.56) | .64 (.64) | .42 (.49) | 1.25 (.35) | .53 (.56) | .50 (.55) | .56 (.58) | .68 (.60) |
| *c. video scores:* |  |  |  |  |
| 6m | EC | .77 (.45) | 1.02 (.66) | .74 (.44) | .25 (.35) | .79 (.51) | .82 (.50) | .39 (.49) | .36 (.45) |
| CH | 1.20 (.80) | .95 (.82) | 1.33 (.83) | 1.25 (1.77) | 1.19 (.83) | 1.19 (.81) | 1.00 (.87) | 1.05 (.96) |
| 9m | EC | .58 (49) | .45 (.59) | .52 (.49) | .50 (.00) | .53 (.50) | .53 (.51) | .61 (.70) | .59 (.63) |
| CH | .73 (80) | 1.23 (.96) | 1.07 (.63) | .75 (1.06) | .95 (.80) | .96 (.80) | .78 (.91) | .77 (.88) |
| 12m | EC | .75 (.55) | .82 (.56) | .53 (.57) | .25 (.35) | .67 (.56) | .69 (.56) | .44 (.68) | .41 (.63) |
| CH | 1.05 (.72) | 1.27 (.68) | 1.18 (.92) | .75 (1.06) | 1.13 (.78) | 1.15 (.78) | 1.11 (.89) | 1.05 (.88) |
| *Notes.* Overall N = 59. Groups with the same letter subscript were compared in the analysis, i.e., constituted the two levels of the dependent measure in the logistic regressions: a = main analysis, b = auxiliary analyses. EC = empathic concern, CH = contagious happiness. LR = low risk; HR-non = high risk-no problems; HR-mild = high risk with minor problems (speech delay or difficulties in emotion or attention regulation); GDD = global developmental delay; ASD = autistic spectrum disorder; Non-ASD total = all four non-ASD groups together (including GDD); NR = normative range, i.e., the non-ASD groups except for GDD; AD = Atypical development (ASD and GDD). For EC the human simulations score is and average of experimenter and mother simulations, for CH the human simulation score is for the experimenter task.  |

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| Table S2. Zero order correlations between empathic responses |
|  | EC | CH |
| *Exp.* | *Mother* | *Video* | *Exp.* | *Video* |
| Emotion | Task | Age | 6 | 9 | 12 | 6 | 9 | 12 | 6 | 9 | 12 | 6 | 9 | 12 | 6 | 9 | 12 |
| EC | *Exp.* | 6 | - |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 9 | .24† | - |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 12 | .30\* | .39\*\* | - |  |  |  |  |  |  |  |  |  |  |  |  |
| *Mother* | 6 | .46\*\* | .50\*\* | .21 | - |  |  |  |  |  |  |  |  |  |  |  |
| 9 | .30\* | .59\*\*\* | .33\* | .34\* | - |  |  |  |  |  |  |  |  |  |  |
| 12 | .06 | .12 | .50\*\*\* | .08 | .24† | - |  |  |  |  |  |  |  |  |  |
| *Video* | 6 | .41\*\* | .44\*\* | .27\* | .43\*\* | .38\*\* | .04 | - |  |  |  |  |  |  |  |  |
| 9 | .09 | .54\*\*\* | .07 | .36\* | .25 | -.08 | .30\* | - |  |  |  |  |  |  |  |
| 12 | .02 | .24 | .34\*\* | .17 | .17 | .18 | .16 | .41\*\* | - |  |  |  |  |  |  |
| CH | *Exp.* | 6 | .10 | .00 | -.11 | -.03 | -.10 | -.08 | .12 | .09 | .02 | - |  |  |  |  |  |
| 9 | .08 | .08 | -.01 | -.12 | -.12 | -.01 | .20 | -.09 | -.15 | .28\* | - |  |  |  |  |
| 12 | .00 | .14 | .17 | -.06 | -.01 | .23† | -.08 | .01 | .03 | .11 | .38\*\* | - |  |  |  |
| *Video* | 6 | .03 | -.01 | .08 | -.23 | -.01 | -.01 | -.16 | .03 | -.14 | .24† | .06 | .00 | - |  |  |
| 9 | .13 | .28\* | .09 | .11 | .08 | -.03 | .20 | .03 | .06 | .30\* | .45\*\* | .19 | .30\* | - |  |
| 12 | .19 | -.01 | .31\* | .10 | -.21 | .00 | -.08 | -.00 | .07 | .11 | -.11 | .05 | .11 | .00 | - |
| *Notes*. †*p* < .10, \* *p* < .05, \*\* *p* < .01, \*\*\* *p* < .01 (all two-tailed). Overall N = 59. EC = empathic concern, CH = contagious happiness. Exp = experimenter. |

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| Table S3: Fixed effects from the mixed-effects linear model predicting empathic response, without the distressed mother task |
| *Fixed effects* | *B* | *S.E.* | *df* | *t-value* | *p-value* |
| Known risk level | -.06 | .06 | 56.30 | -1.12 | .266 |
| Diagnosis | -.15 | .11 | 58.01 | -1.38 | .172 |
| Age | -.02 | .01 | 614.85 | -1.66 | .098 |
| Target | -.04 | .02 | 614.34 | -1.84 | .067 |
| Emotion | .01 | .05 | 614.43 | .33 | .746 |
| Diagnosis X Age | -.01 | .03 | 614.38 | -.41 | .681 |
| Diagnosis X Target | .04 | .07 | 614.52 | .64 | .521 |
| Age X Target | 00 | .01 | 614.49 | .33 | .742 |
| Diagnosis X Emotion | .39 | .13 | 614.72 | 3.05 | .002 |
| Age X Emotion | -.03 | .02 | 614.60 | -1.71 | .088 |
| Target X Emotion | .41 | .05 | 614.65 | 8.94 | < .001 |
| Diagnosis X Age X Target | .04 | .03 | 614.31 | 1.56 | .120 |
| Diagnosis X Age X Emotion | -.02 | .05 | 614.54 | -.43 | .667 |
| Diagnosis X Target X Emotion | -.33 | .13 | 614.77 | -2.55 | .011 |
| Age X Target X Emotion | .04 | .02 | 614.99 | 2.33 | .020 |
| Diagnosis X Age X Target X Emotion | .02 | .05 | 614.61 | .38 | .707 |
| *Notes*. Known risk level is the sum score of familial risk (0 = low risk, 1 = high risk) and infants gender (0 = girls, 1 = boys). Diagnosis is subsequent ASD diagnosis (0 = non-ASD, 1 = ASD). Age is infants age in empathy assessment (6, 9, and 12 months). Target is the target of empathic response (0 = experimenter, 1 = video stimuli). Emotion is the emotion portrayed by the target (0 = distress, 1 = joy). The analysis included 59 participants and 686 observations.  |

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| Table S4: Fixed effects from the mixed-effects linear model predicting empathic response, using atypical diagnosis (ASD or GDD) |
| *Fixed effects* | *B* | *S.E.* | *df* | *t-value* | *p-value* |
| Known risk level | -.08 | .05 | 55.89 | -1.46 | .151 |
| Diagnosis | -.16 | .09 | 55.95 | -1.78 | .081 |
| Age | -.01 | .01 | 767.43 | -.71 | .478 |
| Target | -.04 | .02 | 765.87 | -1.86 | .063 |
| Emotion | .06 | .04 | 767.01 | 1.35 | .178 |
| Diagnosis X Age | -.01 | .02 | 767.29 | -.60 | .548 |
| Diagnosis X Target | .02 | .06 | 765.95 | .37 | .710 |
| Age X Target | .00 | .01 | 766.01 | .36 | .723 |
| Diagnosis X Emotion | .47 | .11 | 767.31 | 4.37 | <.001 |
| Age X Emotion | -.05 | .02 | 765.89 | -2.84 | .005 |
| Target X Emotion | .41 | .05 | 766.24 | 9.07 | < .001 |
| Diagnosis X Age X Target | .03 | .02 | 765.81 | 1.43 | .154 |
| Diagnosis X Age X Emotion | -.03 | .04 | 765.80 | -.73 | .465 |
| Diagnosis X Target X Emotion | -.36 | .12 | 766.14 | -3.14 | .002 |
| Age X Target X Emotion | .04 | .02 | 766.61 | 2.34 | .019 |
| Diagnosis X Age X Target X Emotion | .01 | .05 | 766.11 | .17 | .867 |
| *Notes*. Known risk level is the sum score of familial risk (0 = low risk, 1 = high risk) and infants gender (0 = girls, 1 = boys). Diagnosis is subsequent atypical diagnosis (0 = normative range, 1 = atypical development of ASD or GDD). Age is infants age in empathy assessment (6, 9, and 12 months). Target is the target of empathic response (0 = human simulation of experimenter or mother, 1 = video stimuli). Emotion is the emotion portrayed by the target (0 = distress, 1 = joy). The analysis included 59 participants and 838 observations.  |
| Table S5: Fixed effects from the mixed-effects linear model predicting empathic response, 6 months only |
| *Fixed effects* | *B* | *S.E.* | *df* | *t-value* | *p-value* |
| Known risk level | -.02 | .08 | 54.73 | -.22 | .831 |
| Diagnosis | -.11 | .14 | 57.32 | -.79 | .431 |
| Target | .05 | .08 | 215.05 | .72 | .474 |
| Emotion | .23 | .08 | 212.31 | 3.05 | .003 |
| Diagnosis X Target | -.33 | .21 | 215.73 | -1.57 | .118 |
| Diagnosis X Emotion | .62 | .22 | 213.01 | 2.88 | .004 |
| Target X Emotion | .31 | .15 | 213.13 | 2.04 | .043 |
| Diagnosis X Target X Emotion | -.66 | .43 | 212.49 | -1.54 | .125 |
| *Notes*. Known risk level is the sum score of familial risk (0 = low risk, 1 = high risk) and infants gender (0 = girls, 1 = boys). Diagnosis is subsequent ASD diagnosis (0 = non-ASD, 1 = ASD). Target is the target of empathic response (0 = human simulation of experimenter or mother, 1 = video stimuli). Emotion is the emotion portrayed by the target (0 = distress, 1 = joy). The analysis included 59 participants and 275 observations.  |

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| a) |  |
| b) |  |
| *Figure S1*. Means of empathic responses by age, emotion, diagnosis group, and target.  |