Cognitive empathy across the lifespan

Liam Dorris1,2 | David Young3 | Karl Byrne4 | Robin Hoyle4

1Paediatric Neurosciences Research Group, Royal Hospital for Children, Glasgow
2Institute of Health & Wellbeing, Medical Veterinary & Life Sciences, University of Glasgow, Glasgow
3Department of Mathematics and Statistics, University of Strathclyde, Glasgow
4Glasgow Science Centre, Pacific Quay, Glasgow, UK

Abstract

Aim: To describe the development of cognitive empathy across the lifespan from a very large cohort using a standardized measure of cognitive empathy ability.

Method: Participants (n=4545, age bands <5y to >75y, 60% female) were a convenience sample recruited voluntarily from visitors to the Glasgow Science Centre in the UK, who completed the Reading the Mind in the Eyes Test.

Results: When compared to preceding age groups, we found significant developmental gains in empathy ability in children aged 6 to 7 years (p=0.048, d=0.45) and again at 10 to 12 years (p=0.042, d=0.23), followed by a slight reduction in ability during adolescence (p=0.087, d=−0.18), and functional maturity in those aged 19 to 25 years (p=0.001, d=0.76). Cognitive empathy abilities remained relatively stable across adulthood but gradually declined in people over 65 years, with notable decline in males over 75 years (p=0.001, d=−0.98). Females performed better than males at all ages.

Interpretation: Understanding developmental issues in cognitive empathy could influence approaches to moral and social education for children, and health and social care support for older people. Standardized cognitive empathy tests could also provide novel approaches in the early detection of developmental vulnerabilities in a range of neurological conditions, and within neuropsychiatric and neurodegenerative disorders in which cognitive empathy is known to be impaired.

Experimental psychologists, philosophers, and neuroscientists have long been interested in social cognitive abilities, that is how we solve the everyday challenge of understanding what another person may be thinking and/or feeling, and how we use those judgements to understand and predict their behaviour and navigate our way through the social environment. Despite the fundamental importance of these cognitive abilities for human survival and adaptation, remarkably little is known regarding their developmental trajectories across the lifespan.

There have been several terms used to describe the phenomena underpinning social cognition, with the aim of studying component processes involved in our understanding of empathy. In recent years the term ‘theory of mind’ (ToM) has become widely used in cognitive psychology and understood to describe the ability to infer and predict the intentions, thoughts, desires, intuitions, behavioural reactions, plans, and beliefs of other people, through an awareness that others have a mind with mental states, information, and motivations that may differ from one's own. For the purpose of the current study, we use the terms cognitive empathy and ToM as near synonyms, but acknowledge there is debate around how phenomenology involved in empathy research are defined.

There has also been increasing evidence for the distinction clinically and neurally between ‘cognitive’ and ‘affective’ empathy. ‘Cognitive empathy’ requires perceptual and cognitive

Abbreviations: GSC, Glasgow Science Centre; RMET, Reading the Mind in the Eyes Test; ToM, Theory of mind.

This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2022 The Authors. Developmental Medicine & Child Neurology published by John Wiley & Sons Ltd on behalf of Mac Keith Press.
neural circuits to identify and make inferences about the thoughts, intentions, and emotional states of others, whilst ‘affective empathy’ might be conceptualized as the ability to make inferences about what another individual is feeling and, crucially, to respond with the appropriate emotion. In this model it is plausible to correctly infer the intentions and beliefs of another but not to respond emotionally in a socially and morally normative manner. This dissociation in cognition and affect has been described in people with psychopathic traits, and in some individuals with autism spectrum disorders.4, 5

There is an increasing understanding of the neural basis of empathy; neuroimaging studies consistently implicate a network of brain regions including the medial prefrontal cortex, superior temporal sulcus, temporoparietal junction, and bilateral temporal poles.6–7 There is also preliminary evidence suggesting cognitive and affective empathy are associated with specific neural architecture, with greater activation of the dorsolateral and ventromedial prefrontal cortex respectively.8–10

Much of the experimental consideration of ToM ability has been conducted with either very young children or with people with autism spectrum disorder, a condition where social cognition is severely affected. Widely used in autism spectrum disorder studies, the Reading the Mind in the Eyes Test (RMET)11 has also been used with typically developing controls, demonstrating that the test is sensitive in measuring so-
cial cognition across a wide ability range, and has been shown to discriminate between the first-degree relatives of people with autism and typically developing controls.12 However, studies have typically been limited by small sample sizes often with around 25 participants in each experimental group.

In addition to autism spectrum disorder, ToM deficits are implicated in a range of other clinical disorders including schizophrenia13 and bipolar disorder,14 and in both children and adults with epilepsy.15 ToM deficits have also been found to mediate friendship quality and social integration after paediatric traumatic brain injury.16 Thus, ToM is a complex metacognitive process which is fundamental to social relationships and is impaired in a range of common neurologi-
cal, neurodevelopmental, and psychiatric disorders.

The current study aimed to gather normative development-
mental data in a large, representative cohort of participants across the lifespan, using a well-established measure of cog-
nitive empathy ability. This information could be of value in understanding important cognitive developmental pro-
cesses in humans, such as the most appropriate developmental age for children to be learning moral and social education in school, and informing our understanding of how empathy supports relationships and prosocial behaviour.

**METHOD**

**Setting**

Participants were visitors to the ‘Mind works’ exhibition at the Glasgow Science Centre (GSC; https://www.glasgowsciencecentre.org) over an 18-month period. The GSC is a large facility providing science education and exhibitions with government subsidies to enable access, for example all schools in the Greater Glasgow urban area are able to send children for planned visits. Ethical approval was provided by the science committee of the GSC.

**Participants**

The participants (n=4545) were prompted to provide their age band, sex, and postcode. Participants were then asked to select one of 12 age bands in years, before begin-
ing the test (<6, 6–7, 8–9, 10–12, 13–18, 19–25, 26–35, 36–45, 46–55, 56–65, 66–75, >75). The largest age group by far was 36 to 45 years, accounting for almost a quar-
ter of all participants (n=1094). Conversely, the over-75s formed the smallest group, making up less than 1% of participants (n=43). Participant data was linked to rou-
tine demographic data collection for all visitors to the GSC.

The Scottish Index of Multiple Deprivation (https://simd.scot/#/simd2020/BTTTFTT/9/-4.0000/55.9000/) uses post-
codes to list every neighbourhood in Scotland in order of deprivation using a number of factors such as income rate and employment rate. The 6505 data zones are split into quintiles, five groups which are ordered from most deprived to least deprived (Q1–Q5).

Figure 1 shows the proportions of GSC visitors observed within each of the five Scottish Index of Multiple Deprivation quintiles. GSC visitors are slightly under-representative of the most deprived Scottish Index of Multiple Deprivation data zones (17.7% vs 20% Q1) and slightly over-represented by the least deprived data zones (23.5% vs 20% Q5) of Scottish Index of Multiple Deprivation areas.

We also compared GSC visitors on a range of demo-
graphic variables to the Scottish census data.17 There were more female visitors to the GSC than the general popula-
tion ratio (61% vs 52%). GSC visitors were also slightly more diverse in terms of ethnicity (90% vs 95% White) and sexual identity (89% vs 95% heterosexual), but had similar rates of full-time employment (52% vs 51%), see Figure 2.

**What this paper adds**

- Cognitive empathy is a late-developing ability and changes across the lifespan.
- Cognitive empathy increases during childhood but with potentially altered abilities during adolescence.
- Cognitive empathy matures during early adulthood and gradually declines in older age.
- There is a female advantage in cognitive empathy abilities.

---

**Figure 1.**

The proportions of GSC visitors observed within each of the five Scottish Index of Multiple Deprivation quintiles compared to the Scottish population. GSC visitors are slightly under-representative of the most deprived Scottish Index of Multiple Deprivation data zones (17.7% vs 20% Q1) and slightly over-represented by the least deprived data zones (23.5% vs 20% Q5) of Scottish Index of Multiple Deprivation areas.

**Figure 2.**

Participant demographic data collected from the GSC, including age band, sex, and postcode.
Measures

The RMET\textsuperscript{11} involves presentation of greyscale images of the eye region of the human face showing a range of emotions exhibited by actors (see Figure 3). The participants are then asked to choose one from four ‘mental state terms’ that ‘best describe what the person is thinking or feeling’. The mental state terms used in this test require linguistic and perceptual processing and are more complex tasks than identifying the six basic emotions as defined by Ekman et al.: happiness, sadness, fear, surprise, anger, and disgust.\textsuperscript{18} The RMET has been widely used in autism research and the original validation studies for the child and adult versions consisted of participants aged 6 to 13 years and 18 to 49 years respectively.\textsuperscript{11, 19} In order to reduce the time required to complete the test, participants were shown the first 21 out of 28 and 21 out of 36 of the original images from the child and adult versions of the test respectively. Children and adults completed versions with identical visual stimuli but the language used in the children’s test was more straightforward. For example, ‘insisting’ in the adults’ test was replaced by ‘making somebody do something’ in the children’s test and similarly ‘decisive’ was substituted by ‘made up her mind’. Participants aged 12 years and under completed the child version of the test, while those aged 13 years and over completed the adult version. The RMET was digitized and presented on a 15-inch computer screen built into a seated workstation located in the corner of a large exhibition space as part of a ‘Mindworks’ exhibition. The instructions were presented in a series of pages requiring completion in order to proceed to the test. Participants were instructed to choose which of four words that were presented in the corners of the visual stimuli best described what the person might be ‘thinking or feeling’. Younger children (<6y) were likely assisted by parent/carer in order to complete the RMET.

Statistical analysis

The effects of age and sex on the RMET empathy score were investigated using multiple regression analysis. To account for guessing in the multiple-choice responses, scores were adjusted using the method proposed by Choppin:\textsuperscript{20} Adjusted percentage = 100 × \frac{P_o - P_e}{1 - P_e}

where Po is the participant’s proportion of correct answers and Pe is the proportion of correctly answered questions that would be expected by chance (i.e. 0.25). Therefore, anyone who correctly answered 100% of questions would remain with an adjusted score of 100%, whilst those who scored 25% in the test would have a corrected score of 0%. However, participants with a result less than 25% would have a negative score: this means they scored less than would be expected.
by chance. Adjusted scores were then analysed using a regression model which included age group, sex, and an age x sex interaction. All analyses were done using Minitab (version 18, Minitab LLC, State College, PA, USA) at a 5% significance level with the final model being chosen using stepwise selection. Where appropriate, a measure of effect size (Cohen’s d) was reported to indicate the standardized difference between means alongside the significance level.

**RESULTS**

There were 4545 participants (40% male) who completed the test included within the analyses. The final model found sex ($p<0.001$) and age ($p<0.001$) were highly significantly associated with cognitive empathy (model $R^2=14.95\%$). There was no evidence of an interaction between age and sex ($p=0.206$). Those under 18 years and over 75 years had the poorest cognitive empathy skills (see Table 1).

**Age effects**

Each of the 12 age bands were compared to the preceding age band to investigate the developmental periods during which cognitive empathy changes were most significant. There were three distinct periods of rapid development in childhood and early adulthood where performance was significantly greater than previous age bands: 6 to 7 years ($p=0.048$, $d=0.45$), 10 to 12 years ($p=0.042$, $d=0.23$), and 19 to 25 years ($p=0.001$, $d=0.76$). The most marked increase in cognitive empathy was between the 13- to 18- years age group.

**FIGURE 3** The Reading the Mind in the Eyes Test showing both child and adult versions.

**TABLE 1** Summary data for each group by age and sex on the Reading the Mind in the Eyes Test

<table>
<thead>
<tr>
<th>Age group, y</th>
<th>Sex</th>
<th>n</th>
<th>Mean (SD)</th>
<th>Median (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;6</td>
<td>Female</td>
<td>24</td>
<td>32 (24.44)</td>
<td>30.67 (−6.67, 74.67)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>44</td>
<td>23 (22.96)</td>
<td>18.67 (−13.33, 81.33)</td>
</tr>
<tr>
<td>6–7</td>
<td>Female</td>
<td>49</td>
<td>40 (24.38)</td>
<td>37.33 (−6.67, 88)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>46</td>
<td>34 (26.85)</td>
<td>37.33 (−13.33, 88)</td>
</tr>
<tr>
<td>8–9</td>
<td>Female</td>
<td>151</td>
<td>42 (26.25)</td>
<td>44.00 (−33.33, 88)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>96</td>
<td>32 (21.57)</td>
<td>34.00 (−20, 74.67)</td>
</tr>
<tr>
<td>10–12</td>
<td>Female</td>
<td>311</td>
<td>44 (22.39)</td>
<td>44.00 (−20, 88)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>232</td>
<td>43 (22.94)</td>
<td>44.00 (−13.33, 88)</td>
</tr>
<tr>
<td>13–18</td>
<td>Female</td>
<td>304</td>
<td>41 (22.95)</td>
<td>44.00 (−26.67, 94.67)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>204</td>
<td>37 (23.01)</td>
<td>37.33 (−6.67, 88)</td>
</tr>
<tr>
<td>19–25</td>
<td>Female</td>
<td>318</td>
<td>57 (20.45)</td>
<td>59.33 (−6.67, 100)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>143</td>
<td>55 (21.28)</td>
<td>56.00 (−6.67, 94.67)</td>
</tr>
<tr>
<td>26–35</td>
<td>Female</td>
<td>412</td>
<td>58 (19.75)</td>
<td>62.67 (−1.33, 94.67)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>238</td>
<td>52 (24.10)</td>
<td>56.00 (−20, 100)</td>
</tr>
<tr>
<td>36–45</td>
<td>Female</td>
<td>666</td>
<td>60 (18.22)</td>
<td>62.67 (−1.33, 100)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>428</td>
<td>58 (20.82)</td>
<td>62.67 (−6.67, 94.67)</td>
</tr>
<tr>
<td>46–55</td>
<td>Female</td>
<td>323</td>
<td>59 (18.83)</td>
<td>62.67 (−6.67, 100)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>228</td>
<td>58 (20.33)</td>
<td>62.67 (−6.67, 94.67)</td>
</tr>
<tr>
<td>56–65</td>
<td>Female</td>
<td>113</td>
<td>56 (18.59)</td>
<td>56.00 (−1.33, 100)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>75</td>
<td>52 (21.89)</td>
<td>56.00 (−6.67, 94.67)</td>
</tr>
<tr>
<td>66–75</td>
<td>Female</td>
<td>54</td>
<td>50 (21.57)</td>
<td>49.33 (−1.33, 88)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>43</td>
<td>48 (21.70)</td>
<td>49.33 (−6.67, 81.33)</td>
</tr>
<tr>
<td>&gt;75</td>
<td>Female</td>
<td>26</td>
<td>33 (22.71)</td>
<td>37.33 (−13.33, 69.33)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>17</td>
<td>19 (22.73)</td>
<td>12.00 (−13.33, 62.67)</td>
</tr>
</tbody>
</table>
Cognitive empathy across the lifespan

and the 19- to 25-years age group, suggesting that late adolescence/early adulthood is a critical point at which cognitive empathy skills reach maturity (see Table 2). Performance remained stable across adulthood before declining in the seventh decade of life and very significantly declining in people aged over 75 years (\(p=0.001\), \(d=0.98\)), see Figure 4.

**Sex differences**

Females performed better than males at all ages (\(p<0.001\)); however, these differences were more prominent at several points across the lifespan. The largest discrepancy was found in the over 75 years group, where the female mean score was 13.9% higher than the male. However, this cohort was far smaller (\(n=43\)) than for other age bands with a wider confidence interval and therefore limits the precision of the population estimate. In contrast, in the 10- to 12-year age group, females only performed 0.22% better than males, suggesting that this is a point in development where there is little difference in empathy ability (see Figure 4).

**DISCUSSION**

Cognitive empathy develops in a nonlinear way across childhood and adolescence before maturing in the third decade of life. We also found that cognitive empathy abilities peak between the ages of 35 to 55 years, and slowly decline in older adults, particularly in males aged over 75 years.

Female sex was associated with enhanced ToM abilities at all stages of the lifespan. There continues to be debate in relation to whether this female advantage is a relatively fixed and stable trait difference, for example reflecting different hormonal effects such as in utero exposure to sex hormones, or whether there are sociocultural influences that may also differentially shape these abilities.21 Interestingly, there is some evidence for the neuroprotective effects of female sex in individuals suspected to have increased genetic loading for social cognitive deficits, for example female siblings of children with autism tend to score higher on empathy tests than typically developing IQ-matched male controls, whilst scoring below female-matched controls.12 Preliminary functional neuroimaging findings also indicate differential activation patterns between males and females on ToM tasks.22 The current findings might be considered alongside those related to sex-related differences in cognitive abilities more generally, for example meta-analytic studies confirm a cross-cultural advantage in reading and writing, language, and verbal memory for females, whilst males tend to be significantly over-represented in studies of those with superior maths and spatial reasoning ability.21 The important thing would seem to concern how we can understand potential sex differences in empathy and use this understanding to maximize developmental potential based on intrinsic cognitive style. Importantly, studies reporting sex-based differences in cognitive ability reflect group differences, and many individuals will not conform to these sex-linked cognitive profiles.

Another issue concerns how to promote the development of empathy abilities in children. The available evidence suggests that children show earlier awareness of mental states if their mothers/main carers explicitly talk about intentions, thoughts, and emotions23 and provide reasons when correcting misbehaviour,24 and that empathy development is also influenced by participation in pretend play, experience of storybook reading, and of talking with others about past experiences.25 There is also some evidence that siblings can accelerate ToM development,24 and that warm, sensitive, and responsive parenting is important for facilitating ToM development in children.26 The critical aspect of these interactions would appear to involve reflection and consideration of perspective and intention with a consistent caregiver. Understanding that prosocial behaviour has cognitive foundations might also actively influence early education approaches.

**Table 2** Theory of mind abilities comparing age bands

<table>
<thead>
<tr>
<th>Age group, y</th>
<th>Difference</th>
<th>95% confidence interval</th>
<th>(p^*)</th>
<th>effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;6–6–7</td>
<td>11.11</td>
<td>3.31, 18.91</td>
<td>0.048</td>
<td>0.45</td>
</tr>
<tr>
<td>6–7–8–9</td>
<td>0.98</td>
<td>−4.98, 6.95</td>
<td>1.000</td>
<td>0.04</td>
</tr>
<tr>
<td>8–9–10–12</td>
<td>5.44</td>
<td>1.92, 8.96</td>
<td>0.042</td>
<td>0.23</td>
</tr>
<tr>
<td>10–12–13–18</td>
<td>−4.05</td>
<td>−6.82, 1.29</td>
<td>0.087</td>
<td>−0.18</td>
</tr>
<tr>
<td>13–18–19–25</td>
<td>16.66</td>
<td>13.88, 19.43</td>
<td>&lt;0.001</td>
<td>0.76</td>
</tr>
<tr>
<td>19–25–26–35</td>
<td>−0.21</td>
<td>−2.75, 2.33</td>
<td>1.000</td>
<td>−0.01</td>
</tr>
<tr>
<td>26–35–36–45</td>
<td>2.99</td>
<td>1.03, 4.95</td>
<td>0.167</td>
<td>0.15</td>
</tr>
<tr>
<td>36–45–46–55</td>
<td>−0.35</td>
<td>−2.34, 1.63</td>
<td>1.000</td>
<td>−0.02</td>
</tr>
<tr>
<td>46–55–56–65</td>
<td>−4.34</td>
<td>−7.59, 1.09</td>
<td>0.400</td>
<td>−0.22</td>
</tr>
<tr>
<td>56–65–66–75</td>
<td>−5.12</td>
<td>−10.17, −0.06</td>
<td>0.746</td>
<td>−0.25</td>
</tr>
<tr>
<td>66–75–&gt;75</td>
<td>−21.73</td>
<td>−29.75, −13.71</td>
<td>&lt;0.001</td>
<td>−0.98</td>
</tr>
</tbody>
</table>

*Adjusted for multiple comparisons.
Interestingly, we found that late childhood (ages 10–12y) is a developmental period where children show greater empathy ability than adolescents. Therefore, late childhood is likely to be an ideal developmental period where moral, social, and relationship education could be particularly effective. Indeed, Weimer et al. found that adolescents who had more advanced ToM also showed more prosocial reasoning about conflict, which in turn mediated the relation with fewer serious behaviour problems in high school, after controlling for academic performance and sex.27

One of the more interesting findings in the current study concerns the moderate decline in ToM/empathy abilities during adolescence, where the 508 adolescent participants scored on average 10% lower than the 543 children aged 10 to 12 years. It is difficult to know why this may be, although there is some limited evidence for specific abilities such as facial recognition ability going ‘offline’ during periods of rapid development and rewiring within the prefrontal cortex.28 There is clearly a need to better understand the social cognitive neuroscience of adolescence in order to increase the engagement of young people, particularly those who may be at greater risk of social and educational exclusion or marginalization. Given the extent of neurological maturation and a corresponding increase in most intellectual abilities during adolescence, the current data on empathy are interesting. There is a need for more detailed studies of how cognition and learning are influenced during this important period of maturation by social and emotional stimuli.

Understanding the developmental trajectory of social cognition in typically developing children might also allow us to consider the development of children with known neurological insults or neurodevelopmental conditions. For example, recent studies suggest that autism may be significantly more common in people with cerebral palsy than in the general population, with reported incidences ranging from 2% to 30%, but that standard diagnostic methods are less sensitive for children with motor disability, particularly when this affects speech production.29,30 One population-based neuroimaging study reported autism in 30% of children with cerebral palsy, found across all imaging patterns but with increased incidence in those with white matter injury.31 There is also a growing number of studies examining the links between basal ganglia injuries and both cognitive dysfunction and neurodevelopmental disorders such as autism, posited to reflect disruptions in reciprocal neural networks between the basal ganglia and frontal cortex.32

There are likely to be a much larger number of children with cerebral palsy who do not have autism, but who may have vulnerability in social cognition and who may benefit from greater awareness and support for these difficulties in developing social relationships.

Another important finding concerns the decline in cognitive empathy shown in older age, particularly by older males in whom functioning by age 75 years was lower than the level attained by children less than 6 years of age. The relatively small sample size limits what we can conclude from the present findings, although age-related decline has been previously reported.33

The implication of this data may be that many males may have difficulty in solving the complex task of recognizing other people’s emotion and intention in later life. This could, under situations of high cognitive demand, lead to feelings of confusion or irritability. Whilst there is undoubtedly something important in the ‘wisdom of age’ hypothesis, and also in acknowledging that there will likely be significant individual variation in cognitive empathy ability, the potential implications of these data for older males seems important. It is also worth noting that ‘healthy’ ageing has been associated with reliable improvement in emotional well-being and social functioning.34

Whilst the present study indicates that cognitive empathy ability may slowly reduce as a feature of typical ageing, there is also an increasing evidence base establishing that empathy deficits are evident across neurodegenerative disorders.35
There is clearly potential utility in exploring whether standardized empathy tests could be used in detecting early cognitive changes in those with suspected neurodegenerative disorders, and which could also inform care planning approaches.

**Strengths and limitations**

The main strengths of this study include the very large sample size and wide age range. Limitations included the use of a single short-form measure of cognitive empathy, and the use of a community sample with no exclusion criterion, but the simplicity of the study also facilitated the participation of a large sample. We were not able to gather data on a range of variables such as physical health, IQ, family factors, social-cultural differences across time, and environmental factors that would allow us to build a more instructive model of what factors more precisely predict better cognitive empathy.

**Conclusion**

These findings demonstrate how cognitive empathy improves across childhood, declines slightly in adolescence, matures in early adulthood remaining stable until late middle age and then declines, with a particularly steep decline in males over the age of 75 years. We confirm previous findings relating to the relative advantage shown by females in cognitive empathy abilities across the lifespan. The implications of this work seem significant; greater understanding of how children and adolescents understand and relate to others could allow improvements in educational approaches to moral and social development. The use of validated cognitive empathy tests could also become useful in the early detection of neurological disorders later in life.

**DATA AVAILABILITY STATEMENT**

The data that support the findings of this study are available from the corresponding author upon reasonable request.

**ORCID**

Liam Dorris https://orcid.org/0000-0002-9502-3154

**REFERENCES**


How to cite this article: Dorris L, Young D, Byrne K, Hoyle R. Cognitive empathy across the lifespan. Dev Med Child Neurol. 2022;00:1–9. https://doi.org/10.1111/dmcn.15263
ORIGINAL ARTICLE

Cognitive empathy across the lifespan

Liam Dorris¹,² | David Young³ | Karl Byrne⁴ | Robin Hoyle⁴

¹Paediatric Neurosciences Research Group, Royal Hospital for Children, Glasgow
²Institute of Health & Wellbeing, Medical Veterinary & Life Sciences, University of Glasgow, Glasgow
³Department of Mathematics and Statistics, University of Strathclyde, Glasgow
⁴Glasgow Science Centre, Pacific Quay, Glasgow, UK

Correspondence
Liam Dorris, 2nd Floor Office Block, Royal Hospital for Children, 1345 Govan Road, Glasgow, Scotland, G51 4TF.
Email: liam.dorris@ggc.scot.nhs.uk

Graphical Abstract
The contents of this page will be used as part of the graphical abstract of html only. It will not be published as part of main article.

Abbreviations: GSC, Glasgow Science Centre; RMET, Reading the Mind in the Eyes Test; ToM, Theory of mind.

This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2022 The Authors. Developmental Medicine & Child Neurology published by John Wiley & Sons Ltd on behalf of Mac Keith Press.