

Data supplement to Carter Leno et al. Callous-unemotional traits in adolescents with autism spectrum disorder. Br J Psychiatry doi: 10.1192/bjp.bp.114.159863

Online Supplement DS1

Method

Item Response Rates from the Antisocial Process Screening Device (APSD) – callous-unemotional subscale (total count/percentage per item).

Item scoring: 0 = not at all true, 1 = sometimes true or 2 = definitely true

Question 3 ‘Cares about school work’ (reverse scored)

0 – 23/25%

1 – 45/48.9%

2 – 24/26.1%

Question 7 ‘Good at keeping promises’ (reverse scored)

0 – 21/22.8%

1 – 50/54.4%

2 – 21/22.8%

Question 12 ‘Feels bad when does something wrong’ (reverse scored)

0 – 27/29.3%

1 – 47/51.1%

2 – 18/19.6%

Question 18 ‘Concerned about other’s feelings’ (reverse scored)

0 – 14/15.2%

1 – 51/55.4%

2 – 27/29.4%

Question 19 'Hides feelings from others'

0 – 32/34.8%

1 – 52/56.5%

2 – 8/8.7%

Question 20 'Keeps some friends' (reverse scored)

0 – 37/40.2%

1 – 32/34.8%

2 – 23/25%

Neurocognitive Tasks

All tasks were programmed in Matlab v6.5 (Mathworks Inc., Sherbon, MA) using Cogent 2000 (Wellcome Department of Imaging Neuroscience, UCL Institute of Neurology, London, UK; <http://vislab.ucl.ac.uk/Cogent/>) and presented on a Hewlett Packard laptop computer with a 15” LCD display screen. For the verbal tasks, stimuli were delivered bi-aurally through headphones (Sennheiser HD 280 pro). Most participants were tested in one of two quiet testing labs. For practical reasons, a minority were tested at home or at school in the best available testing space but always in a quiet 1:1 environment. Participants were positioned with their eye line approximately 50 cm from the screen.

Emotion Recognition

Ekman-Friesen Test. The stimuli were black and white halftone photographs of male and female faces expressing six 'basic' emotions (happiness, sadness, anger, fear, surprise, disgust). Each stimulus was displayed on the screen until the examiner had input the participant's response. A total of 60 faces were presented, 10 of each emotion, in same order as

the original Ekman–Friesen test. The measured variable was total number of correctly identified emotions, this was calculated for each emotion separately and as a total overall score.

Executive Functioning

Card Sort task. For three trials, participants were shown a photograph of a character (e.g. Sally) and a pack of 64 cards with a separate character and pack of cards for each trial. The cards depicted single objects that varied on three dimensions: colour, shape and size. Participants were told that the character had some favourite cards and that it was their job to work out what those cards were; they were also shown four of the cards as exemplars. They were then instructed: “I will show you the cards one at a time and I will ask you if you think it is one of Sally’s favourite cards. There is a rule about which cards Sally likes best. I would like you to try to work out the rule and remember it.” The participant was informed that they would be told if they were correct or not. A counterbalanced ordering system was used to dictate the dimension on which the cards were sorted on each trial. The participant’s decision on the first trial was always taken as the correct one and the trial continued until the participant was correct on six consecutive sorts or after 20 trials. The measured variable was number of trials to correctly identify the set.

Trail Making task. The task comprised three trials. For Part A1, the participant was asked to “join the dots” in numerical order of circles numbered 1-25. For Part A2, the participant was asked to “join the dots” in alphabetic order of circles labelled A-Y. For Part B1, the participant was asked to “join the dots” by switching between numbers (1-13) and letters (A-L) (i.e. 1-A-2-B-3-C and so on). For each trial, a short practice was initiated prior to the test. Time taken to complete each trial was recorded to the nearest millisecond. The subtraction of Part A1 from Part B served as a measure of switching ability.

Theory of Mind

Strange Stories. This task required understanding of the effect of and motivation for double bluffs, misunderstanding, lies and persuasion. The participants were read a series of stories, which were also written out in front of them and accompanied by an appropriate illustration. Four of the stories had a ToM component, where the participant had to demonstrate understanding of the character's thoughts, feelings and intentions, and two were control "physical" stories, which did not demand mental state understanding. The order of story presentation was counterbalanced. Following Bowler,⁴⁷ a zero-one-two scoring system was implemented, with zero representing an incorrect or "don't know" response and two representing a full and explicitly correct answer. The outcome variable was the average score from the four ToM stories. Thirty-two out of a possible 129 scripts in the full dataset were selected and independently rated, with intraclass correlations coefficients of 0.91-0.98.

Frith-Happé Animations. The task used six silent 2D animations that are part of an established set of mental state cartoons, and previously described procedures were followed (see Tregay *et al*,⁴⁸ Reitan & Wolfson⁴⁹ for further details). All featured two interacting "characters," a big red triangle and a small blue triangle, moving within a white framed space.). The animations were matched as closely as possible for visual characteristics. The length of the animations averaged at 41 sec (SD 5 4.1 sec). Participants had to watch the animation and to describe what they thought the two triangles were doing, with their verbal response recorded for later transcription and scoring. Intentionality scores were calculated by scoring the degree of mental state attribution, with zero = no mental state language, i.e. describing a non-deliberate action, and five = sophisticated use of mental state language, i.e. describing deliberate action with goal of affecting mental state. Intraclass correlation coefficients between independent raters on 72 participants' scores were between 0.82-0.98.

Penny Hiding. The task began by the experimenter placing their hands behind their back to

hide a penny in one of their hands. They then produced their closed fists to show the participant and the participant was asked to guess which hand the penny was in. After their guess, the penny was revealed and the participant would learn whether they were correct or not. This was repeated a further five times, with a fixed order of hidden locations (right or left fist). After completion of this phase, the participant was told: "Now it's your turn. See if you can trick me. Hide it really well, just like I did". The participant was given six trials of hiding the penny. Each trial was coded as a pass or a fail, based on whether a participant deception error led the experimenter to explicitly know where the penny was. Separate coding of the types of deception errors was made (does not keep both hands out of sight when hiding the penny; only one hand used for either hiding or presenting; hand(s) are open; tells you where the penny is; display error (i.e. the penny is hidden but you can tell where it is e.g. by grip), with a total score calculated. It was possible to display more than one error on a trial. The task was scored on-line as much as was possible without disrupting the flow of the game, with a video recording of the session being used for additional scoring, as necessary. The outcome variable was the total number of errors across the session.

Combined false belief story. Participants were read a story about two characters; Mary and John, whilst viewing cartoon depictions of the story. They were told that Mary and John hide some chocolate in the kitchen fridge but whilst Mary was outside, John removes the chocolate and places it in his bag. The first order false belief question asks: "Where does Mary think the chocolate is?". The participant is also asked a justification question ("Why does Mary think the chocolate is in the ____?") and a control question ("Where has John put the chocolate really?"). For the second order part of the story, the participant is told that when John was hiding the chocolate Mary saw him from the kitchen window, but that John did not see Mary looking. The second order false belief question asks: "Where does John think Mary will look for the chocolate?". The participant is also asked is also asked a justification question ("Why does John think Mary will look for the chocolate in the ____?")

and three control questions (“Did John see Mary watching him through the window?”; “Where is the chocolate really?”; “Where was the chocolate first of all?”). The outcome variables were performance on the first order part of the story and performance on the second order part of the story.

Second Order False Belief. Participants listened to the experimenter reading a story about two characters, Peter and Jane, who visit two shops at lunchtime to find Peter a new coat; they identify a preferred coat in one of the shops and plan to purchase it that evening. Later that day, both characters independently discover that the coat Peter had wanted to purchase has sold out. The participants are tested on their understanding of Jane’s second order false belief that Peter will have gone to the shop they had both planned to go to, and not to the other shop (“Where does Jane think Peter has gone to buy his coat?”). This is followed by a justification question (“Why?”), reality question (“Where has Peter really gone to buy his coat?”) and memory question (“In which shop did Peter see the coat he liked the best?”). A series of basic prompt questions to ensure comprehension were included earlier in the story. A full transcript of the story can be found in Moffit & Silva.⁵¹

For the first order section, the participant scored one point for passing the false belief question correctly and an additional point for passing the justification question correctly. For the second order section, the participant scored one point for passing the false belief question correctly and a score of one or two for passing the justification question correctly

Table DS1 Correlations between psychiatric and autistic measure associations and callous-unemotional traits

	CU trait score
Emotional and behavioural problems at 16 (parent-rated)	
SDQ conduct problems	.25*
SDQ hyperactivity	.23*
SDQ emotional symptoms	-.02
SDQ peer relations	.29**
SDQ prosocial behaviour	-.55**
SRS Social responsiveness	.47**

SDQ indicates Strengths and difficulties questionnaire; SRS Social responsiveness scale

*p<0.05, ** p<0.05

Table DS2 Correlations between tasks of emotional recognition and Theory of Mind and callous-unemotional traits

	CU trait score
Ekman emotional face recognition task	
Total Score	-.25*
Happiness	-.04
Sadness	-.16
Fear	-.26*
Anger	-.03
Surprise	-.11
Disgust	-.17
ToM tasks	
Strange Stories	-.01
Penny Hiding Errors	.17
Castelli Animations	-.13
Combined 1 st Order False Belief	-.06
Combined 2 nd Order False Belief	-.12
2 nd Order False Belief	-.13

ToM indicates theory of mind

*p<0.05

Table DS3 Correlations between tasks of executive functioning (response reversal and attention switching) and callous-unemotional traits

	CU trait score
Trail Making Difference Score	0.12
Card Sort Total Sorts Required	0.05

Table DS4 Correlations between ToM tasks and autism severity, as measured by the SRS and ICD-10 clinician ratings of symptom severity

ToM task	SRS Total	ICD-10 Symptom Severity
Strange Stories	-.18	-.21*
Penny Hiding Errors	.20*	.34**
Castelli Animations	-.09	-.31**
Combined 1 st Order False Belief	-.19*	-.21*
Combined 2 nd Order False Belief	-.19*	-.03
2 nd Order False Belief	-.06	-.05

SRS Social responsiveness scale

* p<0.1, ** p<0.05