

**ENVIRONMENTAL-RISK (E-RISK) LONGITUDINAL TWIN STUDY
CONCEPT PAPER FORM**

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Provisional Paper Title: Associations between childhood cognitive factors and trajectories of bullying behaviours and conduct problems: Investigating underlying mechanisms in a population-based cohort

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Objective of the study and its significance:

Cognitive abilities, such as executive functions, IQ and Theory of Mind (ToM), develop during childhood and play an essential role in many spheres of child development and mental health (Diamond, 2016; Imuta et al., 2016; Mathiassen et al., 2012; Zelazo, 2020). A growing body of research on risk factors associated with the development of antisocial behaviours, such as bullying and conduct problems, recognizes the role of cognitive factors in the onset and persistence of antisocial behaviours across the life span (Coolidge et al., 2004; Ogilvie et al., 2011; Wallinius et al., 2019; Zeier et al., 2012). It has been argued that cognitive impairments could increase the risk of engaging in such behavior through decreasing behavioural inhibition, poorer ability to detect social cues needed to understand intention and emotions, anticipate behavioural consequences, and assess punishment and reward, which results in impairing the capability to generate socially appropriate behaviour in challenging contexts (Ogilvie et al., 2011; Shakoor et al., 2012). However, even though some studies have shown that bullying behaviours and conduct problems are positively associated with lower cognitive abilities in executive functions, IQ and ToM in children (Farrington & Baldry, 2010; Holl et al., 2021; Liu et al., 2017; Shakoor et al., 2012), inconsistency is found across studies about which cognitive factors are the most at play in the development of antisocial behaviours.

Although bullying behaviours and conduct problems share similarities and can be comorbid, these are found to be distinct from each other (Ganesan et al., 2021). Furthermore, the severity and persistence of antisocial behaviours such as bullying and conduct problems are not uniform across all children and may differ in their trajectories or etiology (Viding et al., 2012). Bullying behaviours and conduct problems constitute serious public health problems (Armitage, 2021; Burt et al., 2018; Nazir, 2018) and are associated with numerous adverse outcomes such as psychopathology and poorer functioning in early adulthood (Ganesan et al., 2021; Wertz et al., 2018).

Given that the seeds of bullying involvement and conduct problems are apparent in the school years, a time in which early intervention is viable, it is crucial to get a better understanding of factors associated with their development and constitute relevant targets for early intervention and to place effective prevention measures. Choosing these measures requires a solid understanding of the developmental predictors and mechanisms that intervene early in their development. Finally, although behavioural genetic studies suggest that antisocial behaviours reflect genetic and environmental contributions (Baker et al., 2007; Boisvert & Vaske, 2011; Koenen et al., 2006), it remains to be clarified to which extent the relation

between those cognitive abilities and bullying behaviours and conduct problems from childhood to preadolescence reflect environmental influences while controlling for genetic factors.

In sum, no studies have examined the trajectories of bullying behaviours and conduct problems or their co-trajectory, using a longitudinal cohort study from childhood to preadolescence. Furthermore, it remains unclear which cognitive risk factors uniquely or cumulatively predict bullying behaviours, conduct problems, or their co-occurrence, according to patterns of stability or change over time. Finally, it remains to be clarified if the association between these cognitive factors and trajectories of bullying behaviours and conduct problems reflects environmental contributions while controlling for genetic factors.

Using data from a UK nationally representative longitudinal cohort study, the study aims to:

- (1) identify developmental trajectories and co-trajectories of bullying behaviours and conduct problems according to patterns of stability and change during childhood to preadolescence (5, 7, 10, and 12), using the dual trajectories approach;
- (2) test which age-5 cognitive factors, including executive functions, IQ and ToM, predict independently or cumulatively later trajectories and co-trajectories of bullying behaviours and conduct problems;
- (3) explore whether associations between age-5 cognitive factors and later trajectories and co-trajectories of bullying behaviours and conduct problems reflect environmental contributions, accounting for genetic factors.

It is hypothesised that children with lower cognitive abilities in executive functions, IQ and ToM will be at greater risk of later bullying behaviours and conduct problems or their co-occurrence, and this association reflects the twin's non-shared environmental experiences while controlling for genetic factors.

Statistical analyses:

Aim 1) To identify developmental trajectories of bullying behaviours and conduct problems or their co-occurrence, the dual trajectories approach analyses will be used (Bentrup, 2020). It allows the description of a relation between time series for two different behaviours. It is based on individual developments (intra- and inter-individual changes) over time. The primary outcomes of a dual trajectory approach are the likelihood of belonging to a particular trajectory for one behaviour and separately for the second behaviour, as well as a table with the joint and conditional probabilities for the possible combinations between the trajectories of both behaviours. This strategy allows the estimation of individual developments and behavioural overlaps in the manifestation of similarities or dissimilarities over time.

Aim 2) To test associations between trajectories and co- trajectories of bullying behaviours and conduct problems and age-5 cognitive factors, we will use the standard three-step method (van de Schoot et al., 2017). We will fit univariate multinomial regressions for all variables separately and then add them into a single multivariate multinomial regression, controlling for sex and socio-economic status.

Aim 3) To explore the mechanisms underlying the association between cognitive factors and children's bullying behaviours and conduct problems or their co-occurrence, we will use the discordant MZ-twin method, as described in Pingault et al. (2018). Focusing on MZ twins, this method examines the causal contribution of nonshared environmental experiences to child development while controlling genetic and environmental factors shared by twins. As MZ twins share the same environment and genetic background, all the differences between them are attributable to nonshared environmental factors. An association is expected between MZ twins' differences in cognitive factors and child bullying behaviours and conduct problems, which would suggest that environmental factors are at play in this association.

Variables Needed at Which Ages (names and labels):

E-RISK

Age 5:

FAMILYID ID Family
ATWINID ID Twin 1
BTWINID ID Twin 2
SAMPSEX Sex of twins
SESWQ35 Social Class Composite

+ IMD Variables (for sample description)

IQE5 / IQY5 Pro-rated IQ score

EXFUNCE5/ EXFUNCY5 Executive function - mean of Mazes, Day Night and SWM

TOMTOTE5 / TOMTOTY5 ToM total score

BULLE5/ BULLY5 'Child bullies others (mum and teacher) – Phase 5'

CDtotexbul_v2_5e/ CDtotexbul_v2_5y 'Mum/Teacher CD Symptom Total [ex bully] NEW (1+/2+, Max=12), 5'

Age 7:

BULLE7/ BULLY7 'Child bullies others (mum and teacher) – Phase 7'

CDtotexbul_v2_7e/ CDtotexbul_v2_7y 'Mum/Teacher CD Symptom Total [ex bully] NEW (1+/2+, Max=12), 7'

Age 10:

BULLE10/ BULLY10 'Child bullies others (mum and teacher) – Phase 10'

CDtotexbul_v2_10e/ CDtotexbul_v2_10y 'Mum/Teacher CD Symptom Total [ex bully] NEW (1+/2+, Max=12), 10'

Age 12:

BULLE12/ BULLY12 'Child bullies others (mum and teacher) – Phase 12'

CDtotexbul_v2_12e CDtotexbul_v2_12y 'Mum/Teacher CD Symptom Total [ex bully] NEW (1+/2+, Max=12), 12'

IMD?

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Data Security Agreement

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Today's Date	22nd June 2022

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- FTC My project has ethical approval from my institution.
- TM FTC I am familiar with the EU General Data Protection Regulation (<https://mrc.ukri.org/documents/pdf/gdpr-guidance-note-3-consent-in-research-and-confidentiality/>), and will use the data in a manner compliant with its requirements.
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