An Evaluation of a Family Preservation Juvenile Justice Program with a Cox Regression Model

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This article illustrates the use of Cox regression to analyze recidivism among felony offending juveniles who were assigned to one of two criminal youth programs. The program that employed an intensive home-based family preservation model was identified as the experimental group. The other program, which did not utilize an intensive home-based family preservation model, was labeled the control group. The study used a quasi-experimental design and Cox regression analysis to compare recidivism outcomes of juvenile offenders treated in the Partners Program with a control group of juvenile offenders who were not given the treatment. The Cox regression analysis revealed that for the juveniles treated in the Partners Program their length of time to recidivism was longer and risk of being re-arrested was lower than for the juveniles in the control group, adjusting for the various covariates.

One alternative to the traditional juvenile justice program is an intensive home-based program strategy utilizing multisystemic treatment. This program had shown significant improvement in reducing recidivism and improving the lives of juveniles who committed serious crime. In a study released in 1992, Henggeler, Melton, and Smith found that a multisystemic treatment strategy (MST) used in South Carolina reduced the rates of criminal activity initially and at the 2.4-year follow-up point (Henggeler, Melton, & Smith, 1992; Henggeler, Melton, Smith, Schoenwald, & Hanley, 1993).

Based on the MST principles and the MST model as published by Henggeler and his associates (Henggeler, 1994), a program labeled The Partners Program was designed. This program, which is a home-based family preservation program, was implemented in January 1995 as a pilot program for the Richland County Juvenile Court in Mansfield, Ohio. The Partners Program was perceived to be successful in reducing juvenile recidivism but had not been evaluated empirically through the use of (a) a quasi-experimental research design and (b) the analysis of the data with a Cox regression model.

The Partners Program

The Partners Program offers the opportunity for juveniles adjudicated delinquent for a felony offense and committed to the Department of Youth Services (DYS) to remain with their families in their homes. The Partners Program provides a community-based intervention program at a cost that is substantially lower than the cost incurred when juveniles are sent to the Department of Youth Services' detention facility (Allen, 1996).

Program Eligibility and Interventions

A juvenile residing with his/her family in Richland County, Ohio having committed a felony and subsequently admitted to or been found guilty of the offense, is adjudicated delinquent. If the offense is great enough to warrant confinement in one of the Department of Juveniles Services' correctional facilities, the Richland County Juvenile Court judge makes a determination in cooperation with the court staff to either send the juvenile to the Department of Youth Services detention facility or offer the juvenile and his/her family the opportunity of going into the Partners Program.

Upon entry into the Partners Program, the juvenile is released from the Richland County juvenile jail to the custody of his/her parent(s) or guardian(s). During the release, the family and delinquent juvenile meet informally with the Partners Program supervisor, the juvenile court director, and the direct service provider that will be personally overseeing treatment and intervention.

Immediately, the direct service provider arranges a meeting with the immediate family and the delinquent juvenile. Rules, expectations, and general structure of the Partners Program are explained. This is individually tailored to the juvenile and family in question. Both the juvenile and the family are involved in the creation of this plan. Direct contacts with the family and the delinquent juvenile are done at the family's home and in the family's neighborhood. Assessment is ongoing, interactive, and designed for continued growth and skill development. The basic principles and tenets of MST as published by Henggeler, Schoenwald, Borduin, Rowland, and Cunningham (1998) are intrinsic to the formation and implementation of the Partners Program.

Prior to the Partners Program, a juvenile committing a serious crime or a sufficient pattern of significant delinquent behavior would be sent to the Department of Youth Service Correctional facility

for a specified time determined by the Richland County Juvenile Court Judge. The Partners Program allows juveniles the opportunity to remain in the community in their homes with their families and receive the intensive home-based treatment necessary to improve social and personal skills that may reduce the likelihood of engaging in felony crime.

Once the initial phase of contact, rapport, and basic implementation of the intensive home-based program are established, community, extended family, peer support, and other systems are brought in and a comprehensive list of intervention needs over eight major life areas are evaluated. The areas of life most commonly reviewed are: (a) spiritual, (b) health, (c) family, (d) social, (e) school, (f) employment, (g) financial, (h) hobbies and recreation, and (i) legal (court expectations). The strengths of the family and the delinquent juvenile are established, all the identified problems in the major life areas are recognized, and plans are implemented to remedy these problems. Individuals brought in from the community including extended and immediate family are called upon to oversee progress with the targeted problem areas. The direct service provider then oversees, coordinates, and remains in contact with all the individuals working to improve the situation. This allows the direct service provider an opportunity to work with all the people connected with the delinquent juvenile as a means to further assess and evaluate how best to help. Further, those individuals in the delinquent juvenile's life that are deleterious to the overall success of the Partners Program and the juvenile can also be addressed.

This process continues to occur over several months depending upon the needs of the delinquent juvenile and his/her family. Once sufficient success has occurred and the staff feels comfortable with the level of skill attained by the delinquent juvenile and his/her family, the juvenile then graduates from the Partners Program. The juvenile is then overseen through the probation department (Aftercare) and tangentially by the Partner's staff and his/her original direct service provider.

Research Methodology

This study utilized a quasi-experimental program evaluation design with non-random non-equivalent groups (Cook & Campbell, 1979; Royse, 1995). This design utilized two non-equivalent groups that consisted of the juveniles treated in the Partners Program (experimental group) and juveniles treated in the traditional DYS system (control group).

Rossi and Freeman (1993) address some of the challenges of an impact assessment/program evaluation study. One challenge is in assessing gross outcomes versus a net outcome. Gross outcomes, which encompass net outcomes, consist of all changes observed as an outcome measure. With regard to Partners Program evaluation, the gross outcome was whether or not the intervention produced a reduction in felony recidivism between the control and experimental groups. Net outcomes were "those results that can be reasonably attributed to the intervention free and clear of the effects of any other causes that may be at work" (Rossi & Freeman, 1993, p. 221). When reviewing the results of this study, one should keep in mind the difficulty encountered in separating the net effect from the gross effect when a quasi-experimental program evaluation design with non-random non-equivalent control groups is used.

Sample Selection

The experimental and control groups consisted of 130 juveniles who were adjudicated delinquent for a first to fourth degree felony. The control group consisted of youth entering the study from January of 1993 through December of 1994. The experimental group consisted of youth entering the study from May 31, 1996 though June 30, 1998. Ohio Revised Code (ORC) numbers were used to ensure consistency of felony degree between the offenses of juveniles in the experimental and control groups. As stated earlier, the juvenile court judge would have referred juveniles from the control group for the Partners Program had it been available at the time the control group juveniles were adjudicated. Juveniles, who were evaluated to be too dangerous for the Partners Program, would have been screened out at this phase by the juvenile court judge and not considered as part of the control group population.

The control group consisted of juveniles who were adjudicated delinquent for a first to fourth degree felony. They were subsequently committed by the Richland County Juvenile Court to the State of Ohio's Department of Youth Services (DYS) correctional facility. To determine what facility best suited the delinquent juveniles, they began by serving a 30-day evaluation period at the Circleville detention site. They were then sent to a detention facility that was best suited to their needs. Upon serving their sentence at the recommended Department of Youth Services' corrections facility, they were released back to the

custody of the Richland County Juvenile Court and subsequently returned to their family. At this time, they were entered into the study. The juveniles from Richland County, Ohio who participated in the traditional juvenile court program from January 1, 1993, through December 31, 1994 comprised the control group, which consisted of 45 felony offending juveniles. One youth under age 13 did go to (DYS) detention.

In the case of the juveniles in the experimental group, the director of the juvenile court identified a juvenile that ordinarily would be sent to the DYS. A referral was made to the Partners Program staff. The supervisor of the Partners Program examined the fit between each juvenile's identified problems and the resources within the court, the family, and the community that would enable the Partners Program to intervene successfully. If the supervisor believed there were sufficient resources and all parties agreed to the terms and rules of the Partners Program (Partners), the juvenile was accepted into the program. The director conferred with the judge, the judge ordered the referral, and a Partners Program staff member was then assigned to the case. There has never been a juvenile or family accepted into Partners who refused to join the program. Any youth over the age of 13 accepted to the program and included in this study would have been incarcerated at the DYS. The five youth in the sample under age 13, would have received county based probation and/or detention in the county juvenile facility. Juveniles in the experimental group were eligible for entry into the study at the point they were released to the Partners Program. All juveniles who participated in the Partners Program of Richland County, Ohio, from May 31, 1996, through July 31, 1998, comprised an experimental group of 85 juveniles who committed felony offenses.

Three factors added to the strength of the selection process and this program evaluation research. First, the four delinquency professionals who conducted subject selection were at the Richland County Juvenile Court for the entire time of the study. Second, Judge Ronald Spon, who was not involved in subject selection but consistently, presided over the Richland County Juvenile Court during the entire length of the study, remains incumbent. His involvement, noted later, added more consistency to the adjudication and incarceration process. Third, in prior research on home-based family preservation programs not all of the juveniles included were actually removed from the home. All juveniles in this study regardless of whether they were in the control and experimental groups over age 13 would have been removed from their homes through their incarceration periods.

Cox Regression and the Dependent Variable

Since the number of days until recidivism occurred for each juvenile was recorded for the data set used in this study, a Cox regression model was used to evaluate the differences between the recidivism rates of the experimental and control groups. An analysis of a Cox regression model is a form of survival analysis that allows the researcher to use various factors to model the length of time it has taken for an event to occur (e.g., re-arrest) even when some of the participants have not experienced the event (i.e., the censored cases).

Cox regression model rather than logistic regression model or a multiple linear regression model was the analytical approach used for two reasons. First, valuable information, specifically the length of time until a felony re-arrest, could be utilized. Such information would not be used if logistic regression had been used to analyze a dichotomized variable in which a juvenile would be simply be classified as being re-arrested or not re-arrested. Second, all cases are selected, not just the ones who where re-arrested (i.e., non-censored cases). It would be possible for a researcher to use only non-censored cases or assign the censored cases the maximum time observed in the study. Such data could be analyzed with a multiple linear regression model with the dependent variable consisting of time to the event. If only the censored cases were analyzed or the censored cases were assigned the maximum time observed, however, the true survival period would be underestimated (Adams, 1996).

To understand what serves as the dependent variable in a Cox regression model, three concepts need to be understood: (a) survival probability, (b) survivor function, and (c) hazard rate. The survival probability is the probability that a juvenile will not be re-arrested until a given point in time. The survivor function depicts the relationship between estimated survival probabilities over time. When graphed, the survival function for this study shows the proportion of juveniles not re-arrested by a specified point in time. According to Blossfeld and Mayer (1989) the hazard rate is the instantaneous rate of change in the survivor function. The hazard rate for this study indicates the instantaneous rate at which juveniles are re-arrested.

In a Cox regression model the dependent variable is the hazard rate. In order to allow the SPSS® computer software to generate the hazard function, the length of time between the day the participants were released from prison (for members of the control group) or the day the participants began the Partners Program (for members of the experimental group) and the day they committed another felony must be entered as a variable in the data set. It is important to note that the entry point for each control group participant was the day the participant was released from DYS detention, while the entry point for each experimental participant was day the participant entered the Partners Program. Participants who were not re-arrested for felony within 850 days were assigned a value of 850.

The number of censored cases was 73, which was 56% of the 130 juveniles. A total of 17 of the 45 juveniles (37.8%) in the control were not re-arrested (censored cases); while 56 of the 85 juveniles (65.9%) in the experimental groups were not re-arrested (censored cases). The median number of days until re-arrested for the 28 non-censored cases in the control group was 241, while the number of days for the 29 non-censored cases in the experimental group was 400.

Cox Regression and the Independent Variable

Based on empirical findings of other researchers (Henggeler, Schoenwald, Borduin, Rowland, & Cunningham, 1998; Allen, 2004), seven independent variables were used as covariates in the Cox regression model. The seven covariates and the group membership variable were defined as follows:

1. Ages of the participants at the time of commitment (X_1) -- Age was defined as an interval measure for any youth entering the study before the age of 18. The zero age point is the point of study entry. Age was portioned into years and months. The year is shown as 13, 14, 15, etc. The months were added to the year as a decimal divisible by 12. So, the data for a person who is 15 years and six months old is quantified as 15.5 (i.e., 15 and 6/12).
2. Ages of the participants at the time they entered the study (X_2) -- The data for this variable were recorded as described in the previous variable.
3. Gender (X_3) -- Gender was defined as a discrete/binomial measure dummy coded as one for male and zero for female.
4. Race (X_4) -- Race was defined and coded as a discrete/binomial measure with one for white and zero for black, with white as stipulated in the guidelines established by the Department of Youth Services in the State of Ohio.
5. Frequency of prior probation and/or misdemeanors (X_5) -- Probation/misdemeanor violations were defined under the Ohio Revised Code and monitored by the Richland County, Ohio court record. Misdemeanor and probation violations were quantified as the frequency of occurrence.
6. Frequency of prior felony convictions (X_6) -- Prior felony violations were defined under the Ohio Revised Code and monitored by the Richland County, Ohio court record. Prior felonies were quantified as the frequency of felonies.
7. Loss due to parental inaccessibility at or prior to the time the juveniles entered the study (X_7) -- Loss due to a parental inaccessibility (the parent is for all intents and purposes unavailable or inaccessible to the child, that is, in prison, lives out of the state, etc.), was coded as dummy coded, one for presence of the event, zero for absence of the event.
8. Group membership (X_8) -- This variable identified whether a juvenile was exposed to the Partner Program (experimental group) or not exposed to the Partner Program (control group). The control and experimental groups were assigned values of zero and one, respectively.

The mean and standard deviation values for seven of the independent variables are listed in Table 1 (X_8, the group variable was excluded). The differences between the mean values of the control and experimental groups were not statistically significant for the following four variables: (a) the ages of the participants at the time of commitment, X_1; (b) gender, X_3; (c) frequency of prior probation and/or misdemeanors, X_5; and (d) frequency of prior felony convictions, X_6.

Table 1. *Descriptive Statistics for the Independent Variables*

Variables	Control Group Mean[a]	SD	Experimental Group Mean	SD	Total Mean	SD
X_1 (Commitment Age)	16.10	1.03	15.73	1.36	15.85	1.26
X_2 (Age at Entry)[b]	16.72	1.05	15.92	1.34	16.20	1.30
X_3 (Gender)	0.91	0.29	0.87	0.34	0.88	0.32
X_4 (Race)[b]	0.49	0.51	0.67	0.47	0.61	0.49
X_5 (Prior Prob./Misd.)	6.07	4.85	4.94	5.05	5.33	4.99
X_6 (Prior Felony Con.)	2.22	1.48	1.84	1.31	1.97	1.38
X_7 (Loss of Access) [b]	0.42	0.50	0.68	0.47	0.59	0.49

[a] The means for the Gender, Race, and Loss of Access variables are the proportions of juveniles in who were male, white, and experienced loss due to parental inaccessibility, respectively.
[b] Differences between the means of the control and experimental groups were significant at the .05 level.

Statistically significant differences existed between the control and experimental groups with respect to three of the independent variables. With respect to the mean age of the participants at the time they entered the study, which was variable X_2, the mean was higher for the control group ($\overline{X}_C$=16.73) and the experimental group ($\overline{X}_E$=15.92). An analysis of variable X_4, which indicated whether each juvenile was white or non-white, revealed that the proportion of white juveniles in the control group (.49) was less than the proportion in the experimental group (.67). And the analysis of variable X_7, which noted whether a juvenile had experienced parental loss due to parental inaccessibility, indicated that the proportion in the control group (.42) was lower than the proportion in the experimental group (.68). Additional group comparison data can be found in Allen (2004).

In Cox regression analysis independent variables are identified as either time-invariant variables or time-varying covariates. As the names imply, time-invariant variables are independent variables that do not change over time, and time-varying variables do change over time. As noted by Adams (1996):

> Some time-varying covariates such as address and income may change relatively quickly; others, such as the level of education may change more slowly. This distinction is important because some time-varying covariates such as age and education may be treated as time-invariant covariates for practical purposes. (p. 274).

It should be noted that the independent variables used in this study were treated as time-invariant variables for the Cox regression analysis.

Cox Regression and the Proportional Hazards Assumption

As noted by Cox (1972), a Cox regression model is a semiparametric regression model. The model is based on the assumption that the groups defined by the covariates have the same underlying hazard function. Adams (1996) noted that:

> The various parameters for each [covariate] group act to shift the hazard function up or down. Because the Cox regression model assumes that the hazard functions are proportional to one another, it is necessary to check the covariates to determine whether they meet this proportional hazard (PH) assumption. (p. 274)

One method used to assess whether PH assumption is met is to plot the log of the negative log transformation of the survival function. If the PH assumption is met, the curves for the covariate groups of interest should not differ from proportionality in a substantial way.

To check the PH assumption we plotted the log of the negative log transformation of the survival function with each variable to be checked acting as the stratification variable. In this procedure we created categorical variables for the continuous variables. The various plots appeared to be proportional. Thus, we assumed the PH assumption was met.

Cox Regression Analysis Results

The results of the Cox regression analysis are listed in Figure 1 and Table 1. The survival function estimates are depicted in Figure 1 for each group (i.e., the experimental group and the control group). Figure 1 displays the estimated differences between the experimental group and the control group, holding the other variables constant.

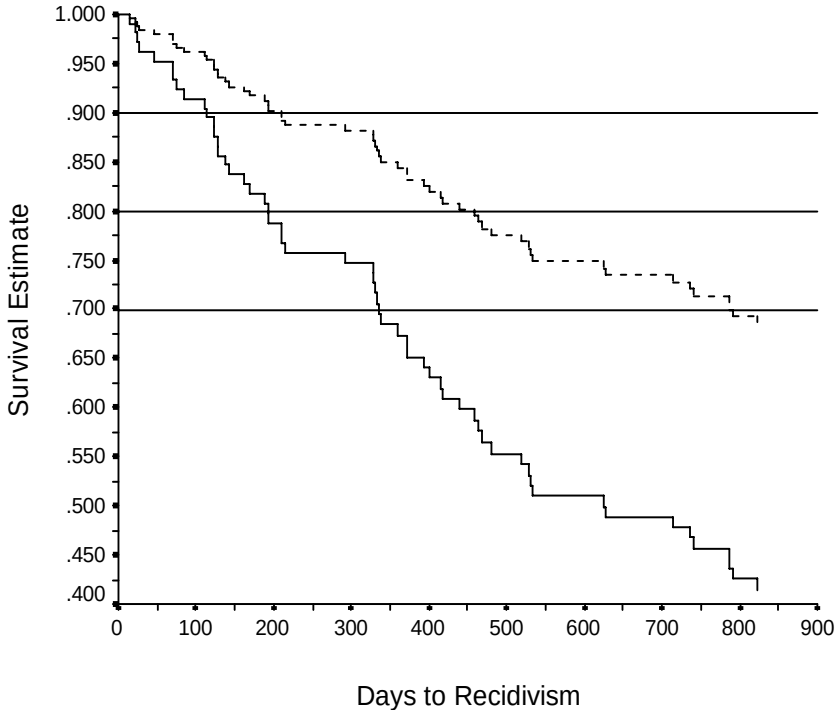

Figure 1. Survival Functions for the Experimental and Control Groups.
[a] The dashed line represents the survival function of the experimental group, while the solid line represents the survival function of the control group.
[b] Reference lines are placed at the .90, .80, and .70 levels.

Figure 1 also contains three horizontal reference lines to indicate the 90%, 80% and 70% survival points. A review of these survival points revealed the following:

1. The percent of juveniles in the experimental group who had not been re-arrested decreased to the 90% level at approximately day 200. For the control group, this 90% level had been reached in approximately 110 days.
2. The percent of juveniles in the experimental group who had not been re-arrested decreased to the 80% level at approximately day 450. For the control group, this 80% level had been reached in approximately 195 days.
3. The percent of juveniles in the experimental group who had not been re-arrested decreased to the 70% level at approximately day 790. For the control group, this 70% level had been reached in approximately 330 days.

Thus, as depicted in the two survival curve estimates, the members of the experimental group (juveniles in the Partners Program) reflected prolonged time to re-arrest when compared with members of the control group (juveniles in the Partners Program).

Table 2 contains further results of the Cox regression analysis. The coefficient for the variable representing the group membership (X_8), which was -0.843, was statistically significant at the established alpha level of .05 (Wald statistic = 6.72, p = .01). This value of -0.843 indicates that being a member of the experimental group reduces the log of the hazard (the hazard of committing another crime) by 0.843, controlling for the other variables in the model. This value can be better understood by interpreting its antilog value, that is, $\exp(\beta_i)$. The antilog of the coefficient for the group membership variable was 0.43. This value, which is referred to as a risk ratio or effect, indicates the risk of experimental group members being re-arrested was 43% of the risk of control group members, holding constant the other variables.

Table 2. *Cox Regression Analysis Results* [a]

Variables	Coefficients	SE	Wald	*p-value*
X_1 (Commitment Age)	0.087	0.283	0.09	0.76
X_2 (Age at Entry)	-0.267	0.288	0.86	0.35
X_3 (Gender)	1.209	0.731	2.73	0.10
X_4 (Race)	-0.522	0.294	3.15	0.08
X_5 (Prior Prob./Misd.)	0.062	0.029	4.49	0.03
X_6 (Prior Felony Con.	0.136	0.089	2.35	0.13
X_7 (Loss of Access)	-0.348	0.283	1.50	0.22
X_8 (Groups)	-0.843	0.325	6.72	0.01

[a] The χ^2 value for the change in the -2 times the log likelihood value when the eight independent variables were added to the analysis was 35.00 ($p < .001$).

It is of interest to note that one other predicted variable, which was a behavioral variable, was statistically significant. The frequency of prior probation and/or misdemeanors (X_5) had a coefficient value of 0.062 (Wald statistic = 4.49, $p = .03$). The antilog of this coefficient 1.064 indicates that an increase of one prior conviction increases the log of the hazard (the hazard of committing another crime) by 6.4%, holding constant the other variables.

Summary and Implications

The analysis of the Cox regression model indicated that compared to the juveniles receiving traditional DYS intervention (control group), the juveniles in the Partners Program (experimental group): (a) reflected prolonged time to re-arrest and (b) lower risks of being re-arrested. Of the other predictor variables entered into the Cox regression model, only prior misdemeanors/probation violations was significant. Thus behavioral and not temporal measures were related to juvenile delinquency.

This study has practical implications for juvenile court administrators who are interested in reducing felony re-arrest rates or substantially prolonging the days until a youth does get re-arrested. The intervention and supervision strategies utilized in the Partners Program appear to create a greater involvement in the lives of the delinquent juveniles and their families. Although such interventions might cause a higher incidence of misdemeanor and probation violation occurrence (see Allen, 2004), it appears to improve the life skills of the youth and those surrounding them, resulting in a reduction in felony re-arrest and subsequent removal from the community. While remaining in the community, these juveniles have the opportunity to learn and grow from more suitable role models (including Partners Program direct service providers) than if in (DYS) detention.

Prior study research shows that each probation or misdemeanor offense increases the likelihood of a felony occurrence by greater than six percent. As noted here, prior misdemeanors/probation violations were the only significant predictor of felony recidivism. Based on all these findings, juvenile court administrators may want to pay greater attention early on to those youths who are repeat misdemeanor and probation violation offenders. Offering greater structure and supervision modeled after the Partners Program intervention strategy may reduce the occurrence of felony offenses in the future.

It should be noted that the home-based family preservation model, generally, has been criticized because of study design. Detractors argue children included in the study may or may not have been placed out of the home thereby creating a sample population that was not truly at risk of placement. With the exception of the six children under age 13 referenced earlier, this critique does not apply to this research as all the youth included in the Partners Program study experimental group would have been incarcerated as those in the control group were, thereby adding important information to the research literature. This research supports prior research on the efficacy of family preservation strategies.

It is important to keep in mind that this study used a non-randomized quasi-experimental design which prohibits one from assuming causation making it difficult to generalize to other populations. The above findings suggest the Partners Program family preservation model should place even more emphasis on intervention with delinquent juveniles at the earliest sign of frequent misdemeanor/probation violation occurrence, thus increasing the likelihood of successful intervention and decreasing the likelihood of delinquent behavior in the future. Further, because the Richland County, Ohio's Partner Program model

successfully allows youth to avoid incarceration into DYS detention, allowing them to remain in the care of their families and community, the family preservation programs modeled after the Richland County, Ohio Partners Program warrant further study.

Although the exact cost savings of the Partners Program intervention is beyond the scope of this study, it is still important to note the economic ramifications of such findings. Since the Partners Program is community based and able to operate at a lower cost than the Department of Youth Services detention facilities, (Allen, 1996), the program is able to save Ohio tax dollars. When a juvenile is able to enter the adult community with skills that allow that juvenile to avoid a criminal career, cost savings is substantial (Snyder & Sickmund, 1999). Cost analysis of the Richland County Juvenile Court's Partners Program merits further study.

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