



















(Table 1) contd....

Age	Gender	n	Mean	Median	Mode	SD
13-18	F	167	6.51	6.75	6.75	2.31
13-18	M	491	7.31	7.5	7.5	2.52
8-12	F	991	5.96	6	7.5	2.55
8-12	M	1180	6.5	6.75	6.75	2.73
Age	Gender	N	Mean	Median	Mode	SD
13-18	F	167	7	6.75	7.5	2.34
13-18	M	491	7.64	7.5	7.5	2.66
8-12	F	991	7.46	7.5	5.25	2.45
8-12	M	1180	7.38	6.75	5.25	2.95

2.2.2. Principal Component Analysis, Age 8-12 Group

Within the Age 8-12 group, 46.8% of the variance was accounted for by four latent factors, each of which showed an eigenvalue of >2 (Table 2). The remaining 53% was accounted for by more than 16 latent factors (Fig. 4). Factor loadings for items across the four principle latent factors show relatively strong associations with the

conceptual constructs of the data model: Trust of Self, Trust of Others, Self-Disclosure and Seeking Change. Factor loadings for items of Trust of Others and Self-Disclosure were strongest overall, but also exhibited some cross-factor loading (Table 2). Overall factor divergence was moderate, indicating that some items could be refined to improve factor discrimination (Fig. 5).

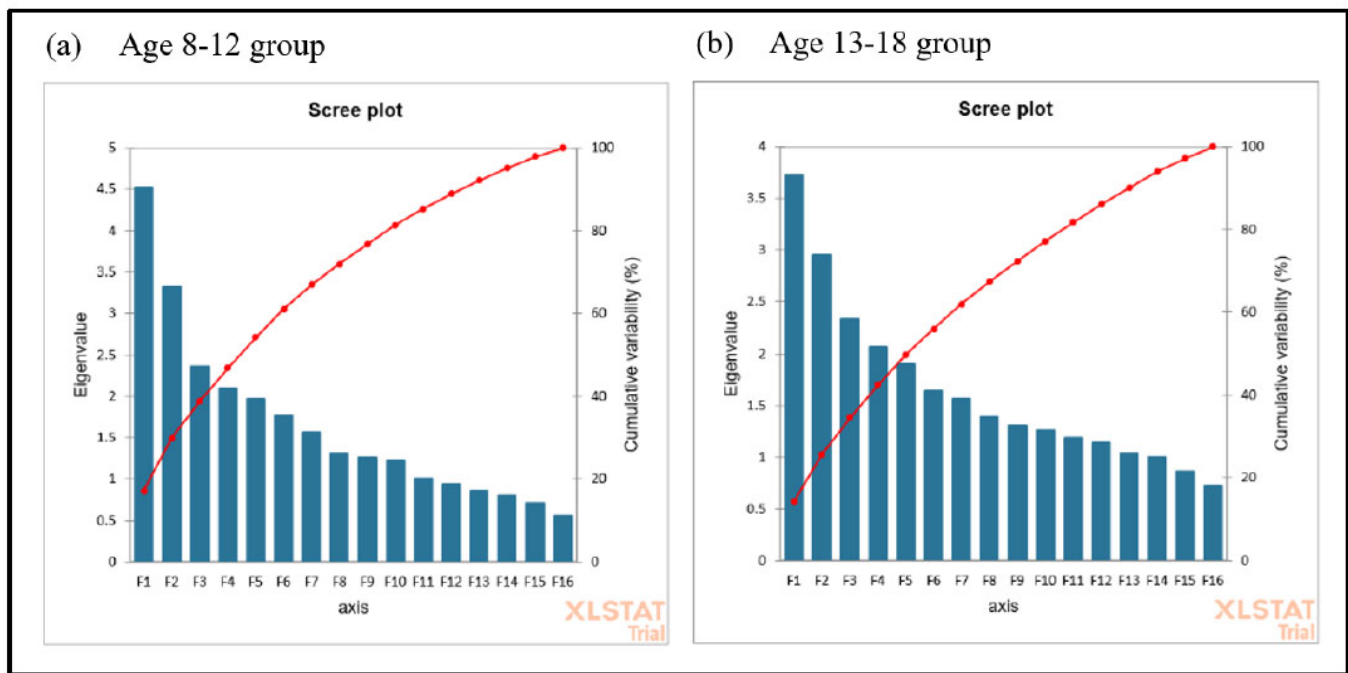


Fig. (4). Scree plots of percentage variance explained by principal components for (a) students aged 8-12 and (b) students aged 13-18.

Table 2. Principal component analysis of the four-factor steer tracking model, with students aged 8 to 12. items with negative loadings are reversed by design in the aged 8-12 instrument.

Item	Factor	F1	F2	F3	F4
1	Trust of Self	<b>-0.411</b>	-0.371	0.096	-0.369
2	Trust of Self	<b>0.447</b>	0.374	-0.353	-0.077
3	Trust of Self	<b>-0.577</b>	0.037	0.414	-0.358
4	Trust of Self	<b>0.348</b>	0.798	-0.397	0.900
5	Trust of Others	0.279	<b>0.544</b>	-0.458	-0.642
6	Trust of Others	-0.082	<b>0.677</b>	-0.581	-0.305

(Table 2) contd....

Item	Factor	F1	F2	F3	F4
7	Trust of Others	-0.283	<b>0.834</b>	0.243	-0.074
8	Trust of Others	-0.062	<b>0.727</b>	-0.156	-0.395
9	Self-Disclosure	0.256	-0.454	<b>-0.577</b>	-0.371
10	Self-Disclosure	-0.153	0.620	<b>0.436</b>	-0.083
11	Self-Disclosure	0.116	0.607	<b>0.713</b>	0.167
12	Self-Disclosure	0.212	-0.493	<b>-0.178</b>	0.022
13	Seeking Change	0.150	0.547	0.064	<b>-0.452</b>
14	Seeking Change	-0.261	-0.171	-0.660	<b>0.096</b>
15	Seeking Change	0.206	0.041	0.549	<b>0.165</b>
16	Seeking Change	0.908	-0.309	0.648	<b>-0.452</b>
	Eigenvalue	4.522	3.317	2.364	2.096
	Variability (%)	17.201	12.620	8.993	7.974
	Cumulative %	17.201	29.821	38.813	46.787

2.2.3. Principal Component Analysis, Age 13-18 Group

Within the Age 13-18 group, 42.4% of the variance was

accounted for by four latent factors, each of which showed an eigenvalue of >2 (Table 3). In other characteristics, factor loadings reflected similar patterns to the 8-12 age group (Table 3), with moderate factor divergence (Fig. 5).

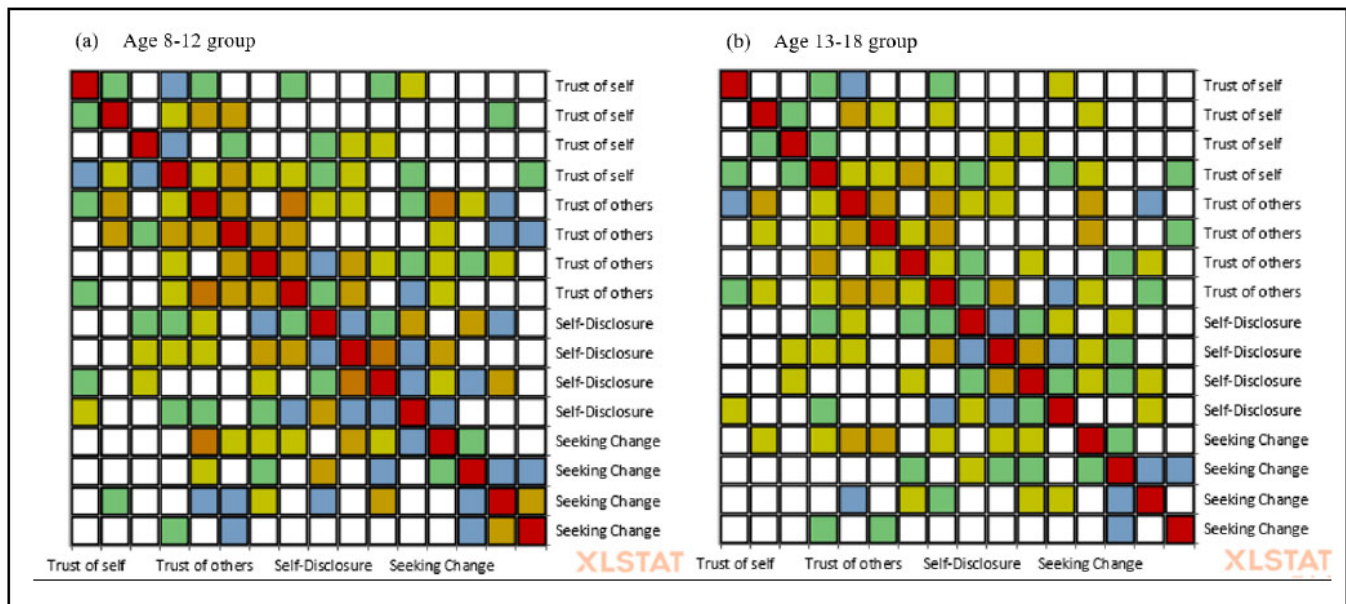


Fig. (5). Intercorrelation between items (a) students aged 8-12 and (b) students aged 13-18.

Table 3. Principal component analysis of the four-factor steer tracking model, with students aged 13 to 18. Items with negative loadings are reversed by design in the aged 13-18 instrument.

Item	Factor	F1	F2	F3	F4
1	Trust of Self	<b>-0.083</b>	-0.331	0.200	-0.097
2	Trust of Self	<b>-0.565</b>	0.401	-0.247	-0.217
3	Trust of Self	<b>-0.148</b>	-0.071	0.462	0.694
4	Trust of Self	<b>0.738</b>	0.873	-0.159	-0.449
5	Trust of Others	-0.553	<b>0.653</b>	-0.479	0.099
6	Trust of Others	-0.367	<b>0.673</b>	-0.181	-0.019
7	Trust of Others	0.342	<b>0.533</b>	0.331	-0.526
8	Trust of Others	-0.159	<b>0.723</b>	-0.152	0.347

Item	Factor	F1	F2	F3	F4
9	Self-Disclosure	-0.270	-0.292	<b>-0.519</b>	-0.017
10	Self-Disclosure	-0.023	0.505	<b>0.450</b>	0.368
11	Self-Disclosure	0.025	0.418	<b>0.907</b>	0.316
12	Self-Disclosure	-0.171	-0.361	<b>-0.101</b>	-0.428
13	Seeking Change	-0.383	0.539	0.052	<b>-0.175</b>
14	Seeking Change	0.256	-0.071	-0.632	<b>0.456</b>
15	Seeking Change	0.091	-0.055	0.412	<b>-0.211</b>
16	Seeking Change	-0.734	-0.238	0.588	<b>-0.469</b>
	Eigenvalue	3.725	2.955	2.338	2.068
	Variability (%)	14.269	11.320	8.958	7.921
	Cumulative %	14.269	25.590	34.548	42.469

### 3. STUDY TWO: ASSOCIATIONS BETWEEN “STEER TRACKING” AND WELLBEING OUTCOMES

#### 3.1. Methods

##### 3.1.1. Participants

Data were collected from 2518 students aged 12 to 18 years old across 16 secondary schools in England. Of these, fourteen were fee-paying schools and two were state-funded. Of the fee-paying schools, six were day schools, and eight were mixed day and boarding students. The sample included 48% girls and 52% boys. Students were not asked to disclose further demographic information (*e.g.*, ethnicity or socioeconomic status).

##### 3.1.2. Procedures

Data collection took place in school classrooms between November and December 2014, under the supervision of teachers. Schools were invited to participate in the study directly by the authors. Schools were selected on the basis of an existing interest in research, as indicated by participation in previous studies. The range of types of school (fee-paying, day and boarding) reflected a market mix in the UK. Schools and students were not paid to participate, and Steer Tracking was provided free of charge. Schools were offered a study report and were invited to attend a webinar explaining over-arching wellbeing conclusions at the school level. Schools chose to participate based on their understanding of the potential advances the assessment might make in supporting students' social-emotional development.

Schools signed a data sharing agreement through which the school gave consent as a surrogate for minors (article 16 Declaration of Helsinki). The data was collected pre-GDPR. Schools used their own policies to determine how to communicate participation with parents. Students were given the choice to opt out of the assessments and if so, were provided with alternative activities by their teachers.

Students completed the Steer Tracking General and School assessments. Students were informed that their Steer Tracking assessments may be seen by their teachers as well as researchers. Students were then asked to respond to three questions about their wellbeing. Students understood that their responses to these questions would be strictly anonymous and would not be seen by their

school. Students understood that they would not have the opportunity to view their personal assessment results.

##### 3.1.3. Measures

In addition to the Steer Tracking General and School assessments described in section 1.4, students responded to three questions about their wellbeing which were written by the researchers for the purpose of this study.

- Bullying: Have you been bullied in the past year? (Never / No / Sometimes / Yes / Often)
- Self-harm: Have you self-harmed or thought about self-harming in the past year? (Never / No / Sometimes / Yes / Often)
- School Pressure: How able are you to manage the pressure of work at school? (Well / Quite well / Ok / Not very well / Not well)

##### 3.1.4. Data Analysis

Theoretically, we did not expect any single factor to be associated with pressure/ bullying/ self-harm. Real-world use of the tool suggested that patterns across the factors would be more likely to show specific associations to these risks.

A Support Vector Machine (SVM) model was therefore used as a method of testing the fit of many models of the combined four factors to students experiencing bullying, thinking about or engaging in self-harm, or struggling with school pressure. SVM is a supervised machine learning model that analyses data using learning algorithms to solve classification and regression tasks.

To begin, binary variables were generated based on responses to the three wellbeing questions:

- Bullying: 0 = Never, No, Sometimes 1 = Yes, Often
- Self-harm: 0 = Never, No 1 = Sometimes, Yes, Often
- School Pressure: 0 = Well, Quite well 1 = Ok, Not very well, Not well

The model was first trained on the dataset with a Radial Basis Function (RBF) kernel to account for non-linear data (*i.e.* both high and low Steer Tracking scores are expected to be associated with bullying, self-harm, and school pressure). The parameters of the model were determined using 10-fold cross-validation. The SVM model was then applied to the non-training data.

The model was cross-validated to test for the probability of accurately classifying students who belong to either category for each wellbeing variable (*e.g.*, bullying/no bullying) based on STEER Tracking factor scores; consistency between the two measures indicates a low chance of false readings.

### 3.2. Results

#### 3.2.1. Bullying

The model achieved an 80% accuracy (83/78% both classes) in identifying students who had experienced bullying in the past year. Experiencing bullying was associated with a significantly higher level of poor self-regulation and specifically with low Self-Disclosure. Students who had a bias towards low Self-Disclosure, as well as a high degree of dysregulated bias (a high deviation from the mean across their item scores), were more likely to report bullying.

#### 3.2.2. Self-Harm

The model achieved an 80% (82/78% both classes) accuracy in identifying children who endorsed self-harm thoughts or behaviours. Self-harm was associated significantly with overall poor self-regulation as well as with low Self-Disclosure and high Seeking Change. Students who show a combination of these factors (high Seeking Change, low Self-Disclosure and high dysregulation) were the most likely to report self-harm.

#### 3.2.3. School Pressure

The model achieved an 83% (88/77% both classes) accuracy in identifying children who were not coping well with pressure at school. Struggling to cope with pressure was statistically associated with overall poor self-regulation as well as, specifically, with Self-Disclosure and Seeking Change. Students who displayed a bias toward low Self-Disclosure or low Seeking Change, or a high degree of dysregulated bias (a high deviation from the mean across their item scores) reported that they managed less well with the pressure experienced at school.

#### 3.2.4. Cross Validation

Cross-validation checks compared the accuracy of both exhibited and non-exhibited conditions (*e.g.*, bullying/no bullying). Across the three wellbeing variables, the difference between conditions was small (bullying 83/78, self-harm 82/78), though slightly higher for school pressure (88/77) with both positive and negative predictions showing high accuracy, thus largely eliminating the explanation of false positive/negative readings. Thus, the assessment exhibited power 8 times greater than statistical chance of correctly identifying students who are experiencing bullying, self-harm, or struggling to cope with school pressure.

## 4. DISCUSSION

We constructed Steer Tracking as a novel means of measuring self-regulation in student populations. This

involved a novel four factor bi-polar conceptual model constructed on the basis of a literature review of necessary self-regulatory tasks: Trust of Self, Trust of Others, Self-Disclosure, and Seeking Change. Healthy self-regulation was conceptualised as the task of “steering” each factor appropriately to the situation at hand (*i.e.*, responding flexibly depending on the context), whilst risk was conceptualised as displaying a fixed bias or rigid response pattern (*i.e.*, responding the same way regardless of context). We developed a novel assessment method, utilising the imagination as a means of priming relevant self-regulatory tasks. In this way, two comparative sets of self-regulatory data were obtained for each subject: General and School context-specific data.

Analyses across two studies provide the first steps in demonstrating the psychometric validity of the Steer Tracking assessment. Principal Component Analyses support the proposed four factor conceptual model across samples of children (ages 8-12) and adolescents (ages 13-18) in UK primary and secondary schools. A Support Vector Machine model indicates the assessment is accurate in identifying at-risk students, as shown by the associations between factor scores and three wellbeing indicators: experiencing bullying, thinking about or engaging in self-harm, and struggling to cope with pressures at school. Thus, results support the practical utility of the Steer Tracking assessment as a mental health tool for schools.

### 4.1. Implications

The Steer Tracking assessment meets a pressing need for evidence-based, accessible tools to help schools identify and provide support to students who are struggling earlier, before formal mental health conditions persist, particularly in the wake of the COVID-19 pandemic. Research demonstrates that the pandemic has negatively impacted self-regulation and contributed to the emergence of anxiety and depression in young people [83]. National evidence confirms that adolescent mental health risks have increased during the pandemic; in 2017, one in nine children was identified as having a probable mental health condition, with estimates rising to one in six by 2021 [84]. One consequence of this increased mental health burden has been increased pressure on the UK Child and Adolescent Mental Health Services (CAMHS) [85].

A UK government 2017 Green Paper recommends early identification and intervention for mental health risks in schools to reduce the cases that reach a clinical level [86]. Funding was subsequently allocated to train and appoint a mental health lead in every school by 2025. Whilst a positive step forward, with 18% of 7 to 16 year olds having a probable mental health disorder, a single mental health lead in secondary schools would be unable to provide individualised support. Steer Tracking has the potential to support the early identification and intervention of young people’s emerging mental health risks. Providing data in a format that a general class teacher can understand can increase the population of

teachers ‘with eyes to see beyond the mask’ of students who are struggling to steer the social-emotional road. Additionally, by providing practical guidance to teachers about activities and messages that can be effective in directing a student back onto the social-emotional road, Steer Tracking can broaden the intervention capacity of a school.

#### 4.2. Limitations

This paper presents an initial evaluation of the Steer Tracking assessment model and its cross-sectional associations with relevant well-being outcomes. However, further validation of the assessment’s psychometric properties, including convergent validity, temporal stability, factor divergence and cross-factor loading, is warranted. The percentage variance accounted for by the four principal factors was relatively low. Further investigation is needed to evaluate the assessment’s measurement invariance across age, gender, and other demographic characteristics, which are associated with differences in self-regulation [87, 88].

#### 4.3. Future Directions

Evaluation of the assessment’s properties across different student populations would support its application across cultures and geographies. Longitudinal research is needed to demonstrate the assessment’s predictive utility for identifying at-risk students and tracking socio-emotional development over time. One application of this longitudinal research would be to evaluate the impact of interventions which support the development of self-regulation [89]. Future studies may also investigate the developmental relationships between the distinct components of self-regulation [90] and potential reciprocal relationships between self-regulation and psychosocial outcomes [91].

#### CONCLUSION

This paper presents the conceptual development and initial validation of a new instrument, Steer Tracking, to assess social-emotional self-regulation in students aged 8 to 18. Whilst it is widely known that the ability to self-regulate underpins academic progress, social competencies and mental health, few tools exist to assess its development across whole-school populations of students. The benefits of such a tool are threefold: for educators, to anticipate student mental health risks earlier, enabling targeted support/referral; for school managers, to obtain data on the impact of their school culture on student social-emotional development; and for students, to empower greater social-emotional self-awareness through personalised data.

#### LIST OF ABBREVIATIONS

ERQ = Emotional Regulation Questionnaire  
 CERQ = Cognitive Emotion Regulation Questionnaire  
 DERS = Difficulties in Emotion Regulation Scale  
 CEMS = Children’s Emotion Management Scale

RBF = Radial Basis Function

#### ETHICAL STATEMENT

STEER Education is an independent company and, therefore could not access formal ethical review and approval from an Independent Review Board or Research Ethics Committee. However, all research was carried out in accordance with ethics standards and data protection principles.

Schools signed a data sharing agreement through which the school gave consent as a surrogate for minors (article 16 Declaration of Helsinki). The data was collected pre-GDPR. Schools used their own policies to determine how to communicate participation with parents.

#### CONSENT FOR PUBLICATION

Schools and students voluntarily participated in the present studies and provided informed consent for their data to be used for research purposes, including publication.

#### STANDARDS OF REPORTING

COREQ guidelines were followed.

#### AVAILABILITY OF DATA AND MATERIALS

The datasets generated and analysed during the current study are not publicly available due to stipulations in the consent process that data will not be shared outside of STEER Education.

For any enquiries regarding the STEER Tracking assessment, please contact the corresponding author [S.W].

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#### CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

#### ACKNOWLEDGEMENTS

Declared none.

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