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STRENGTHENING SOCIAL AND EMOTIONAL HEALTH

Investigating Eligibility Criteria for Primary Project:

Predictive Analytic Rules Based on the T-CRS

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Executive Summary

This report defines various metrics of success for children enrolled in the Primary Project based on Teacher-Child Rating Scale change scores. Various predictive analytic models were estimated to determine the T-CRS initial characteristics associated with the various metrics of success. The goal was to identify the characteristics of children for whom Primary Project is most, and least, successful.

Findings:

Children for whom Primary Project works best based on pre-post Teacher-Child Rating Scale percentile growth:

- Children with 2 or more presenting problems.
- Children with assertive social skills baseline score at or below the 50th percentile.
- Children with behavior control skills baseline score at or below the 25th percentile.

  Children with at least one baseline T-CRS subscale in the 15th to 30th range, the current selection rule, also perform better than the whole sample who actually received Primary Project services.

Children for whom Primary Project works least well based on pre-post Teacher-Child Rating Scale percentile growth:

- Children with no presenting problems.
- Children with only one presenting problem.
- Children above the 50th percentile in the assertive social skills baseline score and above the 25th percentile in the behavior control baseline score.

Recommendations for Primary Project:

Based on conversations regarding the findings of this report with Primary Project staff at Children's Institute we recommend the following:

- Create a measurable definition of success for Primary Project at the individual level.
- Consider excluding children with no presenting problems from receiving services in Primary Project.
- Target children with 2 or more presenting problems, particularly those with the assertive social skills baseline score at or below the 50th percentile and/or the behavior control baseline score at or below the 25th percentile.

Implications for further research:

- The predictive power of the models is relatively low (ranging from 55% to 84% in validation subsamples), suggesting that we need additional information besides the T-CRS to create more accurate predictions of TCRS growth as a result of Primary Project participation.
- It is important to fund on-going research on who benefits, and who does not, from receiving services in primary Project.

Purpose of the Study

The purpose of this study was to discover Teacher-Child Rating Scale (T-CRS) eligibility rules that lead to higher success rates, using predictive analytic methods.

Constructing Definitions of Success for Primary Project

In consultation with Primary Project staff at the Children's Institute, the T-CRS based categories of success listed below were created. A child was deemed to have a ***presenting problem*** in one of the four domains (Behavior Control, Task Orientation, Peer Sociability, and Assertive Social Skills) of the T-CRS if the child scored at or below the 30th percentile for that domain.

- Success Criterion 1 (SC1): Number of presenting problems decreased from pre to post or it was maintained at no problems for those children who entered program with no presenting problems.
- Success Criterion 2 (SC2): Regardless of the T-CRS status at time 1, the child had no presenting problems at post.
- Success Criterion 3 (SC3): Child improved in all T-CRS subscales by 5 percentiles or no decrease if child was at the 95th percentile or above at time 1.

A potential fourth criterion (*SC4: Child improves in any T-CRS subscale*) was considered and eliminated as "too easy" and not suitable for predictive analytic methods. Analysis showed that 93% of children in the data achieved SC4.

The standard way of measuring success for Primary Project is by calculating the pre-post change in the T-CRS . We will include an aggregate way of calculating success (Success SQ Criterion = the sum of all percentile gains/losses across all four subscales) as well in the analyses that follow.

Table 1 shows the overall success criteria rates in the data. It shows that successive criteria are more stringent.

Table 1. Rates of Success by Criteria

Success Criterion	Rate (%)
SC1	52%
SC2	28%
SC3	18%

Status Quo (SQ) Eligibility Criteria for Primary Project

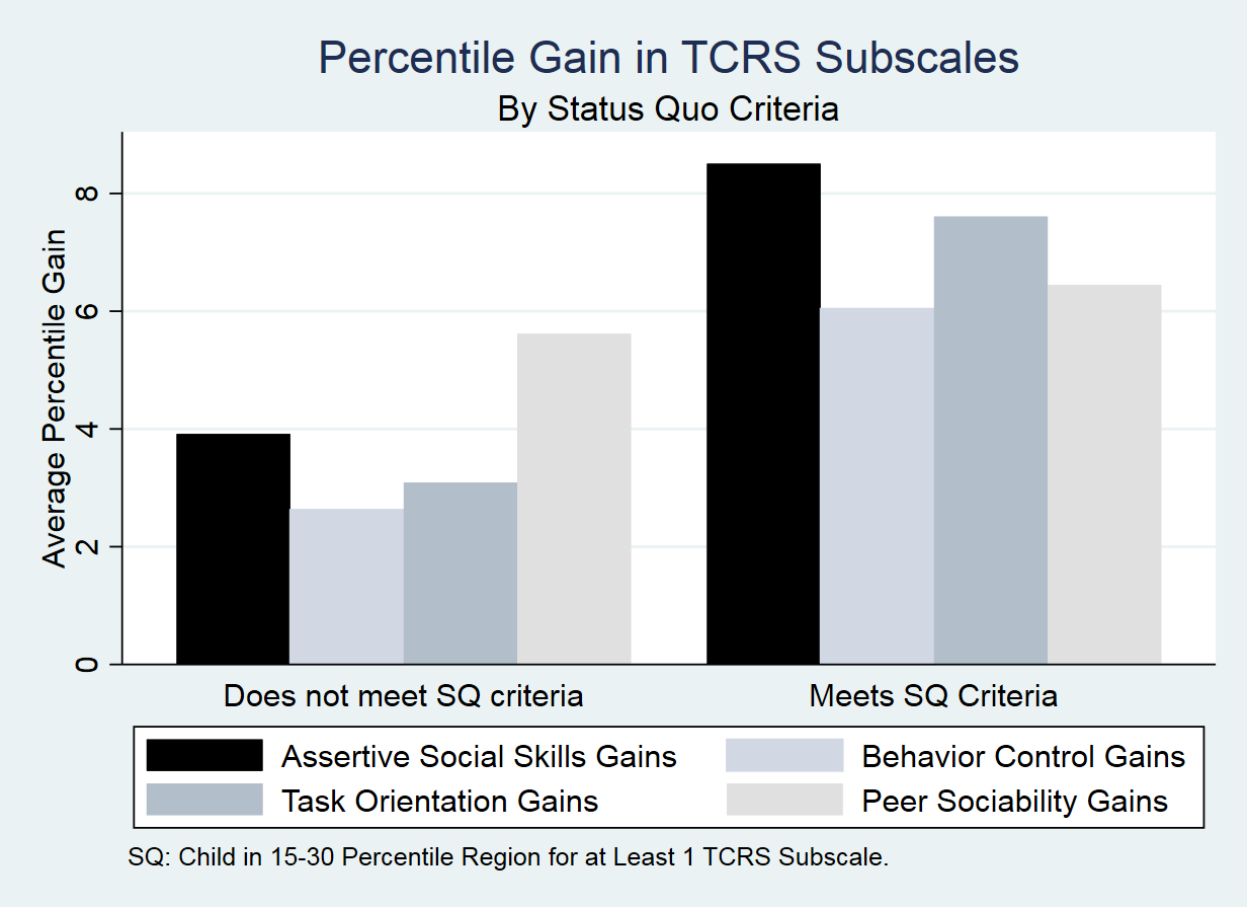
Primary Project staff have indicated in the past that *children within the 15th to 30th percentile of the T-CRS subscales are ideal for Primary Project*. Thus, we consider children with at least one T-CRS domain in that range as the Status Quo (SQ) subsample. This section of the report analyzes how SQ children performed in average pre-post T-CRS change and on the three success metrics compared with non-SQ children.

Table 2. Percentile Gain in T-CRS Subscales by SQ Eligibility Criteria

	SQ Criteria Met		SQ Criteria Not Met	
T-CRS Subscale	**M**	**SD**	**M**	**SD**
Assertive Social Skills	8.51	21.63	3.92	21.14
Behavior Control	6.04	21.24	2.63	23.36
Task Orientation	7.61	20.07	3.09	20.25
Peer Sociability	6.44	19.65	5.62	23.37

Note: All differences are statistically significant at p<.001. MANOVA W=0.9861, F=4.80, p<.001.

Figure 1 – Percentile Gain in T-CRS Subscales by SQ Eligibility Criteria.



As Table 1 and Figure 1 show, children who met the SQ criterion had greater gains in all 4 T-CRS subscales than children who did not meet the criterion.

Table 3. Percentage of Children that Met Success Criteria by SQ Eligibility Criteria

Success Criteria	Overall Rate	Met SQ	Did Not Meet SQ
SC1	52%	53.9%	41.5%
SC2	28%	25.6%	35.4%
SC3	18%	16.8%	12.2%

Note: Success criteria percentages estimated on validation subsample for comparability purposes. Only SC1 differences are statistically significant, χ^2 =4.15, p<.05, Cohen's h = 0.12.

As Table 3 shows, the traditional SQ criterion yields betters results for success metric 1 (Cohen's h is 0.12, a small effect size) but both SQ groups were statistically indistinguishable using the other two success metrics.

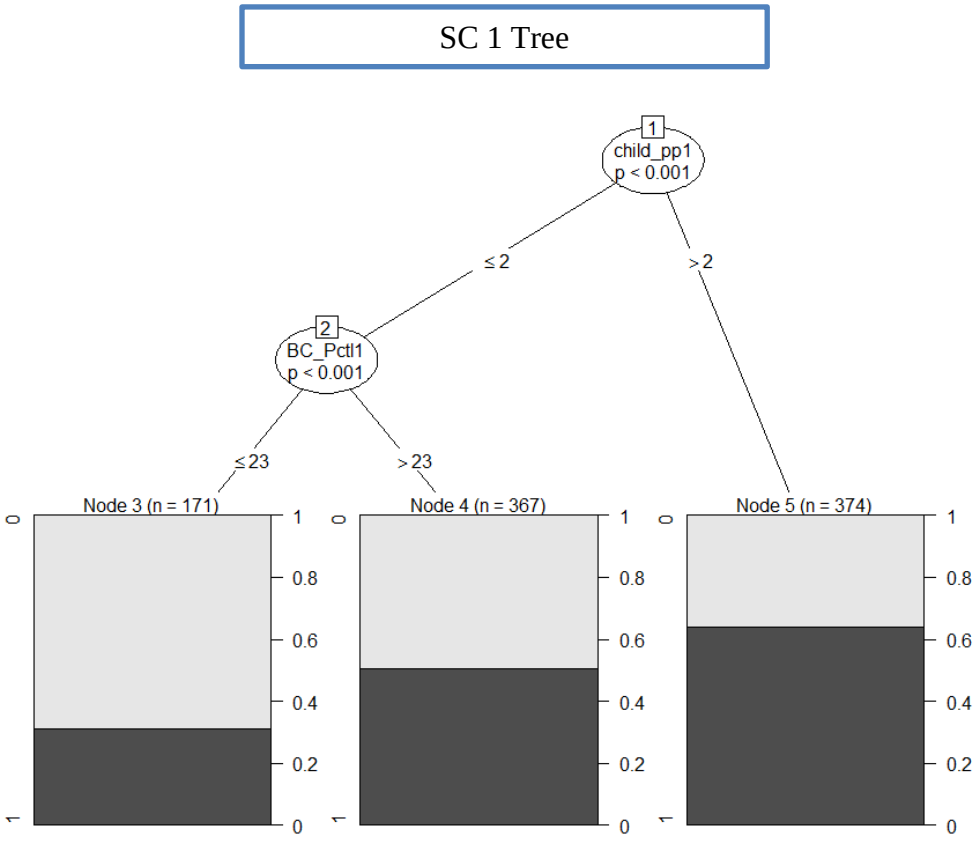
Predictive Analytic Models

Please see technical appendix for detailed information on predictive power and information about how the training and validation subsamples were created.

Success 1 Criterion Conditional Inference Tree Model

Figure 2 shows the conditional inference tree model estimated. It identified 3 groups: children with more than two presenting problems at time 1, children above the 23rd percentile in behavior control who had two or fewer presenting problems and children at or below the 23rd percentile in behavior control at time 1 who had two or fewer presenting problems at time 1.

Figure 2 –Conditional Inference Tree Model for Success Criterion 1.



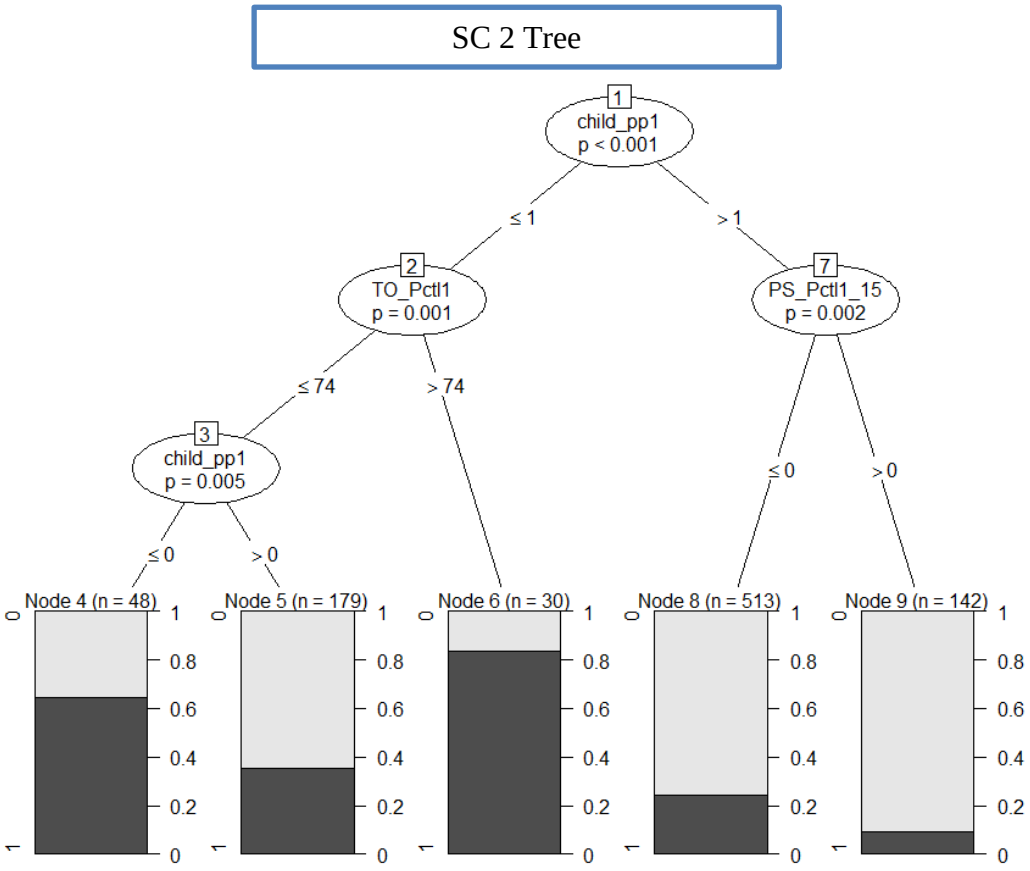
Note: child_pp1: Number of presenting problems at time 1. BC_Pctl1: percentile score in behavior control at baseline.

The figure shows that Primary Project was more likely to achieve success criterion 1 for children who had two or more presenting problems at time 1. It also identified a group (children at or below the 23 percentile in behavior control and 2 or fewer presenting problems) for whom it was more likely than not to fail to achieve success criterion 1.

Success 2 Criterion Conditional Inference Tree Model

Figure 3 shows the conditional inference tree model estimated. It identified 5 distinct groups, with two groups likely to succeed according to success criterion 2 and three groups more likely to fail than to succeed according to this criterion.

Figure 3 –Conditional Inference Tree Model for Success Criterion 2.



Note: child_pp1: Number of presenting problems at baseline. TO_Pctl1: percentile score in task orientation at baseline. PS_Pctl1_15 is a dummy variable equal to 1 if the child is between the 15 and 30 percentile in peer sociability at baseline, and zero otherwise.

Groups likely to achieve Success criterion 2:

- Child had one or no presenting problems and a task orientation baseline score higher than the 74th percentile.
- Child had no presenting problems and had a task orientation baseline score at or below the 74th percentile.

Groups unlikely to achieve Success criterion 2:

- Children with more than 1 presenting problem (two groups: node 8 and node 9).
- Children with 1 presenting problem and a task orientation time 1 score at or below the 74th percentile.

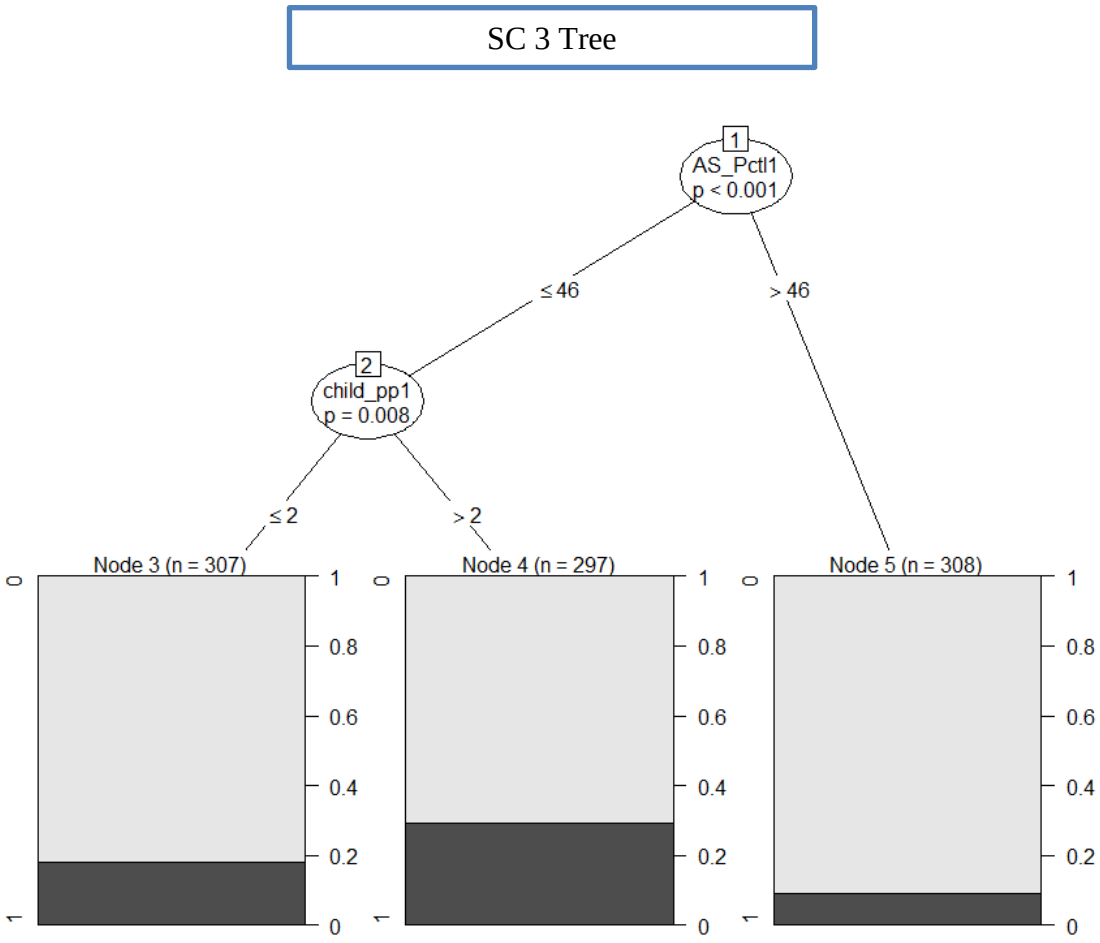
Success 3 Criterion Conditional Inference Tree Model

Figure 4 shows the conditional inference tree model estimated. It separates the data into three groups of children, all of whom were unlikely to achieve success criterion 3. Recall that this criterion had an overall success rate of just 18%. The model identifies a group that is more likely

to achieve success criterion 3: children with more than 2 presenting problems and an assertive social skills baseline score at or below the 46th percentile.

Children who scored above the 46th percentile in assertive social skills were particularly unlikely to achieve the success criterion 3.

Figure 4 –Conditional Inference Tree Model for Success Criterion 3.



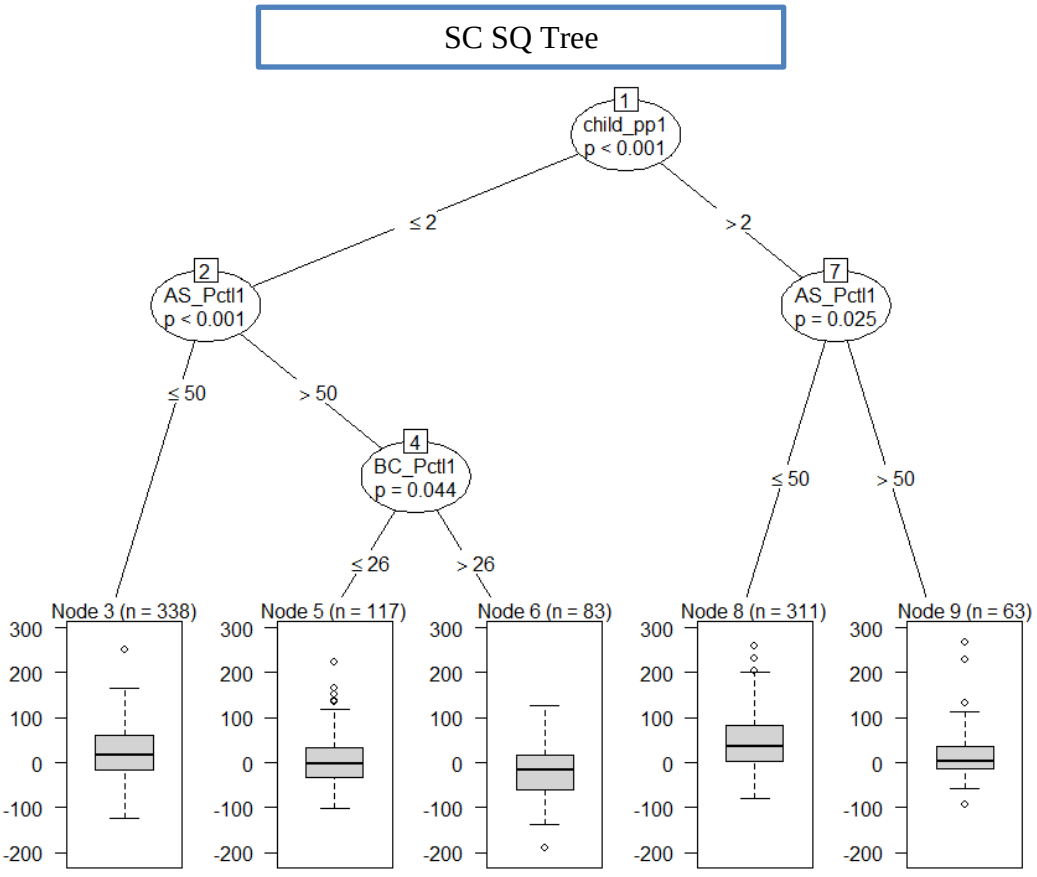
Note: child_pp1: Number of presenting problems at time 1. AS_Pctl1: percentile score in assertive social skills at time 1.

Success Criterion SQ Conditional Inference Tree Model

The success criterion SQ is simply the sum of percentiles gained or lost between time 1 and time 2 across all four T-CRS subscales. Therefore, the success criterion is a continuous, almost normally distributed variable.

Figure 5 shows the conditional inference tree model estimated. It separates the data into five groups of children with different probabilities of gaining in the Success criterion SQ.

Figure 5 –Conditional Inference Tree Model for Success Criterion SQ.



Note: child_pp1: Number of presenting problems at time 1. AS_Pctl1: percentile score in assertive social skills at baseline. BC_Pctl1: percentile score in behavior control at baseline.

Table 4 shows the overall percentile gain or lost across all four T-CRS subscales by groups identified in the conditional inference tree estimated on the success SQ criterion. As can be readily seen, the tree identifies a subset of children likely to substantially grow in the T-CRS: children with relatively low Assertive Social skills (at or below the 50 percentile). In particular, the two groups likely to substantially grow across all 4 T-CRS subscales are:

- With an estimated median gain of 30 .5 percentiles: Children with more than 2 presenting problems and with Assertive Social Skills Scores at time 1 at or below the 50th percentile score.
- With an estimated median gain of 24 percentiles: Children with 2 or fewer presenting problems and with Assertive Social Skills Scores at time 1 at or below the 50th percentile score.

The model also identifies a group unlikely to gain in the overall success SQ metric.

- With an estimated median loss of 4 percentiles: Children with two or fewer presenting problems, assertive social skills higher than the 50 percentile and behavior control baseline scores higher than the 26 percentile.

Two groups of children were predicted to have intermediate results in the success SQ metric.

- With an estimated median loss of 4 percentiles: Children with two or fewer presenting problems, assertive social skills higher than the 50 percentile and behavior control baseline scores at or lower than the 26 percentile.
- With an estimated median loss of 18 percentiles: Children with more than two presenting problems, and assertive social skills higher than the 50th percentile.

Table 4. Overall Percentile Change by Group Identified by Tree for Success Criterion SQ.

	Overall Percentiles Gained or Lost Across the Four T-CRS Subscales		
Group	**Median**	**Mean**	**Standard Deviation**
Node 6 Group	-4.0	-12.67	65.84
Node 5 Group	15.0	16.75	66.97
Node 9 Group	18.0	32.47	71.19
Node 3 Group	24.0	26.12	60.28
Node 8 Group	30.5	43.57	66.63

Note: Statistics calculated in the validation subsample.

In sum, the Success SQ Model indicates that children who have scored above the 50th percentile in assertive social skills are likely to benefit little from the program.

For Whom Does Project Work Best?

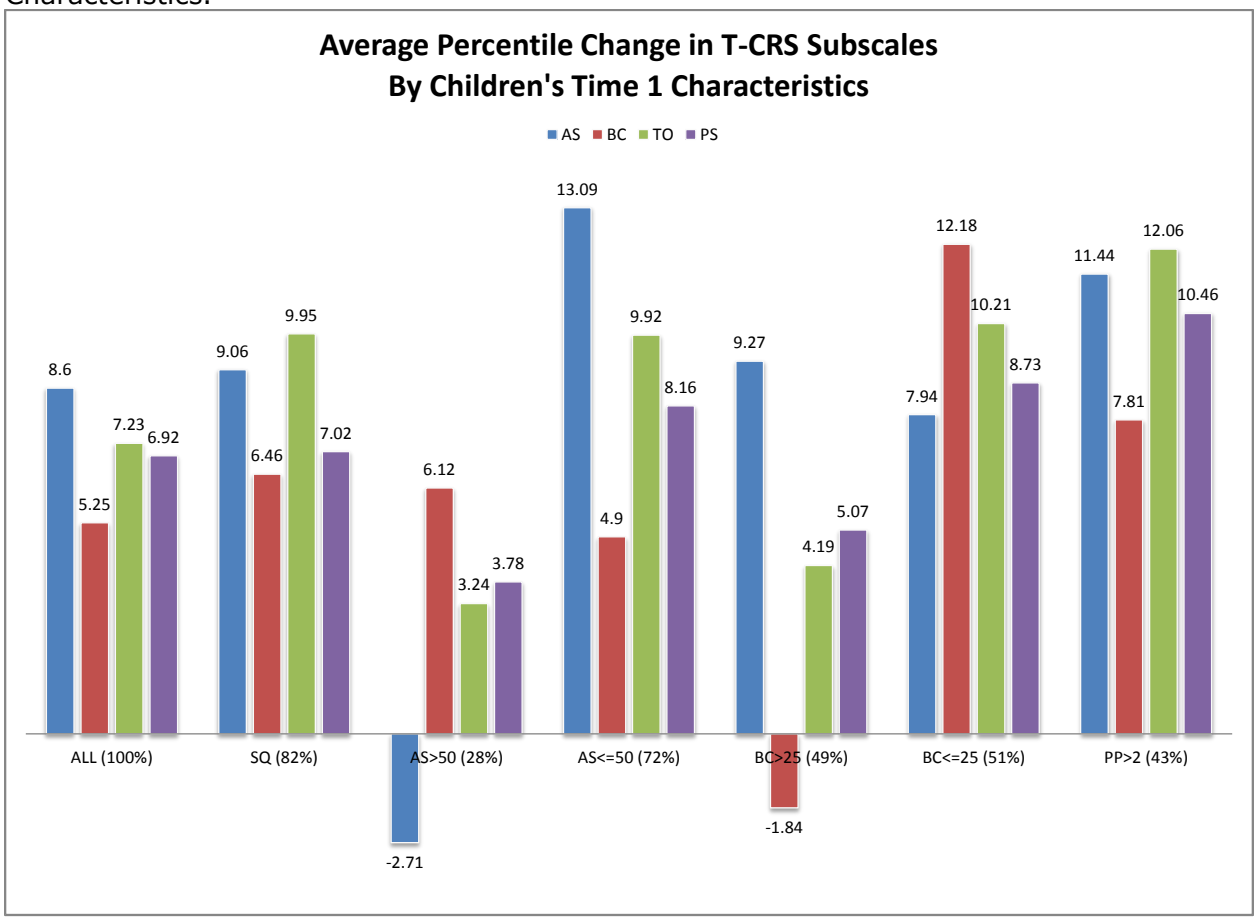
Performance of Various Subsets of Children in Project

Based on the models outlined before, we investigated the performance of the following sets of children in Primary Project:

- The whole sample
- Children with at least 1 T-CRS area in the 15-30th percentile range (The SQ).
- Children with 2 or more presenting problems.
- Children below the 50th percentile of Assertive Social Skills.
- Children at or below the 25th percentile of Behavior Control subscale.

Figure 6 shows the average percentile change in each of the T-CRS subscales for the subsets of children described above. As can be seen, Children with 2 or more presenting problems, children with assertive social skills at or below the 50 percentile and children with behavior control at or below 25 percentile show important gains, as does the traditional rule (SQ) of serving children who have at least 1 T-CRS subscale in the 15-30 percentile range.

Figure 6 –Average Percentile Change in T-CRS Subscales by Children's Time 1 Characteristics.



Note: Numbers in parenthesis in labels are the share of the validation sample with that condition met. AS: Assertive Social Skills. BC: Behavior Control. TO: Task orientation. PS: Peer Sociability. SQ Child has 1 or more subscales between 15-30th percentiles. PP: Number of presenting problems.

For Whom Does Project Work Least Well?

Performance of Various Subsets of Children in Project

Based on the predictive models outlined before, we investigated the performance of the following sets of children in Primary Project as candidates for poor performance in Project:

- The whole sample (as reference group)
- Children with no presenting problems
- Children with only 1 presenting problem.
- Children above 50 percentile in Assertive Social Skills and Behavior Control at or above 25 percentile.

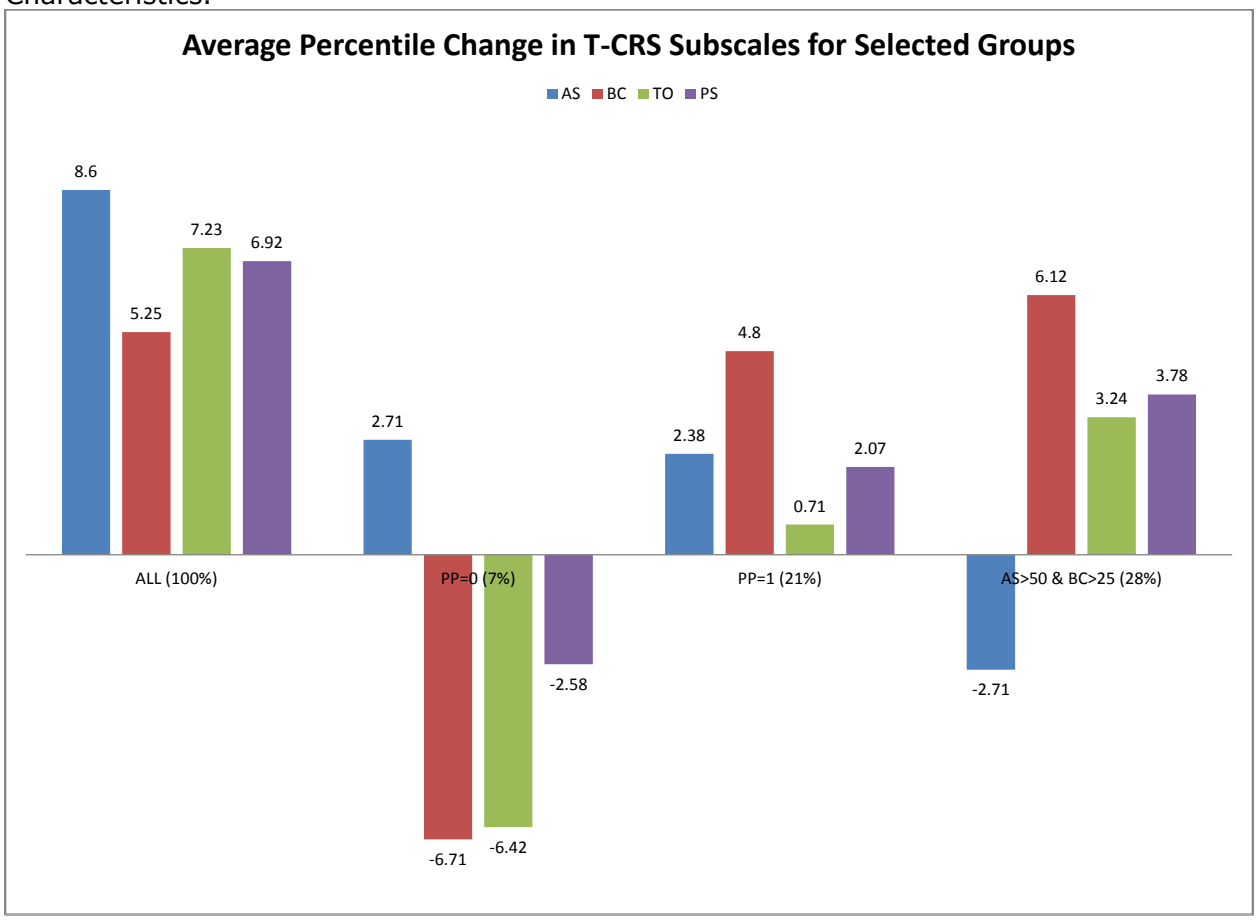
Figure 7 shows the average percentile change in each of the T-CRS subscales for the subsets of children described above. As can be seen, these subsets are relatively small subsets of the population served. The 7% of the validation sample who had no presenting problems showed the

most dramatic losses in T-CRS, and the graph suggests *the program may be counter-indicated for this population.*

The 21% of the validation sample who had a single presenting problem did increase in all 4 subscales but did so at a lower rate than the overall reference results, indicating that this group is also low performing.

The 28% of the validation sample identified by the SQ criterion conditional inference tree as at risk group for poor performance did indeed perform worse than the overall reference group, except for a slight increase in behavior control. Special attention must be paid to this group in the future.

Figure 7 –Average Percentile Change in T-CRS Subscales by Children's Time 1 Characteristics.



Note: Numbers in parenthesis in labels are the share of the validation sample with that condition met. AS: Assertive Social Skills. BC: Behavior Control. TO: Task orientation. PS: Peer Sociability. PP: Number of presenting problems.

TECHNICAL APPENDIX

Data were obtained using archival pre-post kindergarten and first grade T-CRS of Primary Project in 2013-14. Data were de-identified prior to analyses. Data from schools with fewer than five Primary Project students were excluded. The data included 1,369 records. Children were 55% male and 45% female, 49% received the program in Kindergarten and 51% in 1st grade. Racial composition was diverse with 40% of the children identifying as White, 18% Latino/Hispanic, 37% Black, 4% Asian American and less than half a percent other ethnicities (including Native American, multiracial, and others). Ages ranged from 4.6 to 8.7 years old, with an average of 6 years old.

TCRS pre-post data was required to have an interval of 60 days or more in order to be used in the study. Three records with missing gender data were deleted. Only complete pre-post TCRS data was used.

The data was randomly split into training (2/3) and validation (1/3) subsamples. As it is standard in predictive analytic methodology, model evaluation is done only in the validation subsample to correct for the problem of overfitting.

Conditional inference tree for success 1 had a 55.14% accuracy rate, with a specificity of 0.88 and a sensitivity of 0.20 in the validation subsample. Conditional inference tree for success 2 had a 73.74% accuracy rate, with a specificity of 0.19 and a sensitivity of 0.94 in the validation subsample. Conditional inference tree for success 3 had a 84.03% accuracy rate, with a specificity of 0 and a sensitivity of 1 in the validation subsample, by predicting that all children in the subsample will fail.

About the authors

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