Using Monozygotic Twin Differences to Develop and Validate a Measure of Students’ Non-Shared Environmental Experiences

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Abstract
A new measure of environmental influences that may help to explain non-shared environmental (NSE) variance in school-leavers’ achievement, life-satisfaction, and future orientation was piloted and validated. Monozygotic (MZ) twins (n = 497 pairs) had previously completed free-response questionnaires about their discordant experiences and outcomes, and 99 particularly discordant pairs were interviewed, in order to generate hypotheses about NSE influences. These hypotheses formed the basis of a new measure (piloted with 117 twin pairs) and Exploratory Factor Analysis revealed ten factors accounting for 63% of the variance in participants’ scores. In a second phase of the study the 49-item measure (SENSES: Student Experiences of Non-Shared Environmental Scales) was administered to 926 twin pairs and Confirmatory Factor Analysis confirmed a valid and reliable measure.

Methods
Our two-phase study (see Table 1 for procedures and analyses) gathered data from the larger Twins’ Early Development Study (TEDS):

- 16-year study included the collection of nationwide public examination results
- 12,054 families have been involved from the beginning

Table 1
SENSES Development: Procedures and Analyses Performed during Phase 1 and Phase 2

<table>
<thead>
<tr>
<th>Procedures</th>
<th>Phase 1</th>
<th>Phase 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedures</td>
<td>• Initial questionnaire to 2,162 pairs of identical twins</td>
<td>• 49-item scale to 526 pairs: 482 MZ &amp; 430 DZ (14 UZ)</td>
</tr>
</tbody>
</table>
| Responses | • Responses from 587 families (~1500 questionnaires) | • Data on grades, life satisfaction & future orientation
| Analyses | • Identified 99 particularly discordant pairs for interviews | • Conducted CFA with MLE in LISREL 8.80
| Analyses | • Results used as to draft 175 potential NSE items | • Randomly selected one twin per pair for CFA
| Analyses | • Feasibility study with 6 adolescents | • Invariance analysis with both samples
| Analyses | • Pilot study with 117 twin pairs (230 individuals) | • Correlations between SENSES and other measures
| Analyses | • Responses from 117 twin pairs: 58 MZ & 57 DZ (2 UZ) | |

Results: 10 Factor Solution
As displayed through Table 2, our analyses revealed a 10-factor solution for a 49-item measure (3 to 9 items per factor): English, Effort, Science (Self, Science, Teacher), Maths (Self, Teacher), Plans (Influence, Plans (Self), Plans (Experience), and Social Media. The ten factors accounted for 63% of the variance in participants’ scores.

Table 2
Non-shared environmental influences on 16 year olds: a 10-factor solution

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
<th>No. of items</th>
<th>% Variance</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>9</td>
<td>19.15</td>
<td>.89</td>
</tr>
<tr>
<td>2</td>
<td>EFFORT (Eng, Maths and Science)</td>
<td>6</td>
<td>9.56</td>
<td>.92</td>
</tr>
<tr>
<td>3</td>
<td>SCIENCE 1: perceptions of self</td>
<td>5</td>
<td>7.78</td>
<td>.89</td>
</tr>
<tr>
<td>4</td>
<td>SCIENCE 2: perceptions of teacher</td>
<td>4</td>
<td>19.15</td>
<td>.85</td>
</tr>
<tr>
<td>5</td>
<td>MATHS 1: perceptions of self</td>
<td>5</td>
<td>4.92</td>
<td>.89</td>
</tr>
<tr>
<td>6</td>
<td>MATHS 2: perceptions of teacher</td>
<td>4</td>
<td>6.08</td>
<td>.90</td>
</tr>
<tr>
<td>7</td>
<td>PLANS 1: family influence</td>
<td>5</td>
<td>9.56</td>
<td>.79</td>
</tr>
<tr>
<td>8</td>
<td>PLANS 2: self-confidence</td>
<td>4</td>
<td>7.78</td>
<td>.82</td>
</tr>
<tr>
<td>9</td>
<td>PLANS 3: work experience</td>
<td>3</td>
<td>4.92</td>
<td>.77</td>
</tr>
<tr>
<td>10</td>
<td>SOCIAL MEDIA CONNECTIONS</td>
<td>4</td>
<td>6.08</td>
<td>.76</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>49</td>
<td>63.05</td>
<td>.85</td>
</tr>
</tbody>
</table>

Results: Validity
- Domain specific factors (perceptions of self and teacher in English, Maths, and Science) were significant and moderately strong correlates of GCSE achievement in English, Maths and Science.
- Correlations between the SENSES factors and life-satisfaction were significant but weak with one exception – self-confidence about the future correlated with life-satisfaction (r = .49).
- Significant correlations between the 10 factors and 3 measures of Future Orientation (Planning Ahead, Time Perspective, Consideration of Future Consequences) → strongest correlations were with effort (average r = .21).

Conclusion
SENSES provides a foundation for assessing relationships between ten non-shared environmental (NSE) factors and a successful - or unsuccessful - transition out of formal compulsory education.

Future Research
We were able to ensure that our factor structure was secure and that our measure appears reliable and valid. Our next steps include:
- assessing the extent to which SENSES can explain the non-shared environmental component of variance in school-leavers’ outcomes
- confirming our factor structure with other (i.e., non-twin specific) samples

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References

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