Analysis of the Automated Voiceprint Recognition Supervision Program in Korea

by

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Abstract

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In Korea, the Ministry of Justice initiated an innovative pilot project – the Automated Voiceprint Recognition Supervision (AVRS) program – as a tool of intensive supervision probation for high risk juvenile probationers in 2003. The AVRS program uses individual human speech patterns and a computerized voiceprint verification system. The logic of the program is straightforward; random phone calls to juveniles' homes make juvenile probationers stay home at night, and it reduces the opportunities for youth to be involved in criminal activities. This idea is a manifestation of the situational crime prevention approach that makes criminal pathways more challenging so that potential offenders desist from crime.

This study seeks to examine the AVRS program by using official data from the 2003 pilot project. The specific aims of the study include (1) examining the effectiveness of the AVRS program, (2) investigating essential predictors of recidivism rates, and (3) comparing the characteristics of program participants and the control group to determine the proper criteria for selection eligibility.

The data are selected from the two official databases: (1) Probation and Integrated Information System (PIIS) and (2) Crime History Data (CHD). There are a total of 508 juvenile probationers in this study. The AVRS sample group is based on universal sampling method, which uses all juveniles from two probation offices (South Seoul and Su-Won) who participated in the AVRS program from April 2003 to June 2005 (N=214). The comparison group samples are selected by a random sampling method from the total juvenile probationers (N=294). In order to account for the group differences between the AVRS group and comparison group, this study uses a logistic regression (backward condition) model to estimate the odds of being assigned to the AVRS program (propensity score). Then, this study investigates the association among program assignment, demographic variables, and recidivism rates. Multiple aspects of outcome variables are included, such as duration of desistence from crime, revocation, and number of rearrests during a one-year follow-up period. In addition, by using survival analysis, this study examines the impact of the AVRS program on recidivism, especially the length of time before recidivism occurs after the program's completion.

Results suggest that generally the AVRS program is not statistically successful in reducing recidivism rates once risk factors are controlled in a one-year follow-up period. Instead, the AVRS program increases the opportunities for the juveniles to receive warning tickets and revocation during the program or probation period.

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Chapter 1 Introduction

1.1 Problem Statement

Historically, incarceration has been the most common means of punishment to remove offenders from society and deter their future crimes. However, there is little evidence of whether or not the use of incarceration actually affects the crime rates and public safety (United Nations, 2007). More importantly, the imprisonment experience has been shown to be detrimental and counterproductive in maintaining family ties and achieving successful reintegration to society, especially when offenders are vulnerable juveniles charged with minor crimes. Effective community based correctional programs can not only prevent offenders from committing future crimes but also can save the criminal justice money while public security is sustained (Bonta, Wallace-Capretta, & Rooney, 2000a). Thus, criminal justice systems around the world have tried to find alternatives to incarceration.

The use of information technology in the field of criminal justice has become a popular focus of alternatives to incarceration. A wide variety of new technologies, such as facial fracture verification, fingerprinting, iris pattern identification, and voiceprint recognition have been developed for verification of the identity of offenders (Cutler, Thigpen, Young, & Mueller, 1972; Hanson, 2007). In addition, different types of electronic supervision instruments and technologies have been developed to track the location of offenders and ensure the person detected is the actual offender (Vaughn, 1991; Nellis, 2004).

In Korea, the Ministry of Justice initiated a new pilot project program – the Automated Voiceprint Recognition Supervision (AVRS) program - as a tool of intensive supervision probation for juvenile probationers under curfew orders in 2003. The AVRS program applies an innovative state-of-the-art technology that employs individual human speech patterns and a computerized voice verification system. Thus, as a tool of intensive supervision, this program aims to regulate and monitor high risk juvenile probationers' deviant behavior, particularly at night, through individual voiceprint and automated computer verification techniques (The Korean Ministry of Justice, 2003).

Intensive Supervision Probation (ISP) refers to a variety of sanctions that are stricter and more punitive than traditional probation supervision, but generally less expensive than incarceration (Petersilia & Turner, 1990). Regular probation supervision has frequently combined with community service orders and attendance orders in Korea as a type of intensive supervision probation (The Korean Ministry of Justice, 2003). Different types of graduated sanctions are considered less punitive than incarceration and more punitive than traditional probation supervision (Tonry, 1997). The AVRS program is designed to provide increased supervision and restraint to high risk offenders in the community. The basic logic of the program is straightforward; random phone calls to juveniles' homes make juvenile probationers stay at their residence at night, and it reduces the opportunities for youth to be involved in criminal activities. This idea is a manifestation of the situational crime prevention approach that makes criminal pathways more challenging so that potential offenders desist from crime (Newman, Clarke, & Shoham, 1987). In the long-term, the experience of being checked up on by a specific program may modify juvenile delinquents' future behavior enough to change their

routine lifestyles at night (Ball & Lilly, 1986; Miltenberger, 2001; Padgett, Bales, & Blomberg, 2006).

Since a probation law was implemented in 1989, the Korean Juvenile Justice System has changed its policy for juvenile delinquents, particularly those charged with relatively minor crimes, from incarceration to a non-custodial policy. In particular, youth court judges have begun to employ a wide variety of graduated sanctions in the community rather than imprisonment. This reflects a belief that a "get-tough policy" based on punishing juvenile delinquents as adults and incarcerating them in institutions is ineffectual in both theoretical and empirical perspectives (Gottfredson, Gottfredson, & Garofalo, 1977; Braithwaite, 1989; Gainey, Payne, & O'Toole, 2000).

The major concern about the AVRS program is whether it is sufficient to guarantee public safety in the community. Some systematic reviews of research on juvenile curfews or electronic monitoring supervision programs do not verify the effectiveness of the programs in terms of program participants' recidivism (Mair & Mortimer, 1996; Ely & Sutherland, 1987; Neills, 2004).

Since graduated sanctions emphasize juveniles' accountability and public safety, the AVRS program is designed to provide more intensive supervision probation for juvenile delinquents who are at high risk of committing crimes at night in Korea. The popularity of the AVRS program has dramatically increased over the past four years in Korea. The number of juvenile probationers assigned to this program increased from 251 in 2003 to 2,857 in 2006, an increase of 114% (The Korean Ministry of Justice, 2006). However, the effectiveness of the AVRS program has not been fully examined by researchers in Korea. Other reviews concerned that the effectiveness of various types of intensive community

supervision programs that utilize house arrest, with or without electronic monitoring, remains unclear (Tonry, 1990; Nellis, 2004; Padgett et al., 2006). There is not enough convincing evidence that policy makers assume the effectiveness of the AVRS program in Korea. Therefore, there is a need to assess the effectiveness of the AVRS program.

While the idea of the AVRS program seems attractive, the complex questions of how "effectiveness" should be defined remains problematic. There is a debate regarding the wisdom of intensive community supervision programs. On the one hand, much of the general public opinion considers house arrest or curfew using electronic monitoring too lenient to ensure the safety of society (Maruna & King, 2004; Larivee, 1993). Media also report that an intensive supervision program, such as electronically monitored home arrests pose reckless risks to the public (Payne & Gainey, 2000). On the other hand, critics point out that intensive supervision programs can cause negative labeling when intensive supervision programs are compared to regular probation. Unnecessary and additional sanctions may cause "accumulative disadvantages," particularly for low risk juvenile delinquents (Schwartz & Skolnick, 1962; Corbett & Marx, 1991). Despite these concerns, public officials, often see intermediate sanctions as a way of solving policy difficulties, such as supervision of high risk offenders and the high costs of institutionalization. Thus, public perception of electronically monitored home confinement, or of scholars, is not always in harmony with that of public officials (Gainey & Payne, 2003).

When probation officers utilize the AVRS program, they have increased options in controlling and supervising juvenile probationers. The graduated sanctions, such as electronic monitoring and boot camp, can endow probation officers and correction

administrators with extra discretion for supervising young offenders (Gainey et al., 2000). However, this increased discretion by program facilitators raises an important issue: how much discretion is adequate to affect program participants and to control their behavior? Program dosages, such as duration of program, frequency of random calls, and types and levels of supervision, should be considered as essential program factors that are associated with the program outcomes (Rossi, Lipsey, & Freeman, 2004).

The AVRS program could be an efficient curfew tool in keeping juvenile probationers off the streets at night, since probation officers do not have to conduct home visits or face-to-face contacts with juvenile probationers late at night. In fact, Kim (2005) demonstrates that the law enforcement community favors the AVRS program more than imprisonment, because the AVRS program does not need additional public money or any significant increase in correctional personnel to supervise juvenile probationers at night. Diverting juvenile delinquents from prison to communities may reduce the cost of punishment. In Korea, while the cost of imprisoning a juvenile delinquent is $8,550 per inmate per year, the cost of the regular probation supervision is only $370 per offender per year (The Korean Ministry of Justice, 2005).

However, a simple cost comparison does not automatically mean that the AVRS program can reduce government expenditures. According to Israel and Chui (2006), not all of the offenders under particular intensive supervision programs are eligible for incarceration. If AVRS were not an option for, not all of them would end up in an institution. This is the issue of ‘net-widening’ when less serious and nonviolent juvenile offenders are assigned to a particular intensive supervision program but would have been a regular probation control (Jolin & Stipak, 1992). Therefore, a direct and simple cost

comparison between the AVRS program and incarceration (or routine probation) may not enable one to judge the effectiveness of the program.

Adams (2003) points out that the actual costs of the program rely entirely on the way the program is implemented by facilitators in practice. In this sense, a specific community-based correction program may require higher expenses and more resources than incarceration, particularly when there is not a valid and reliable offender classification system (Jin, 2002).

The full cost of the AVRS program should include the expense of program failure and negative outcomes, such as revocation of probation and recidivism. If the juvenile probationers under the program receive warning tickets, there will be additional costs, related to a wide variety of administrative processes. Also, if the program participants commit new crimes, there will be substantial direct and indirect social costs.

As Marc Renzema (1989) has stated, "…. while the hardware is cheap, installing it, maintaining it, processing the information it provides, and taking action on information suggesting deviant activities can be very expensive and can contribute to further strain of already strained resources" (p. 85).

In April, 2003, the Seoul Probation Office initiated a pilot project of the AVRS program as a condition of curfew orders for juvenile probationers. Only one study in Korea has focused on evaluating this project (Kim, 2005). Kim (2005) found that the AVRS program had statistical significance in reducing the reconviction rate as well as in increasing opportunities for establishing positive relationships between juvenile probationers and their parents. However, Kim's study did not obtain a representative comparison group and so the conclusions are suspect. In a quasi-experimental design

study, researchers need to conduct a matching sample technique in order to minimize the risk of sampling bias (Luellen, Shadish, & Clark, 2005; Imbens, 2000). Furthermore, there were no program factors or service delivery factors in Kim's study. In order to conduct a more comprehensive and reliable evaluation, a wider range of program process factors for evaluation must be included (Rossi et al., 2004).

This study aims to evaluate the effectiveness of the AVRS program using official data from the pilot project from the Korean Ministry of Justice. Additional official data with respect to the number of rearrests are used for analyzing the participants of the pilot project. The treatment group and the comparison group are compared and assessed in terms of their recidivism rates. This study adopts the matching sample technique based on a propensity score strategy for group comparison. The basic idea of this strategy is that key demographic variables are used to predict the probability of being referred to the treatment group (Imbens, 2000). Then an experiment group and a comparison group are matched on the basis of the probability score. This study then investigates the association among program factors, individual demographic variables, and recidivism rates in the sample of juvenile probationers. Multiple aspects of outcome variables are included, such as different official responses to re-offenses, duration of desistence from crime after completing the program, and number of re-offenses committed during a one-year follow-up period.

1.2 Objectives

This study seeks to examine the AVRS program by employing official data from the 2003 pilot project that probation officers collected in two different probation offices: South Seoul and Su-Won probation offices. The data are selected from the Probation and Integrated Information System (PIIS) of the Korean Ministry of Justice. The specific aims of the study include examining the effectiveness of the AVRS program, investigating essential predictors of recidivism rates, and comparing the characteristics of program participants and the comparison group to determine the proper criteria for selection eligibility.

1.2.1 Examination of the Effectiveness of the AVRS Program

This study examines the efficacy of the AVRS program, which was introduced for the first time by the Seoul Probation Office in 2003. The most representative and common dependent variable in measuring the effectiveness of the intermediate sanctions can be the recidivism rate (Turner & Petersilia, 1992; Giblin, 2002). Using additional official data, this study compares the recidivism rates of juvenile probationers in the AVRS program to those of juvenile probationers in routine probation supervision.

One of the advantages of community-based correction for juvenile delinquents is that it can provide them with opportunities to continue their schooling and maintain family ties while living in the community (Courtright, Berg, & Mutchnick, 1997; Pertersilia , 1986). Numerous types of outcomes can be utilized in evaluating this program. Bonta, Wallance-Capretta and Rooney (2000a) measure participants'

satisfaction with electronic monitoring as well as staff-offender relationships. Other studies of community-based correction programs focus on offenders' behavior changes, family relationships, and attitude modification (Trulson, Triplett, & Snell, 2001) and rehabilitation (Rayne & Gainey, 2000). The AVRS program assumes that juvenile probationers would give up committing crimes when intensive direct or indirect supervision and physical obstacles prevent them from getting involved with criminal activities. It also assumes that people are rational enough to minimize their chance of being punished and maximize their rewards (Clark & Felson, 1993). Certain, severe, and swift punishment would offset the pleasure of committing crimes (Beccaria, 1963; Gainey et al., 2000). By requiring high risk juvenile probationers to stay home all night, the AVRS program seeks to prevent crime in ways consistent with rational choice theory and the situational crime prevention approach. Aim is to reduce the opportunities for juvenile probationers to leave home and commit crimes at night.

1.2.2 Investigation of the Association of Demographics, Program Factors and Recidivism Rates

Using individual official documentation and official criminal history data, this study examines demographics, family background, and types of offenses of both the AVRS program participants and the comparison group. In order to conduct a regression analysis for recidivism rates, demographic variables are used and utilized as factors that may impact the program's outcome.

Moreover, this study assesses the way program-related factors affect the juvenile probationers' recidivism rates. Because the AVRS program has different types and

frequency of phone calls, it is necessary to evaluate the relationship between the types of AVRS phone calls and recidivism rates. In addition, the length of the program is regarded as an additional important factor affecting the recidivism rates (Gainey et al., 2000). Thus, program dosage variables are included as factors that may affect the recidivism rates in this study.

Finally, this study investigates the relationship between the reactions of probation officers toward violations of program conditions and subsequent recidivism rates, particularly the number of rearrests for committing new crimes. The different types of responses from probation officers can directly impact the program's success or failure rates. The number of warnings and citations can be used to measure probation officers' responses to violations of program conditions. Theses multifaceted outcome variables provide more information to judge the effectiveness of the program (Rossi et al., 2004). Specifically, the extent to which warnings or citations is needed to reduce recidivism rates.

1.2.3 Comparison of the Characteristics between the AVRS Program Group and the non-AVRS Program Group

The study examines the AVRS program during its pilot period, April 2003 through June 2005. It determines whether program participants and non-participants differ in terms of age, gender, types of crime, types of sentencing, criminal histories, family backgrounds, and level of education. Specifically, this study determines what factors court judges use for referring juvenile delinquents to this program. It then uses those factors to construct propensity scores which control for the major factors that youth court

judges consider when they determine the assignment of juvenile offenders to the program. The propensity scores, when employed a logistic regression, reduce the impact of selection bias on the program outcomes.

1.2.4 Suggestion of the Criteria for Program Selection Eligibility

As a graduated sanction, the program is designed to monitor juvenile probationers who are at high risk of committing crimes at night. Thus, from a practical perspective, the central step for evaluating the program is to understand the major factors that judges consider in deciding to assign juvenile delinquents to the AVRS program. This has never been investigated before in Korea. This study will be the first effort to examine the appropriate standards for program eligibility. Identifying these standards is important for program sustainability and development. Improper subject selection subverts the goals of the program by using valuable resources on low risk offenders who would have otherwise been placed on regular probation, and who do not require an increased level of supervision. In fact, studies in the United States and Korea have found that many offenders selected for intensive supervision programs are actually low risk (Jin, 2003; Clear & Hardyman, 1990). Thus, a final objective of this study is to improve the selection eligibility and standards for better program operation and enhancement of program effectiveness.

1.3 Research Questions

This study has five research questions: (1) Do the data show that the AVRS program reduces recidivism during a one-year follow-up period? (2) Do the data illustrate that juveniles assigned to the AVRS program are higher risk offenders than juveniles referred to the regular probation? (3) Do the data illustrate that the AVRS program affects the duration of desistence from crime? (4) Do the data demonstrate that the program dosages are statistically significant factors that affect the recidivism rates? (5) Do the data reveal that the outcomes of the AVRS program are affected by individual factors, such as criminal history, family backgrounds, education, age, gender, and types of offenses? Each research question has sub-hypotheses:

Question 1. Do the data show that the AVRS program reduces recidivism (or violation of program conditions) during a one-year follow-up period?

H1-1 Juveniles in the AVRS program have lower rearrest rates than those on routine probation.

H1-2 Juveniles in the AVRS program have lower revocation rates than those on regular probation.

H1-3 Juveniles in the AVRS program have fewer warning tickets than those on routine probation.

Question 2. Do the data illustrate that juveniles assigned to the AVRS program are higher risk offenders than juveniles referred to regular probation?

H2-1 Juveniles assigned to the AVRS program have higher number of prior criminal convictions than the juveniles referred to regular probation.

H2-2 Juveniles assigned to the AVRS program are younger than the juveniles referred to regular probation.

H2-3 Juveniles assigned to the AVRS program are more likely to have parents with financial difficulty than juveniles referred to regular probation.

H2-4 Juveniles assigned to the AVRS program are more likely to have non-student status than the juveniles assigned to regular probation.

Question 3. Do the data illustrate that the AVRS program affects the durations of desistence from crime?

H3-1 Juveniles in the AVRS program have longer durations of desistance than those on routine probation.

H3-2 Juveniles in the extended version (more than three months) of the AVRS program have longer durations of desistance than those in the shorter version (three months) of the AVRS program.

Question 4. Do the data demonstrate that the AVRS program dosages are statistically significant factors that affect the recidivism rates?

H4-1 Juveniles in increased supervision levels of the AVRS program (A or B) have lower rearrest rates than juvenile probationers in less intensive levels of the AVRS program (C, D, or E).

H4-2 Juveniles who experience longer periods of the AVRS program (more than three months) have lower rearrest rates than juvenile probationers under shorter periods of the AVRS program (three months).

Question 5. Do the data reveal that the outcomes of the AVRS program are affected by individual demographic factors?

H5-1 Juveniles who have a higher number of prior convictions are more likely to commit a crime after the completion of the AVRS program.

H5-2 Juveniles whose parents have stable financial status are less likely to commit crime after the completion of the AVRS program.

Chapter 2 Overview of the AVRS Program

2.1 Trend of Youth Crime in Korea

The most outstanding trend in the Korean juvenile justice system is that the number of youth offenders has been continuously decreasing since 2000. The total number of youth crimes in 1991, including status offenses, was 102,537. Table 1 shows that that number dropped to 67,478 in 2005. This decreased crime rate is correlated with the rapid decline of the total youth population in Korea. The youth population decreased from 6, 610,059 in 1991 to 5,194,546 in 2005 (The Korean Ministry of Justice, 2006; Kim et al., 2007).

Table 1. Number of Youth Crimes per Youth Population in Korea

Type / Year	Youth Crimes	Youth Population	Youth Crimes (Per 100,000)
1991	102,537	6,610,059	1551.2
1995	124,244	6,339,477	1959.8
2000	143,643	5,711,899	2514.7
2001	130,983	5,470,013	2394.6
2002	115,423	5,276,412	2187.5
2003	96,085	5,171,736	1857.9
2004	72,770	5,152,787	1412.2
2005	67,478	5,194,546	1299.0

■ Source: New Issues and Paradigm toward 21th century Juvenile Justice System in Korea (Kim et al., 2007)

Table 2. Proportion of Youth Crime to Total Crimes

Type / Year	Total	Increase Rate (%)	Proportion	Criminal Law	Other laws
1993	110,604	11.4	6.7	35,607	74,997
1994	108,342	-2.0	6.8	37,284	70,518
1995	124,244	14.7	6.9	39,381	84,863
1996	137,503	10.7	7.2	41,122	96,381
1997	150,199	9.2	7.6	42,903	107,296
1998	148,558	-1.1	6.8	51,026	97,352
1999	143,155	03.6	6.2	43,135	100,020
2000	143,637	0.3	6.8	42,866	100,771
2001	130,983	-8.8	6.0	36,381	94,602
2002	115,423	-11.9	5.5	40,352	75,098

■ Increase rate is calculated by the percentage of increase from the previous year.

The juvenile crime rates per youth population show that the number of crimes committed by youth under 20 years of age has decreased in Korea. In addition, Table 2 shows that the percentage of youth crimes out of total crime is only 5.5% in 2002.

However, according to the Korean Uniform Crime Report (2006), the age range of youth offenders has been getting lower since 1999. While the percentage of youth offenders between the ages of 14 and 15 increased from 19.9% of all youth offenders in 1999 to 27.8% in 2005, the percentage of youth offenders between 18 and 19 years old decreased from 43.3% to 37.6% (The Korean Prosecutors' Office, 2006). Thus, it is seen

as imperative to establish effective intervention programs that focus on young offenders who are between 14 and 15 years of age.

Table 3. Age Trend of Youth Crime in Korea

Category / Year	Total	12-13		14-15		16-17		18-19	
		N	%	N	%	N	%	N	%
1999	143,155	1,585	1.1	28,550	19.9	51,117	35.7	61,903	43.3
2000	143,643	1,567	1.1	31,400	21.9	50,667	35.3	60,009	41.7
2001	130,983	1,600	1.2	26,206	20.0	43,591	33.3	59,586	45.5
2002	115,423	1,753	1.5	23,656	20.5	38,286	33.2	51,728	44.8
2003	96,085	1,423	1.5	21,852	22.7	32,091	33.4	40,719	42.4
2004	72,770	676	0.9	15,899	21.9	22,788	31.3	33,407	45.9
2005	67,478	523	0.8	18,761	27.8	22,785	33.8	25,409	37.6

■ Source: New Issues and Paradigm toward 21th century Juvenile Justice System in Korea (Kim et al., 2007)

In Korea, there are two pathways in sentencing youth offenders under 20 years of age. According to the Korean Youth Law, youths between 14 and 20 who commit crimes are tried and convicted in adult criminal court when they commit certain types of heinous crimes, such as homicide and rape (Kim et al., 2007). When youth court judges determine that they have incorrigible criminality or serious repeated criminal histories, the judges can refer the case to prosecutors to let it be processed in the adult criminal courts. Although the young offenders are separated from adult offenders in prisons, their legal status is the same as adult inmates who are labeled convicted criminals.

The alternative is to deal with young offenders between 12 and 20 years of age in youth courts when they have different treatment needs than adults. Table 4 illustrates that 16.4% of total youth offenses were dealt with in youth courts in 2002 (The Korean Prosecutors' Office, 2006). This alternative process aims to help youths' positive development and adjustment in society by using supervision and guidance. Youth court judges have a wide range of discretion in sentencing those who need special treatment or intervention programs. They usually employ different types of intermediate sanctions, such as community service orders, attendance orders, curfew orders, and intensive supervision probation (Kim et al., 2007).

In certain cases, youth courts assign juvenile offenders to custodial schools that incarcerate them for a maximum of two years. In fact, most youth probationers from 12 to 20 years of age are regarded as juvenile delinquents in the Korean juvenile justice system, because they do not have any legal responsibility for their criminal acts. Thus, the intermediate sanctions from youth court judges do not give Korean youth any permanent criminal records. In this study, both participants in the routine probation program and AVRS program participants are juvenile probationers who do not have any criminal records.

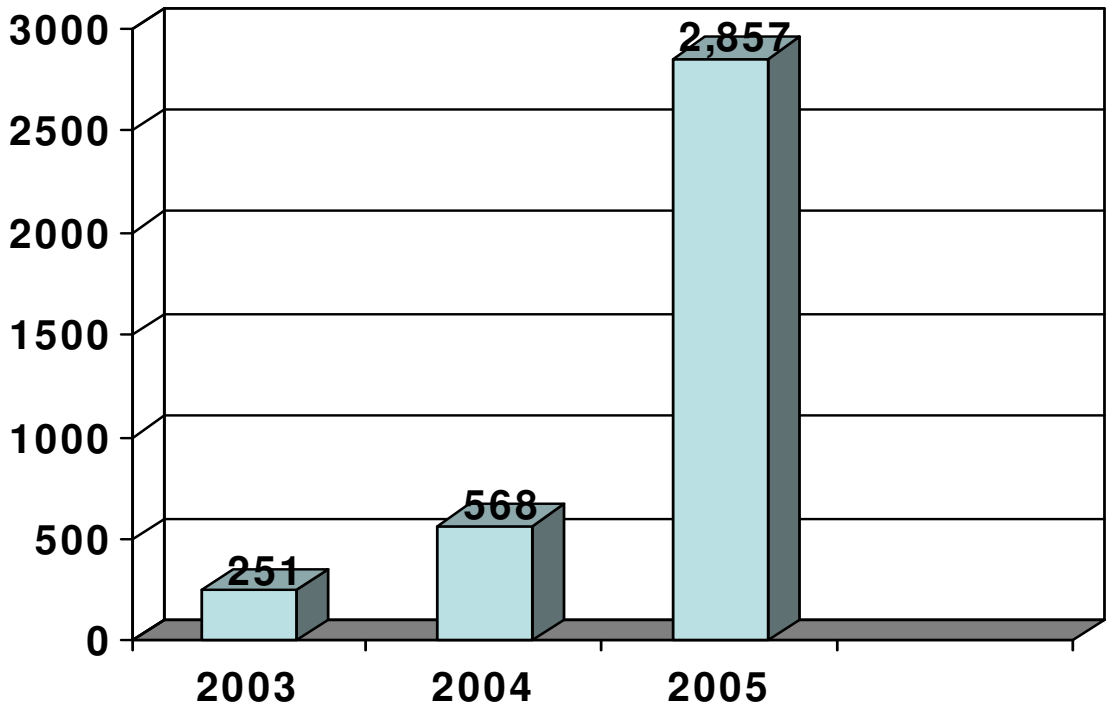
Table 4. Sentencing for Youth Crime in Korea

Type / Year	Total (%)	Criminal Court (%)	Dismissal (%)	Youth Court (%)
1999	143,155 (100)	48,578 (33.9)	71,856 (50.1)	22,691 (16.0)
2000	143,643 (100)	44,095 (30.7)	75,080 (52.3)	24,435 (17.0)
2001	130,983 (100)	42,884 (32.7)	66,816 (51.0)	21,221 (16.3)
2002	115,423 (100)	35,073 (30.4)	61,403 (53.2)	18,925 (16.4)

■ Source: New Issues and Paradigm toward 21th century Juvenile Justice System in Korea (Kim et al., 2007)

As a new graduated sanction in the community, the AVRS program was implemented in 2003 by youth court judges in Korea. The popularity of the AVRS program has noticeably increased over the past four years in Korea. The number of juvenile probationers assigned to this program increased from 251 in 2003 to 2,857 in 2006, which is an increase of 114% (The Korean Ministry of Justice, 2006).

Figure 1. Total Number of AVRS Program Participants[1]



[1] The Korean Ministry of Justice. (2006). The Annual Probation Report, Korea Ministry of Justice, Seoul, Korea.

2.2 Purpose of the AVRS Program

The AVRS program targets juvenile probationers who are under 20 years of age. *The Guideline for the Automated Voiceprint Recognition Supervision* states that the AVRS program uses a new curfew monitoring tool that is designed to prevent specific crimes that are frequently committed by juvenile delinquents at night, such as theft, robbery, repeated sexual crimes and motor vehicle violations (The Korean Ministry of Justice, 2003). According to Korean criminal law, certain types of crimes that are committed at night must receive more severe punishment than the same crimes committed during the day (The Korean Ministry of Justice, 2004).

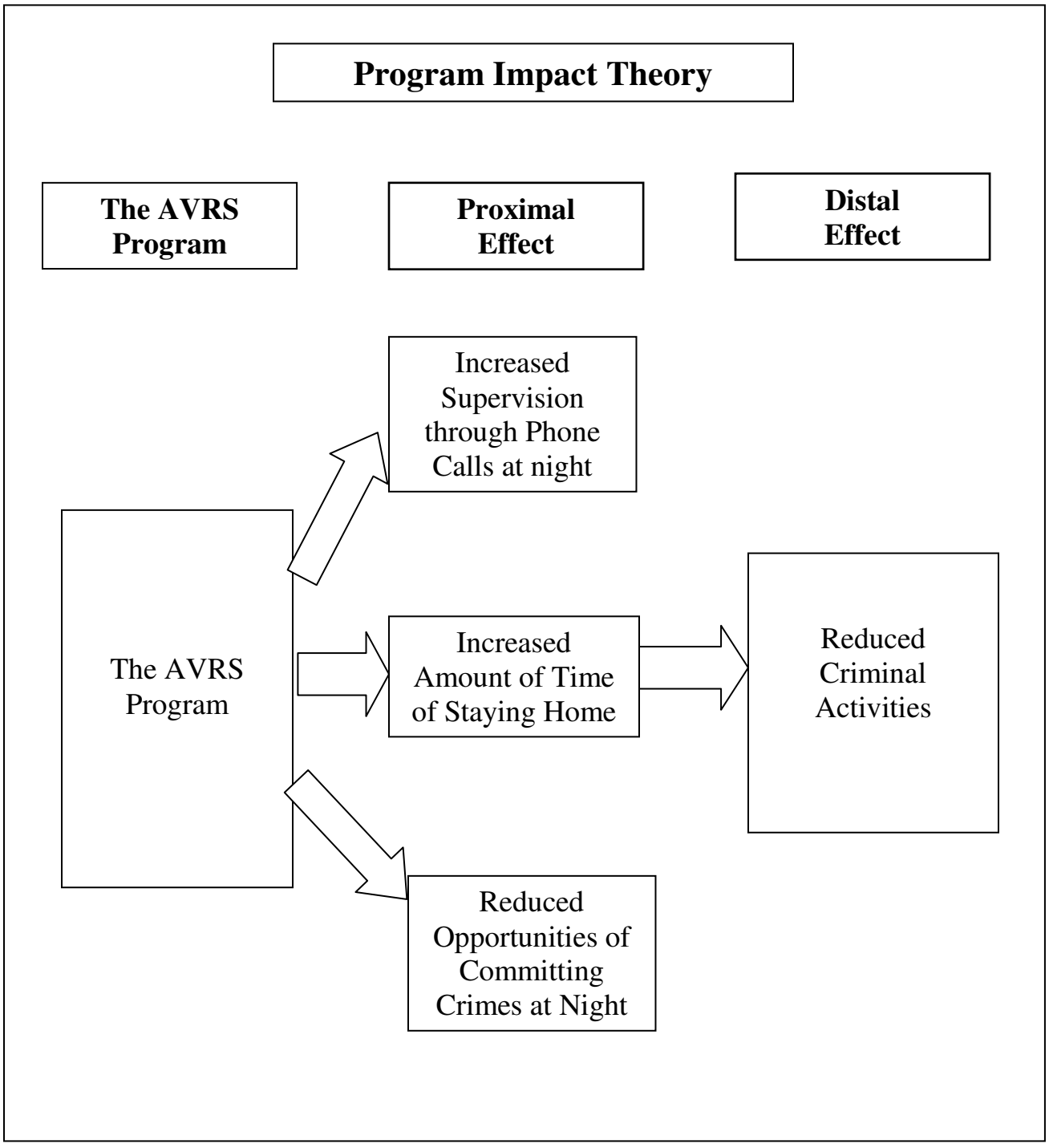
The AVRS program aims to use a voiceprint verification system to monitor juvenile probationers who are placed under house arrest by youth courts. It is expected to achieve two major objectives. First, this program seeks to enhance the level of probation supervision using automated phone calls. Instead of relying on face-to-face contact with probation officers, this program is designed to utilize bio-technology and human voiceprints in order to increase the amount of time that the juvenile probationers stay home at night. Thus, the major goal of the program is to increase the level of probation supervision for juvenile probationers and guarantee their home detention using an integrated computer and telephone system.

A second objective of the AVRS program is to prevent juvenile probationers from violating curfew orders or committing crimes. The random phone calls that are programmed by the computer are meant to discourage program participants from leaving home at night because they might be sent back to jail when they do not answer the random phone calls. They also mean to deter inclinations towards illegal night time

activities. This new supervising condition fosters positive routines for youth and encourages them to have self-control over their behaviors. They may spend more time with family members at home, after chances of meeting delinquent peers at night on the street are reduced. In fact, Kim (2005) found that youth in the AVRS program showed a reduced number of contacts with their delinquent peers at night.

In the AVRS program setting, the prize can be earlier release from the intensive supervision. Juveniles who complied with all regulations and rules of the AVRS program may be assigned, as an incentive, to a more lenient supervision level, which most probationers seek. To the extent probationers are affected by the threat and possibility of being sent back to jail for violation of probation conditions, and to the extent the AVRS participants are aware that they might be released earlier than they are sentenced. Rapid feedback and proper responses from probation officers are used to try to strengthen the positive target behaviors in the AVRS program. The basic logic of the program is that whenever the juvenile probationers successfully finish the random voice verification process, positive feedback from probation officers will reinforce their modified behavior and affect their future behavior decision processes. The program impact theory (Figure 2) shows the basic purposes of the AVRS program and the processes of the program implementation.

Figure 2. Program Impact Theory



2.3 Targets of the AVRS program

The AVRS program is designed to supervise juvenile probationers who are referred by youth court judges. Youth court judges can employ the AVRS program as an additional condition of curfew orders. All program participants are basically under regular probation supervision in the community. However, when judges believe that there is a need for more restrictive guidance in the community, they can assign the juvenile probationers to the AVRS program, especially when there is a repeated criminal history.

In Korea, juvenile delinquency indicates a broad range of criminal activities and status offenses committed by minors who are under 20 years of age (Choi, 2002). According to Korean Youth Law, offenders less than 20 years of age can be sentenced in youth court if their crimes are not abhorrent acts and they do not have continual criminal histories (Lee, 2002). Thus, most cases of youth are treated separately from adult courts and their sentencing and sanctions within the Korean youth criminal justice system are called treatments or interventions instead of penalties.

Since all program participants are assigned from the youth courts, they do not have any lasting official criminal records for their offenses.

2.4 Operational Elements of the AVRS Program

2.4.1 Program Components

While traditional electronic monitoring supervision uses an electronic signal detection instrument attached to the offender's wrist or ankle and functions by using a Global Positioning System (GPS) or location tracking system, the AVRS program employs a relatively simple computer system that records and registers the juvenile delinquent's voiceprint. The computer system makes automated random phone calls to the participants at home to track their location and asks random questions of the participants to verify their voiceprints and investigate the consistency of their speech patterns. The AVRS program consists of four major program components.

First, the recording terminal is the most essential part for implementing this program. The original voiceprints of program participants are recorded in this unit by probation officers (The Korean Ministry of Justice, 2003).

Second, there is a need to have an automated voiceprint identification system in the computer. When the random phone call is made, this system automatically chooses questions, such as the program participant's name, social security number, and address in order to verify his or her voiceprints. There are more than ten different types of questions with regard to personal information, including parents' names, home phone numbers, name of current school, and name of their sentencing courts (The Korean Ministry of Justice, 2003).

Third, the program participants have to have home phones to receive the calls from the program terminal. When the offenders do not have a phone in their residence, the probation officers have to install a home phone to implement the AVRS program.

Fourth, the program must have an information management system. When the program asks several random questions, such as verification of participant's social security number and home address, the program identification outcomes and all other answers from the participants are recorded and accumulated. The collected information shows how the participants respond to the questions as well as the success rates or failure rates in recognizing the original voiceprint of offenders. This information makes the AVRS program more reliable and effective. More importantly, the data from this information management unit can be used as evidence in court for a new trial or probation revocation (Hoe, 2006).

2.4.2 Types of Program

The AVRS program was primarily intended to change the basic way in which young probationers are supervised and treated by a probation officer. Behavior change and attitude modification are strongly affected by the program dosage, such as duration and supervision level of the program. As the program dosage increases, the outcome of the AVRS program may increase deterrent effects, or the effectiveness of the AVRS program may decrease with the increase of the program dosage.

Regular contact between probation officers and offenders is conducted in probation offices any time between from 9 AM to 6 PM. In addition, when probation officers have to make unexpected home visits, they generally avoid calling on offenders late at night due to privacy protection. Thus, routine probation contact is generally once a month face-to-face contact in the office during the day time. The AVRS program, on the other hand, has more intensive contact frequency: more than three times a week. The program makes random automated phone calls between the hours of 10 PM and 6 AM to the houses where the offenders are supposed to reside, to see if they are truly home at night. The purpose of the phone calls is simply to verify the voiceprint identification, rather than to have a direct interview with probationers. The frequency of the phone calls is determined by the levels of supervision. The duration of the program is generally from three months to one year, which is shorter than routine probation periods of six months to two years (Kim, 2005; The Korean Ministry of Justice, 2003).

Probation officers can assign a lower or higher level of supervision to juvenile probationers in this program. Different types of the AVRS program are based on two processes: voiceprint authentication and signal dispatch verification. The voiceprint

authentication process identifies whether or not the answered voiceprint is consistent with the recorded voiceprints. On the other hand, the signal validation process determines the place from which the offenders answer the phone calls. There are six different types of supervision in the AVRS program system (Hoe, 2006). The first type of supervision is called “Type A” phone calls. Type A is a sequential double verification system. First, the computer makes a phone call randomly to recognize the voiceprint. Then, the program automatically requests young probationers to call back in five minutes to make sure that the place of dispatch, where the offenders make the phone call from, is the residence where they should stay during the probation period. If the program participants call back to the computer system, the system makes an additional voiceprint verification process by asking various random questions.

The second type of supervision is called “Type B” phone calls. Type B is a simultaneous double verification system. First, the system calls the offenders randomly to ask them to call a certain phone number back in five minutes without any verification process. Then, the computer program concurrently confirms whether or not the voiceprint is consistent with the original voiceprint and whether the signal dispatch is also in agreement with the residence address.

The third type of supervision is called “Type C” phone calls. Type C is a simple one-way voice verification system. The AVRS program makes a random phone call to confirm the voiceprint authentication. There is no additional step to reconfirm the identification.

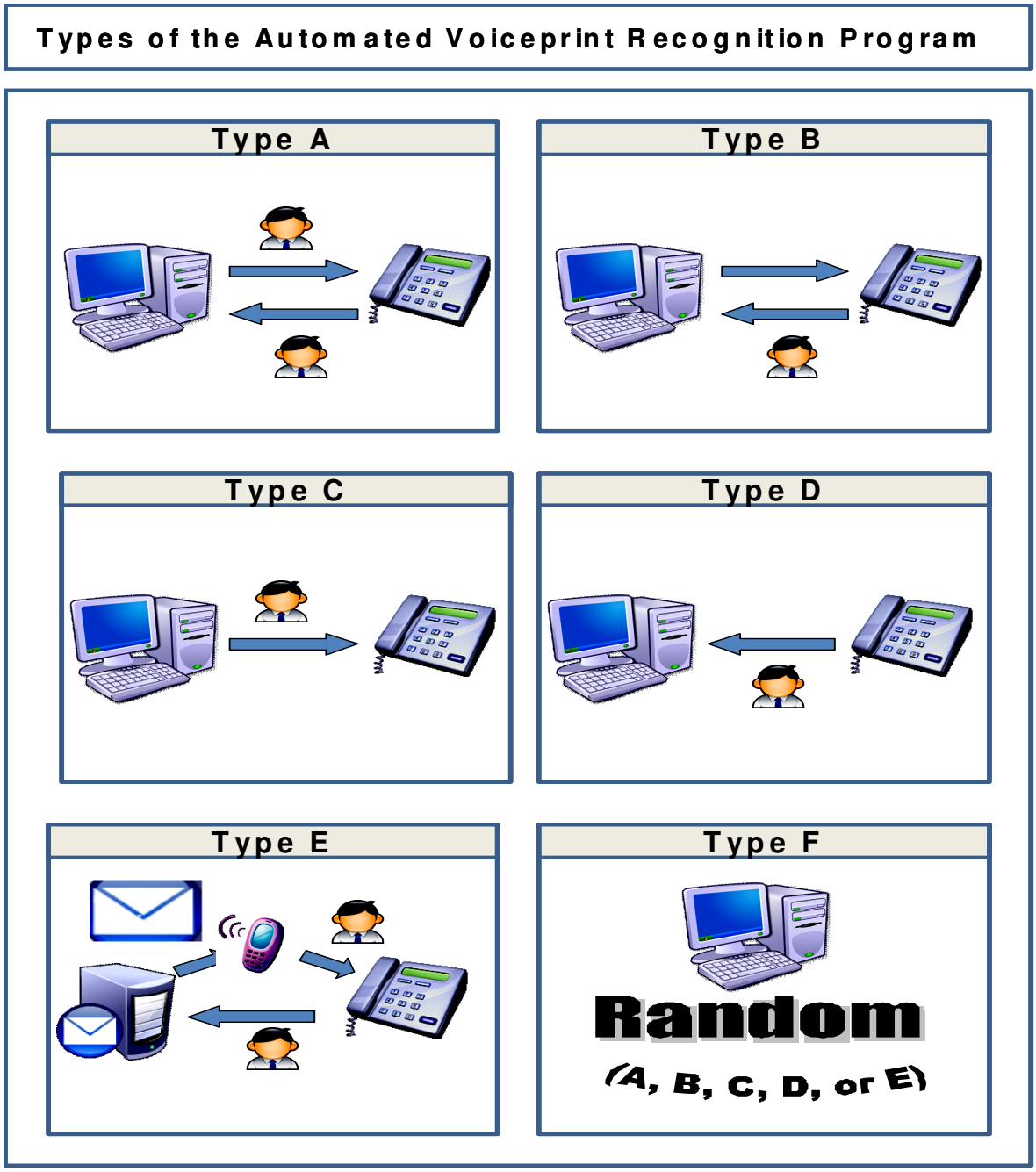
The fourth type of supervision is called “Type D” phone calls. Type D is a non-random verification system. This type allows the offenders to know what time the system

calls them. When the offenders get the calls at a certain fixed time, they have to call the system back again in five minutes to let the program computer recognize their voiceprint and the place of their signal dispatch. As the most lenient supervision type, this type can be imposed on low risk offenders, such as those who were compliant with other restrictive types of program supervision.

The fifth type of supervision is called “Type E” phone calls. Type E is a text message transmittal system. Interestingly, this type employs the mobile phone of the offenders. Once the program system sends automated text messages to the offenders’ cellular phones, the offenders have to call the system back from their home phone to have the voiceprint and place identification process done. This type is designed to meet the request of the offenders’ family members for an uninterrupted night’s sleep. When young offenders have access to mobile phones, probation officers can consider choosing this type to minimize the inconvenience to the family members (Hoe, 2006).

Finally, “Type F” is called random style phone calls. The automated computer system can choose one of the previous five different types of contacts in order to enhance flexibility of the program’s implementation. When juvenile probationers are sentenced to a relatively long period, particularly more than six months for the AVRS program, Type F forces the program participants to have an increasing sense of awareness and active attitude for answering phone calls since they do not have any clue of the types of phone contacts (Hoe, 2006; The Korean Ministry of Justice, 2003).

Figure 3. Types of the AVRS program[2]



[2] ■ Type A: Sequential Double Verification System
■ Type B: Simultaneous Double Verification System
■ Type C: Simple One-Way Verification System
■ Type D: Nonrandom Verification System
■ Type E: Text Message Transmit System
■ Type F: Random Style Phone Call.

2.5 Logic Model of the AVRS Program

The logic model of the AVRS program includes four components: input, activity, output, and outcome (Rossi et al., 2004). First, input contains appointed probation officers, program instructors, voiceprint recording computer terminals, certified program teaching manuals, mandatory program training courses, and telephone supplies.

Second, activities consist of voiceprint recording into the computer terminals, program orientation for participants and their parents, selection of specific types of program supervision, automatic phone calls between 10 PM and 6 AM, identification questions on the phone, and voiceprint or signal dispatch verification. One crucial characteristic of the activity element is that it uses a special program orientation for parents of the program participants. The parents or other family members are required to attend the orientation class to understand the process and instruction of the AVRS program.

Third, output refers to the program participants who reply to the random phone calls. Thus, the AVRS program management tool can check the concordance rates between the offender's original voiceprint and answering voiceprint.

Fourth, there are outcome elements in the logic model for the AVRS program, which can be divided into initial, intermediate, and long-term outcomes. First, the initial goal is to let young probationers understand the conditions of the program and to prevent them from running away without permission while they are under this program. Next, the intermediate goal is to make the young offenders spend most of their night home with their family members, reducing the opportunity to run away and associate with delinquent peers. Because the calls are random, psychologically, the youths may be more

compliant to the rules and conditions of probation. Also, the intermediate outcome is to encourage participants to have positive relationships with their family members, which will minimize the chances of the involvement with delinquent peers. Finally, a long-term outcome is to reduce recidivism after program graduation.

Table 5. Logic Model of the AVRS Program

Input	**Activities**	**Output**	**Outcomes**		
			Initials	Intermediate	Long term
■ Target group assignment from youth courts	■ Different types of phone calls (A,B,C,D,E,F)	■ Location detection	■ Increased time of staying home at night	■ Changed routine activities	■ Reduced recidivism rate
■ Voiceprint registration processes	■ Random questions from computers	■ Voice verification processes	■ Reduced chance of associating with peer delinquents	■ Positive relationship with family members	
■ AVRS materials	■ Answering phone calls	■ Detection of bypass		■ Increased chances to be caught	
■ AVRS introduction section for participants and parents					

2.6 Limitations of the AVRS Program

The AVRS program's success depends in part on the validity and reliability of the program's capability to be able to differentiate the unique human voiceprints and speech patterns. Recently, biometric technology has become trendy, and relevant techniques also have rapidly advanced. For instance, research in the United States reveals that the voiceprint identification system has only 0.31 percent of an error rate in detecting false identification (Koenig, 1986). However, it is very important to assess the accuracy level of the voiceprint verification system in all its settings. The Special Technology Unit of the Seoul Program Office AVRS program has more than a ninety-nine percent accuracy rate for verifying individuals' unique voiceprints (2005 The Korean Ministry of Justice).

The program participants may attempt to avoid the AVRS program by disobeying the regulations and conditions of the program. For instance, the juvenile probationers in AVRS may recode their voices into another record machine to substitute their voices with the recorded voices (The Korean Ministry of Justice, 2005). When a program participant tries to displace his or her genuine voice with another person's voice, the AVRS program verification terminal automatically detects the inconsistency of the voiceprints and instantly notifies the probation officers about the discrepancy. When red signs are reported from the voice verification system, probation officers in charge have to make a home visit or a direct face-to-face contact with the program participants (The Korean Ministry of Justice, 2003).

In addition, the AVRS program participants may attempt to have a specialized phone service, such as call-forwarding or a phone number change while they are under the AVRS program. The voiceprint verification system has a prominent capacity to detect

auto-answering services and pre-recorded voice services. Also, when the program participants have the phone service that allows them to change their phone number, the AVRS program can sense the violation of the program condition.

However, there are certain inherent limitations in the processes of this program's implementation. The first problem of the program is that staff members who respond to the red signals from the verification system are not on duty in the probation offices at all times. Therefore, the warning tickets and additional investigations usually occur at least seven hours after the red signals are detected and recorded in the automatic terminal.

Second, there is a five-minute gap between tracking the location and voiceprint verification when the program system uses type A, B, and D phone calls. If program participants are involved with criminal activities near their home, five minutes are sufficient to come back home from the crime scene and call back to the computer system. This weakness of the AVRS program raises a serious issue in the validity of the program if the program record terminal is used in courts. There is a possibility that this time gap can be used as compelling evidence in courts if the juvenile probationers fall under a suspicious criminal case (Kim, 2005).

Chapter 3 Literature Review

3.1 Routine Activity and Situational Crime Prevention Theory

Offenders may be understood as rational people who try to seek to maximize their pleasure and minimize their pain (Clarke & Felson, 1993). The fundamental logic of the AVRS program is based on the rational choice theory. When there is intensive supervision by frequent random phone calls, the offenders may carefully calculate and weigh the expected chances of getting caught. In this sense, this program may result in a deterrent effect. The AVRS program can increase the opportunity of being caught, especially at night when juvenile probationers violate the program conditions or are involved in criminal activities.

The routine activity approach is strongly embodied in the AVRS program's structure and operation. Instead of emphasizing the root causes of crime, such as individuals' disposition or personality, the routine activity perspective focuses on the impact of changed circumstances on crime rates (Clarke, 1980). Specifically, the routine activity approach emphasizes three basic situational elements that are required to determine offenders' choices in criminal activities: motivated offenders, suitable crime targets, and absence of guidelines (Newman et al., 1997).

First of all, the juvenile probationers can be regarded as potential criminals who have a high motivation to commit crimes. Although there is an argument with regard to making accurate predictions about future behaviors, the AVRS program participants seem more inclined towards criminal activities than youth who have never been in the

justice system. In fact, juvenile probationers have higher recidivism rates than adult probationers in Korea (Kim, Kim, Lee, & Lee, 2007).

Second, suitable targets or victims can be any person or property near the potential offenders. If youth are outside at night, there is an increased likelihood that they will be involved in the commission of a crime. According to a report by the United States Department of Justice (1996), the most probable time of murders committed by juveniles is between 10 PM and 1 AM. Also, aggravated assaults by juveniles are most likely to occur between 11 PM and 1 AM (Bilchik, 1996). A study in Korea shows that juvenile delinquents are more likely to select victims or targets that are acquainted with them when they commit crimes (Kim et al., 2007). Random phone calls from the AVRS program can constitute intermittent guidance that can impact the potential criminals.

While electronic monitoring systems which are constant, the AVRS program provides intermittent random phone calls to juvenile probationers. Constant computer systems, which are often used in electronic monitoring, use active physical attachment of a transmitter to the offenders' ankles or wrists, while the AVRS program involves an intermittent style of phone calls (Finn & Muirhead-Steves, 2002). Thus, the AVRS program tries to manipulate the potential offenders' circumstances by decreasing their opportunity to commit crimes at night by using automated random phone calls. In this sense, the program goal is equivalent with the routine activity approach that emphasizes challenging conditions and practical thinking about how to prevent certain crimes that are associated with opportunity of crime. Moreover, forcing offenders to be home every night may produce structural changes in their routine life. In other words, their increased time at home would increase the opportunities of spending more time with juveniles' family

members at home. According to a study in Korea, the AVRS program helps the program participants establish more positive relationships with their family members. AVRS and family members have a higher level of satisfaction toward the program participants' behavior changes (Kim, 2005).

Another crime prevention approach, the situational approach, introduces more theoretical background of "situational thinking" by involving an action research strategy (Clarke, 1992). The initial emphasis of situational crime prevention is to reduce the chance of committing crime by target hardening and management of circumstances in a systematic way (Clarke, 1980). The approach of focusing on situational determinants of crimes is different from the traditional perspective. While traditional criminology theories focus on personal background or disposition in order to find root causes of crimes, the situational crime prevention perspective highlights different techniques of manipulating a situation so that it crime circumstances become more challenging (Clarke & Homel, 1997). Although the situational crime prevention strategies are not very valuable in finding the starting points of criminal activity, they are effective in preventing certain types of crimes.

Specifically, according to Clarke (1992), five elements are required to obtain the advantages of the situational crime prevention approach: (1) data collection with regard to the characteristics of the crime problems, (2) evaluation of the situational conditions associated with occurrence of crimes, (3) research on possible methods of preventing the occurrence of crimes, (4) implementation of the most cost-effective measures, and (5) monitoring of the outcomes of the implementation and dissemination of the experience.

Clarke (1992) also states that the situational crime prevention approach is only useful for reducing highly specific types of crime, especially opportunistic crimes. However, there are limitations to the application of situational crime prevention to AVRS in Korea. The first weakness of the situational crime prevention approach is that the theory cannot explain certain types of crimes that are committed by extremely motivated offenders. Small numbers of offenders, especially deeply "hardened" criminals do not easily give up their willingness regardless of the challenging situations (Trasler, 1986). Because AVRS is not a constant 24-hour surveillance program, it may have a limited ability to control and affect the "incorrigible offenders."

Another flaw of situational crime prevention is that potential offenders may change their crime plans in order to commit their crimes in different places and times with different methods. Avoiding the challenging situations can lead to the "displacement effect" that makes crimes increase in different places or in different ways as a result of inhibiting offenders from committing specific types of crimes where and when they usually would (Clarke, 1992). For example, the juveniles in the AVRS program may attempt to commit crimes during the day before the curfew begins in order to keep away from the violation of program conditions. Also, the youth in the program may get involved with criminal activities at home, such as internet crime, prostitution, or domestic violence while following the regulations of the program.

However, the essential point is that most offenders, regardless of the types of crimes and ages of offenders, are very likely to be affected by the difficult circumstances created by the situational crime prevention strategy. Offenders, even though the root causes of their crimes may be from anger or strain, cannot help changing their crime

plans in a way to deal with the challenging situations (Farrington & Burrow, 1993). Thus, the situational crime prevention approach promises to affect almost all types of young potential offenders. Furthermore, the displacement effect relies on the offenders' criminal skills. When offenders do not have professional capability in committing crimes, the displacement effect is less likely to affect the cognitive processes of deciding to commit crimes (Farrington et al., 1996; Farrington & Burrow, 1993).

Cornish and Clarke (1987) have also developed the concept of "choice structuring properties" of crimes to counter the "displacement effect attack." Structuring properties include the potential offenders' personal perception and confidence about their criminal abilities, skills, and methods. The properties impact the number of choices that a motivated offender may perceive to be available. In this sense, the AVRS program can be regarded as an action research plan to be able to prevent juvenile crimes at night, and can make the potential young offenders think that they are blocked from having opportunities to become involved with criminal activities at other times and places.

According to the situational crime prevention approach, "deflecting offenders" is one of the significant strategies that can result in crime reduction via increasing the perceived difficulty of crime (Clarke & Homel, 1997). The "deflecting offenders" technique manipulates conditions so it becomes more risky and difficult for offenders to commit crimes. It prevents offenders from encountering situations favorable for crime. Historically, incarceration can be one of the extreme methods that use the "deflecting offender" techniques (Newman, Clarke, & Shoham, 1997). Clarke (1997) introduced less intrusive examples of this strategy in a way that is a more acceptable application of the situational crime prevention approach. For instance, when soccer fans' violence caused

serious problems in the United Kingdom, the simple changes of departure and arrival times resulted in decreased probabilities of running into fans of the opposing soccer teams (Clarke & Homel, 1997). In this perspective, the automated random phone calls of the AVRS program can be an action strategy for deflecting offenders that forces them to stay home at night and minimizes the chance of being involved in criminal activities.

3.2 Previous Studies on ISP and EM Programs

3.2.1 History of Intensive Supervision Probation

Intensive Supervision Probation (ISP) refers to a diversity of sanctions that are more stringent and punitive than traditional community-based correction, but less costly and cruel than incarceration (Petersilia & Turner, 1990). The ISP programs are combined with increased direct and indirect contacts between offenders and probation officers. In many cases, these ISPs are coupled with house arrest, electronic monitors, or other restriction methods that can further increase monitoring levels (Morris & Tonry, 1990). ISP is designed to provide increased supervision and restraints on high risk offenders in the community. Therefore, the AVRS program can be regarded as intensive supervision probation which relies on human voiceprints and automated voiceprint recognition computer systems.

ISPs aim primarily to provide enhanced supervision for high risk offenders in the community. However, there are no general ISP programs. Even if the common objective of ISPs is the same, the types of programs implemented and practiced are different. The only common characteristic of the ISP programs is that they are more intrusive than normal probation (Petersilia & Turner, 1990).

In Korea, the use of the AVRS program has been encouraged by a fiscal need for supervision and treatment for juvenile probationers (The Korean Ministry of Justice, 2003). In the United States, it also intended to deal with the high cost of incarceration (Pearson, 1987). Different types of intensive supervision programs, such as electronic

monitoring and home confinement also were introduced to reduce the cost of imprisonment (Palumbo, Clifford, & Snyder-Joy, 1992).

Although there are numerous varieties of ISP programs, they are basically categorized into three types (Tonry, 1998). First, probation enhancement refers to the diversion of offenders from traditional supervision to intensive levels of supervision. The ISPs are controlled by probation officers, and targets at high risk are selected because of their serious or repeated crimes (Finn & Muirhead-Steves, 2002). Second, prison-diversion, also called "front door," targets relatively low risk offenders who can be released into the community instead of being imprisoned for their non-serious crimes (Clear & Dammer, 2000). Third, early-release, referred to as "back door," targets prisoners and hastens their release through ISPs, which aims to save prison resources and costs (Brown & Roy, 1995).

Traditionally, ISPs have been used to manage heavy caseloads of offenders who are at high risk or in need of complicated services. In other words, early ISPs were primarily probation case management tools, designed to determine the appropriate caseload size for rehabilitation not punishment. However, studies on ISP evaluation indicated that smaller caseloads tended to produce more technical violations (Clear et al., 2000). Those findings show that the quality of the contacts is more important than simply increasing the number of contacts. If the contacts in ISP are no more than "check-ins," the reduced caseloads and intensive supervision are not likely to impact and change offenders' behavior (Taxman, 2002). Therefore, it is necessary to examine the impact of the increased direct and indirect contacts by the automated phone call system on the offenders' future behavior.

Since the late 1970s, probation and parole were encouraged during the "get-tough" movement in the United States. The newer ISPs were not concerned about the offenders' needs or rehabilitation, but rather focused on crime prevention and community safety. The ISPs were influenced by the new penology philosophy of crime control in the United States, coming out of the dissatisfaction with past rehabilitation efforts. The promulgation of Martinson's "nothing works" idea in 1974 resulted in a strong emphasis on intensive supervision in the community in the United States (Martinson, 1974; Maxwell & Gray, 2000).

3.2.2 Effectiveness of Intensive Supervision Probation

While regular probation supervision requires once a month contact, the AVRS program participants have direct and indirect contacts with probation officers more than three times a week due to the automated voiceprints verification system. Because the probation officer in charge has to ensure the processes and implementation of the AVRS program, there are increased face-to-face contacts or home visits during the program implementation. So, the question is, how do the increased contacts with probation officers impact the juvenile probationers' future behavior, especially their criminal behavior?

The effectiveness of ISPs is not entirely proven. Some reports indicate that particular ISPs result in a substantial reduction in recidivism rates (Erwin, 1987). A simple argument about what "works" in ISPs is that if regular supervision by a probation officer works, ISPs will also work in a way that impacts on the frequency of contact and the relationship between the offender and the supervision agent. Byrne and Pattavina

(1992) suggested that supervision itself has obviously viable results. In particular, a report on a Georgia ISP (1983) demonstrates that the program has succeeded in controlling high risk offenders in the community. The Georgia program is based on the "front door" policy wherein convicted offenders otherwise would have been sent to prison. The ISP participants had a lower rate of reconviction for serious crimes against persons than the routine probationers or imprisonment comparison group.

Georgia's ISP program also reflected the effectiveness of ISPs in terms of cost-benefit analysis. For each ISP probationer who was diverted from prison, about $ 6,775 was saved (Erwin, 1987).[3] New Jersey's ISP program of 1985 also showed the effectiveness of ISPs. This program was for low risk prisoners who were released from prison through careful assessment processes (Petersilia, 1998). Two-year follow-up data pointed out that just eleven percent of the ISP offenders were rearrested, compared to twenty-six percent of the ordinary imprisonment comparison group during the first year. However, there are high rates of revocations for failure to comply with program conditions in the ISP programs (Pearson, 1987; Clear & Latessa, 1993). In addition, Petersilia (1999) pointed out that if there are some treatment programs in ISPs, the "get-tough" programs may have a positive impact on reducing recidivism. Taxman (2002) argues that the key point is how to include therapeutic elements in ISPs.

On the other hand, some researchers demonstrate that ISPs do not produce lower recidivism than regular probation (Person, 1987; Byrne & Kelly, 1989; Sherman, et al., 1997). With a few exceptions, studies on ISPs generally have suggested that the ISP had a negligible effect on recidivism (MacKenzie, 1997; Gendreau, Goggin, & Smith, 2001).

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[3] The average cost for routine probation in Georgia was $300 per person a year; the cost for ISP was $1,600 per probationer a year, and prison costs were $9,000 per person a year (Petersilia and Turner, 1990).

Petersilia and Turner (1990) compared the ISP participants with a control group. Their report is one of the most widely recognized assessments on ISPs. They reported that seventy percent of the ISP participants had technical violations, while only forty percent of the control group had technical violations. They also found that there were more offenders under ISPs reoffending after one year. In addition, national research based on meta-analysis has generally concluded that ISPs are ineffective in reducing recidivism (Mackenzie, 1997).

An evaluation of a Marion County ISP program compared fourteen offenders who had been randomly assigned to the ISP program with fourteen inmates who had been assigned to prison (Petersilia & Turner, 1990). None of the experimental group participants remained on ISP after one year. Half of the ISP participants had been sent to prison for technical violations, while two-thirds of prison-control offenders had been released from prison. The average amount of time in prison was nearly equivalent over a one-year follow-up period between the two groups, which indicates that the ISP is not effective in terms of costs.

In addition, a report on a Massachusetts ISP program found that recidivism rates for both an ISP intervention group and a control group were approximated to be sixty percent. The program was based on the "enhancement probation" designed by the state probation department in which probationers were classified on the basis of risk of offending (Petersilia, 1990). No overall differences were found in offender recidivism. In addition, an analysis measuring duration until failure showed that intensive supervision might initially have a deterrent effect, but the effect disappeared by the end of the second month of supervision (Byrne & Kelly, 1989). However, the evaluators concluded that

ISPs had an indirect effect on offender change such as substance abuse, employment, and family relationships. Although the main goals of ISPs are to reduce re-offending, enhance the safety of communities, and reduce prison costs, nationwide evaluations have shown disappointing results (MacKenzie, 1997).

Moreover, ISP studies demonstrate that intensive supervision can result in more serious problems such as net-widening, high revocation rates, and related case processing costs (Tonry, 1998). If there are no scientific classification instruments or valid selection guidelines for the program, the AVRS program could result in a waste of resources through a "net-widening" effect. There is a lack of evidence with regard to the criteria for suitable participant selection for juvenile probationers in Korea (Jin, 2003). A study in the United States also shows that juvenile intensive probation supervision is more likely to target offenders who committed gruesome crimes instead of targeting youth who have a genuine future risk for committing crimes (Clear, 1993). In this sense, it is essential to examine the association between recidivism and program selection guidelines on which youth court judges rely.

3.2.3 Effectiveness of the Electronic Monitoring

Overall, previous studies on ISPs have focused on the impact of increased face-to-face contacts with probation officers on recidivism rates. With the rapid growth of information technology, however, the electronically monitored home detention or curfew programs began to be added as conditions of intensive supervision. Electronic monitoring (EM) is a graduated sanction that uses electronic devices or technologies, such as satellite systems and electronic transmitters to guarantee that offenders stay at the approved residence in the community (Finn & Muirhead-Steaves, 2002).

Although the AVRS program is not equivalent to EM and does not use any electronically monitored constant surveillance devices, it is useful to understand the outcomes of evaluation studies on the electronic monitoring programs. The two programs have certain similarities, such as program targets and implementation processes by using technologies. Thus, studies on monitoring devices, cost analysis, predictive factors for program success, percentage of successful program completion, and post program recidivism of the electronic monitoring programs are helpful for examining the potential effectiveness of the AVRS program.

In the United States, electronically monitored home confinement has been regarded as an influential, cost-effective intermediate sanction that has a deterrent effect (Hofer & Meierhoefer, 1987; Tonry, 1998). However, there is a paucity of research on the effectiveness of EM, and the few studies that have been done offer few findings that are mixed and inconclusive (Padgett et al., 2006). According to studies on the effect of EM on recidivism, EM is effective in reducing recidivism rates, especially during the program's implementation (Cooprider & Kerby, 1990; Gainey et al., 2000; Jolin &

Stipak, 1992). A recent study using data on 75,661 offenders in Florida found that EM had a statistically significant association with the likelihood of reducing technical violations, reconviction, and absconding (Padgett et al., 2006). Other studies show that EM does not have any relationship with recidivism rates (Bonta, Wallace-Capretta, & Rooney, 2000b; Courtright et al., 1997; Renzema & Mayo-Wilson, 2005). Cadigan (1991) states that EM participants have a substantially increased number of rearrests.

A major issue of this mixed evidence on EM is that the increased supervision or restrictive surveillance conditions may not ensure public safety. As illustrated by DiIulio's (1997) criticism, EM is only a "cuff on the wrist." Finn and Muirhead-Stevens (2002) indicate that EM is not effective enough to reduce the probability of reincarceration, especially to high risk parolees. They also report that offenders who have drug problems under EM are more likely to commit crimes and return to prison. There are certain possibilities that offenders under EM continue to commit crime in spite of the enhanced closer supervision. Empirical evidence showed that EM or house arrest results in an increased stress level for program participants' family members (Doherty, 1995). In addition, while offenders are in EM, some of them continue to participate in certain types of crime, such as prostitution and drug possession or selling (Rogers & Jolin, 1989). Studies argue that increased controls do not have a strong effect on reducing recidivism rates (Andrews & Bonta, 1998; Gendreau & Goggin, 1996). However, it is difficult to make a clear conclusion about EM because the program provisions, the conditions of supervision, selection criteria, duration of the program, and follow-up periods are different across the types of interventions (Finn & Muirhead-Stevens, 2002).

Issues on the effectiveness of EM are also related to the selection criteria and classification system within the criminal justice system. Although EM is designed to supervise high risk offenders in the community to deter them from committing crime, most offenders under EM are not quite high risk offenders (Whittington, 1987; Roy, 1997; Ontario, 1991; Mortimer & May, 1997). Bonna, Wallace-Capretta and Rooney (2000b) evaluated three different Canadian EM programs and stated that "Programs that accept high risk offenders are the exception rather than the rule" (p. 62). When a specific intermediate sanction is given to low risk offenders, it is actually more likely to increase recidivism rates (Andrews, Bonta, & Hoge, 1990; Bonta et al., 2000b). Therefore, it is necessary to use the right guidelines, and classification instruments before implementing specific EM programs to make sure that those admitted to the program are truly hish-risk.

Generally speaking, the effectiveness of EM is correlated with various factors. In particular, Courtright, Berg, and Mutchnick (2002) indicate that employment, prior offense, and conjugal status are significantly related to the successful completion of the EM program. Although this study did not use recidivism rates for measuring the effectiveness of EM, it shows that certain demographic factors are statistically significant in predicting successful graduation from the EM program. Also, gender, age, and income are vital elements that can impact the efficacy of EM. Lilly, Ball, Curry, and McMullen (1993) state that female EM participants are less likely to drop EM than male participants and offenders under forty years of age are less likely to succeed in completing EM. They also indicate that offenders who had annual incomes over $10,000 are more successful in finishing their sentences than those earning less than $10,000 annually, to finish their sentences successfully. In addition, previous criminal history can be an important factor

affecting EM outcomes. Offenders with previous convictions are more likely to fail to complete EM compared to their cohorts with no prior conviction records (Roy, 1999; Lilly, Ball, Curry, & McMullen, 1993).

Furthermore, program-related factors may be associated with EM results. For instance, the amount of EM time is a significant factor impacting the effectiveness of the program. Renzema and Skelton (1990) found that sentence length is an important predictor of "exit status." Specifically, they argue that if the sentence length exceeds six months, the likelihood of a successful exit increases. Gainey, Payne and O'Toole (2000) argue that the longer the program time on EM, the lower the probability that the offenders commit crimes.

One of the major criticisms of EM is that it does not provide offenders with individualized treatment services in the community. If there are no concerns about treatment programs in criminal justice systems, then the effectiveness of the sanctions is limited (Cullen, Wright, & Applegate, 1996; Larivee, 1993). Bonta, Wallace-Capretta and Rooney (2000a) state that punishment without a rehabilitation element cannot result in the reduction of recidivism. When there are no individualized interventions or rehabilitation concerns, especially for young offenders, the intensive surveillance technique may result in negative outcomes, such as a "labeling effect" or "snowball effect" (Bernburg & Krohn, 2003; Schwartz & Skolnick, 1962; Corbett & Marx, 1991). Thus, the deficiency of treatment elements in EM could be a major weakness of the intensive supervision. However, when EM is combined with rehabilitation elements, it can enhance rehabilitation effectiveness. Bonta, Wallace-Capretta, and Rooney (2000a) reveal that a crucial benefit of EM is that the closer supervision contributes to increased

compliance with conditions of the intervention programs, thus maximizing the treatment effect in EM. It seems that there can be a synergistic effect wherein intermediate sanctions may reinforce the treatment outcomes.

EM has been examined in terms of a cost-effective perspective, and one may think that EM is less expensive than incarceration (Courtright et al., 1997; Lilly et al., 1993; Finn & Muirhead-Steaves, 2002). However, the cost-effectiveness analysis is too obscure to make a comprehensive conclusion regarding the effectiveness of EM. When EM expenditure and prison costs are simply compared, it is difficult to avoid making arbitrary assumptions on the duration of imprisonment avoided. Specifically, if three months of EM assignments replaced imprisonment sentencing, the length of custody would be less than three months. However, there are no apparent criteria on exactly how long the duration of imprisonment would have been if EM is an alternative to incarceration. It could have been one month or two months for the three months of EM by the discretion of judges. Thus, a simple calculation for the cost comparison seems to rely on untested assumptions. Smith (2007) states that the annual net saving would be about £1.7 million with "somewhat generous assumption," while the saving would be only £ 0.3 million with "less generous but still optimistic assumption" (p. 209). Hence, it is not clear whether there is a beneficial outcome in EM when we focus only on the cost-effective analysis approach. A study on Canadian EM programs shows that there is no cost saving advantage in EM. EM programs cause a "net-widening" effect instead of reducing the cost and resources (Bonta et al., 2000b). According to Israel and Chui (2006), not all of the offenders under EM or other intensive programs are qualified to be incarcerated. This issue is also related to the "net-widening" effect of the program because, in general, less

serious and non violent juvenile offenders are more likely to be assigned to a particular intensive supervision program (Jolin & Stipak, 1992). The plain measurements of cost are not sufficient to include all direct and indirect expenses of EM.

In general, the findings of the studies on EM are not consistent enough to make a comprehensive conclusion about the program's effectiveness (Finn & Muirhead-Steves, 2002).

3.2.4 Methodological Problems on ISPs and EM

There are serious problems in previous studies on IPs and EM in terms of their research methods and research designs. A major limitation of the methodological design is that most analyses on the IPs or EM failed to use an unbiased comparison group (Padgett et al., 2006; Bonta et al., 2000b). Many researchers ignored the differences between the EM group and the comparison group (Cadigan, 1991; Whittingon, 1987; Roy, 1997; Mortimer & Baum, 1997; Denton, 1998). There are few studies on ISPs or EM that show a well-balanced intervention group and a control group. For instance, Ontario (1991) found that EM participants are relatively low-risk offenders, while the comparison group is classified into high-risk offenders. However, there was no further effort for controlling the different risk levels of the two groups.

According to a review of the literature, numerous ISPs or EM targets relatively low risk offenders (Mainprize, 1992; Cullen, Wright, & Applegate, 1996; Clear, 1990). It is not clear whether the reduced recidivism rates of the intervention group result from the program effect or original characteristics of offenders' low risk (Bonta et al., 2000b). Although it is difficult for researchers to conduct a pure experimental study in criminal

justice settings, it is necessary to use a representative comparison group for estimating the efficacy of a specific program (Bonta et al., 2000a). If the comparison group has lower recidivism rates, they could be due to the selection bias, not because of the treatment effect.

Another key problem of the previous studies is that numerous studies use a program completion or failure factor as the program outcome variable (Padgett et al., 2006; Bonta et al., 2000a; Finn & Muirhead-Steves, 2002). The increased surveillance level leads to the increased likelihood of being caught. Instead of highlighting technical program violations or consequential program drop out rates, it is more beneficial to emphasize arrest rates. If the goals of the AVRS program are to supervise high risk offenders and maintain community safety, the evaluation outcome should put more focus on arrest rates, such as numbers of rearrest, reconviction and reincarceration (Petersilia, 1998; Dodgson & Mortimer, 2000). A recent study on EM used multiple outcome variables to deal with this problem. Padgett, Bales, and Blomberg (2006) utilized three outcome measures: revocation for EM technical violation, revocation for a new crime, and simple absconding. Furthermore, studies on ISPs and EM do not include sufficient sample sizes in their studies. Numerous studies utilized less than 100 cases (Payne & Gainey, 2004; Bonta et al., 2000b). Bonta, Wallace-Capretta, and Ronney (2000b) used only 30 probationers for the comparison group. Payne and Gainey (2004) surveyed only 49 offenders who were on EM to find their perception on EM experience. The small sample size can lead to decreased precision in estimates of properties of total population. The small sample number also can be against the fundamental statistical rules of the central limit theorem and the law of large number.

3.3 The Proposed Study

The preceding section identified three main methodological problems in prior studies of ISP and EM: poor comparison groups, inadequate outcome measures, and mismeasurement of recidivism. This study of AVRS addresses each of these issues, in the hopes that a more reliable program evaluation will inform policy-makers about the value and guidelines of the program.

3.3.1 Use of the Matching Sample Design Based on Propensity Score

This study uses a quasi-experimental design. The intervention group consists of the AVRS program participants who were assigned to probation. The comparison group consists of juvenile probationers under routine probation. In order to minimize sampling bias, this study employs propensity score techniques. Since there is a selection bias caused by youth court judges' discretion in program assignment, it is necessary to make an equivalent comparison group using a matching design.

Kim (2005) failed to conduct a matching sample analysis when he examined the AVRS program pilot project data set. Therefore, Kim's findings on the effectiveness of the AVRS program are not convincing. Because the program participants and juvenile offenders under regular probation have different characteristics and risk levels from the beginning of the program implementation, their different recidivism rates and attitude changes may not be due to the program impact, but instead may result from sampling bias.

In order to make two balanced groups (AVRS vs. comparison), all demographic variables between the two groups, such as age, gender, prior crime histories, employment, housing status, and types of offenses are matched statistically. Propensity scores are used to balance two different groups, particularly for quasi-experimental designs (Luellen et al., 2005). As described by Rosenbaum and Rubin (1983), a propensity score is the probability that a participant may belong to one condition, such as a specific treatment or intervention, rather than to another. It has a range between 0 and 1, since the propensity score is associated with a conditional probability. The propensity score matching allows the researchers to control for selection bias that is a result of the observed covariates.

3.3.2 Employment of Multi-Faceted Outcome Elements to Evaluate Effectiveness

There are three different outcome measurements used in this study; The first dependent variable is the recidivism rates of program participants and non-participants, measured by the number of rearrests after a one-year follow-up period. Number of rearrests is expected to represent a less tainted view of actual recidivism than those of reconviction or reincarceration rates. Others (Bonta, Wallace-Capretta and Rooney, 2000a) have used reconviction rates for evaluating community correction programs, but the use of conviction is problematic. Numerous offenders who are arrested do not actually get through the entire criminal justice system to become convicted. Many cases, especially for juvenile delinquents, are dismissed by police with only a warning or admonition.

In Korea, 61,403 youth offenders, which represent 53.2 percent of total youth criminals, were released from police stations without any prosecution processes in 2002 (Korean Prosecutors' Office, 2006). Therefore, the reconviction rates poorly measure the recidivism of the program participants. However, when the number of rearrests is used for measuring the recidivism rates, there could be a "false arrest" problem. The false arrest indicates the violation of law that plaintiffs are arrested without any probable cause for the custody. The false arrest could be involved with excessive use of police forces or threats. Although it is possible to have a false arrest problem, this challenge can be minimized in the current criminal law systems due to the intolerance policy for the false arrest. Korean Criminal Law states that police officer should not use unlawful detention and unnecessarily excessive amount of police forces in order to

arrest plaintiffs. Police officer should depend on only an amount of forces that is reasonably needed to handle an incident effectively for the purpose of protecting the officers and citizens. In addition, Korea criminal law states that illegally obtained evidence should be excluded from trial. Thus, these moderately strict criteria for recidivism in Korea and other evaluation studies can distort the true picture of re-offense. Accordingly, researchers have to take a more accurate view of recidivism in order to draw a more accurate picture when they conduct an evaluation study of the AVRS program. This study will use the number of rearrests one year after completion of the AVRS program for measuring the recidivism rates. In Korea, none of the studies have analyzed the number of rearrests for estimating the effectiveness of the AVRS program. For the first time, this study will utilize additional official data regarding juvenile probationers' rearrest numbers one year after completion of the AVRS program.

The second outcome measure is the program drop-out rate. Failure to complete the program is a significant gauge that can determine the effectiveness of the program. Specifically, this current study will examine whether or not the program participants receive warning tickets or revocation during the program implementation.

The third outcome measurement is duration of desistance from crime, measured as time-to failure. This study will investigate the differences of duration of desistance from crime between the AVRS program participants and the juvenile offenders under regular probation.

Chapter 4 Research Methods

4.1 Research Design

4.1.1 Quasi-Experimental Design

Experimental design is one effective way of using the most representative groups and controlling for internal rival causal variables. However, it is difficult for social scientists to use a pure experimental design, especially in criminal justice settings. It is often impossible to make genuine random assignments of subjects to programs when offenders are sentenced. Because offenders are sentenced in courts by judges, there is a selection bias in the screening process and program eligibility standard.

Entry into the AVRS program is ordered by youth court judges, so it is more difficult to eliminate the judges' opinions and criteria through randomization in the juvenile justice system. As a result, it is more desirable to use a quasi-experimental design study in real-world settings (Luellen et al., 2005). In a quasi-experimental design study, researchers use a various matching sample techniques in order to minimize the risk of a sampling bias caused by non-random approaches (Imbens, 2000).

A matching analysis based on propensity scores will be used in the current study to create two balanced groups (the AVRS group and the comparison group), thereby reducing the impact of sampling bias. The propensity score matching technique creates matching samples, by controlling for all characteristics that are associated with selection bias. Rosenbaum and Rubin (1985) demonstrated that predicting probability of being placed in a specific treatment group, which is transformed into propensity scores, is the

most efficient way to obtain matched samples in a quasi-experimental design. In addition, recidivism rates are measured one year after completion of the AVRS program completion. A one-year follow-up period is used because the AVRS program ended in June 2005 and data collection began in August 2006.

4.1.2 Data and Procedure

In April 2003, for the first time, the Seoul Probation Office initiated the pilot project of the AVRS program as a condition of curfew orders for juvenile probationers (Kim, 2005). Data were collected for this study in August 2006, from the databases of the Korean Ministry of Justice. This study examines all program participants who were placed in the AVRS program from April 2003 to June 2005 from two different probation offices: South Seoul and Su-Won (N=214). Even though the two probation offices are in different districts, they are both in populated areas near the center of Seoul. Because all of the AVRS program participants are included in the study, the issue of sample selection for the AVRS group did not arise. The control group is collected from the same probation offices by using random sampling. Among the total population of juvenile probationers in the two probation offices, randomly selected individuals are included only in the comparison group (N=294).

There are two major data sources for this study. First, data are obtained from the Probation and Integrated Information System (PIIS). Comprehensive individual data, such as age, sex, type of crime, probation history, family structure, school, job, and address are obtained from PIIS intake records from the probation offices. PIIS also has a variety of information about offenders' drug history, family background, prior criminal

history, individual medical needs and financial status. These PIIS data are based on intake information that is encoded by probation officers and kept for official records.

Second, data are drawn from the Crime History Database (CHD). Data collection from the criminal records was conducted in August 2006. Because this study used a one-year follow-up period to measure recidivism, the data selection process was implemented one year after the completion of the pilot project. From the CHD, the number of rearrests, rearrest dates, types of new crimes and total prior conviction rates were selected. Because the beginning dates of the AVRS program were different for all subjects, it was necessary to calculate the time elapsed between the beginning dates of the program and the dates of rearrest for each individual. After the first PIIS data were selected, the corresponding criminal history data were drawn from CHD.

The period of time between the beginning dates of the program and the rearrest dates is a crucial variable because it helps estimate how long the subjects in this study refrained from committing new crime. By using survival analysis, the study investigates the impact of the AVRS program on recidivism, especially the length of time before recidivism occurs. Since the two data sets are combined from different databases, the information is transformed from an Excel file into an SPSS statistical package program file. Then the AVRS program group and the comparison group are compared to see whether or not the subjects in AVRS have relatively high-risk factors.

4.2 Population and Sampling

Since 2003, youth court judges have referred youth offenders who require close monitoring and intensive control at night to the AVRS pilot project. At the beginning of the pilot project, three probation offices, including Seoul, participated in the AVRS program for temporary testing. The three probation offices were all situated in areas of Seoul with large, urban populations (Seoul Probation Office, South Seoul Probation Office, and Su-Won Probation Office). However, youth court judges assigned a very small number of offenders to the Seoul probation office in the first year of the pilot project, and the program guidelines were not clear enough to actively implement the AVRS program in Korea. In April 2003, only seven juvenile probationers in the Seoul probation office were placed in the AVRS program. Since there were not enough subjects to validate the effectiveness of the AVRS program, the AVRS program pilot project was extended until June 2005.

One of the research goals in this study is to compare the two groups in order to investigate the youth court judges' criteria for assigning youth offenders to AVRS. Although the AVRS group and the comparison group received different sentences from youth court judges, their legal status and age range are identical. Both groups are juvenile probationers who do not have permanent criminal records for the crimes they committed. According to the Korean Youth Law, all of the subjects in this study are youths between 12 and 20 years old. Furthermore, as a quasi-experimental design, this study compares the AVRS group and the comparison group by employing propensity scores as a matching sample technique in order to minimize the risk of sampling bias (Luellen, Shadish, & Clark, 2005; Imbens, 2000).

The samples of the current study were obtained from the two different probation offices that participated in the pilot project: the South-Seoul and Su-Won probation offices. The total participants in the study are 508 juvenile probationers from the two different probation offices. The AVRS sample group includes all juvenile probationers from April 2003 to June 2005 (N=214) in those two offices[4].

The comparison group was selected by a random sampling method from all the juvenile probationers in the two probation offices. In 2004, the total population in the two probation offices was 1,175 (The Korean Ministry of Justice, 2006). Among them, 294 juveniles were selected by random sampling. To conduct statistical analyses, the comparison group and the AVRS intervention group will be balanced by calculating propensity scores. Although the comparison group was derived by random sampling from the total juvenile probationers, the comparison group still differs from the AVRS group in terms of its characteristics and risk levels for committing crimes, due to selection bias. Therefore, demographic variables (age, gender, employment, and financial status) and risk factors (the types of offense and the number of prior convictions) are used as independent variables to determine referral to the AVRS program. In order to estimate propensity scores for all subjects, logistic regression (backwards) analysis will be conducted.

[4] Total sample number is expected to provide more stable and reliable results than random sampling. Although there was a probation office that began to use AVRS from 2004 in Korea, the probation office is excluded from the sample group in this study because the probation office is located in a relatively rural area, and the program participant numbers are small enough to cause sampling bias. Therefore, this study targets universal AVRS participants from the South-Seoul and Su-Won probation offices to estimate the effectiveness of AVRS.

4.3 Operationalization and Variables

This study examines whether the AVRS program reduced recidivism among youth probationers. This study measures the rate of recidivism one year after program completion. By using a logistic regression with propensity score technique, the AVRS program group and the comparison group are balanced in terms of their risk variables. By controlling the covariates, this study can compare the AVRS group and the comparison group to see if the AVRS program has had an impact on the number of rearrests after a one-year follow-up. This study also tests whether this program affects the duration of desistance from crime. If the AVRS program has only a short-term effect, it is necessary to assess the critical stage at which recidivism began to increase.

First of all, the program outcome is measured through recidivism rates. Because the long-term goal of the AVRS program is to reduce crimes and deter criminal activities by juvenile probationers in the community, the most important dependent variable is the rate of recidivism, defined as the number of rearrests. Instead of taking a limited view of recidivism, such as reconviction or reincarceration, this study employs the number of rearrests, in a one-year follow-up period in order to draw a more accurate picture of recidivism. However, simple technical violations of the AVRS rules will be excluded from the total number of rearrests in order to assess the true number of new crimes the participants committed. Most simple technical violations of the program requirements and conditions may not be directly associated with public safety, and so are not included in the number of rearrests in this study. As others have found, increased surveillance and supervision are more likely to result in increased levels of probation violations (Giblin,

2002). Furthermore, the number of rearrests will be recoded into a dichotomous variable to conduct logistic regression (yes=1, no=0).

When this study conducts linear regression, the number of rearrests is transformed into logged measurement to minimize the skew. Skewness is a statistical measure of the asymmetry of distribution that describes the tail of the probability distribution. It is usually required to minimize the skewness by using natural log. The natural log transformed data provide the most desirable approximation to normal distribution.

Second, the duration of desistance from crime is estimated by recording the number of days that juvenile probationers abstained from committing crime in a year. The duration of desistance from crime can offer the criterion for the appropriate program length. By conducting survival analysis, the amount of time before recidivism will be estimated in the current study.

Third, program dosage factors are conceptualized into the different types of program contacts: A, B, C, D, E, and F. As a matter of fact, the program dosage is defined as the frequency of contact, level of supervision, or duration of the program. Hence, the six different types in the AVRS program can be considered as a program-related factor. Types A and B have relatively higher levels of supervision than types C, D, and E. Types A and B use a double verification system, which includes a location tracking system and a voiceprints verification system, while types C, D, and E have a one-way simple verification system. Moreover, the program dosage factor is defined as the duration of the program in the study. Most of program participants received three-month sentences for the AVRS program. However, other juvenile probationers received more than three months. Therefore, two categories will be created for the duration of the

program: (1) below three months, (2) more than three months. The measurement of current crimes includes three categories: property crime, personal crime, and traffic violation.

Finally, program condition violations and revocation of probation are examined as independent from the number of rearrests. This study will investigate the number of warning tickets and of revocations as program outcomes. Although the number of rearrests is a crucial dependent variable for examining the effectiveness of the AVRS program, the revocations and warning tickets are also meaningful factors that may affect the juveniles' future behavior. Comparing the two variables with the number of rearrests will provide practitioners with enhanced information regarding appropriate discretion level and program outcomes. In summary, this study uses the number of rearrests as a major dependent variable in order to estimate the outcome of the AVRS program. As alternative dependent variables, this study also investigates whether or not juvenile probationers had revocation (a dichotomous variable, yes=1, no=0) and warning tickets (a continuous variable, number of warning tickets).

Table 6. Operationalization of Key Variables

Types	Variable Name	Operationalization	Questions
Dependent Variable (1)	Recidivism	Number of rearrests	What was the subjects' number of rearrests after one-year follow-up?
Dependent Variable (2)	Program failure	The incidence of receiving revocation	Did the subjects receive revocation?
Dependent Variable (3)	Level of Compliance	Number of warning tickets for violations of probation	How many times did the subjects receive warning tickets?
Dependent Variable (4)	Time to recidiviate	Duration of desistance from crime	How many months elapsed before subjects committed crimes after completion of the program?
Independent Variable (1)	Program Types	Different types of verification (Type A, B = double) (Type C, D, and E = one-way)	Are types A and B more effective than types C, D, and E?
Independent Variable (2)	Duration of program	Different periods of the AVRS program (three months or less vs. more than three months)	Are longer periods of AVRS more effective than shorter periods of AVRS?

4.4 Statistical analysis

4.4.1 Propensity Score Matching

With PIIS data and official criminal history data, it is possible to obtain important information related to demographics, types of offenses, number of rearrests, rearrest dates, and crime history of AVRS and control groups. This study uses a descriptive and inferential statistical analysis in examining 508 youth offenders, 214 in the intervention group (AVRS) and 294 in the comparison group. To correct sampling bias between the two groups, the study adopts propensity score as a matching technique. The fundamental logic of the matching technique is that the probability of being placed on the intervention group is controlled (Imbens, 2000; Rosenbaum & Rubin, 1983). If it is possible to make two balanced groups on the basis of the probability scores, the analysis outcomes of the AVRS program's effectiveness are more valid.

In a pure experimental design, there would be an equal probability of being assigned to the AVRS program and the comparison group. However, judicial program assignment is not proper for random assignment. Thus, the AVRS subjects are different from the comparison subjects.

Luellen, Shadish, and Clark (2005) demonstrated that the results from quasi-experimental studies are obviously different from those of randomized experimental design. They suggested that propensity score matching is required in order to eliminate bias. The propensity score is an estimated probability that a subject can be placed in a specific treatment or intervention condition rather than in other conditions (Rosenbaum and Rubin, 1983). The predicted scores of backward logistic regression are employed as

the predicted odds of referral to the AVRS program. These simple probability values are regarded as "propensity scores" (Berk, 2004). This technique is beneficial to minimize the selection bias that results from the quasi-experimental design.

In order to predict the probability, the propensity score analysis employs all possible observed covariates. In this study, propensity scores will be expressed as an independent variable in the model estimating the effect of the AVRS program. Propensity scores make the model for predicting the effectiveness of the program simple enough to clarify and examine the key hypothesis. In other words, if the created propensity scores are included in the model as a predictor, there will be only two predictors (propensity score and the program participation) in an ultimate model for predicting the impact of the program (Berk, 2004).

The purpose of the propensity score analysis is to match two nonequivalent groups in order to estimate the direct effects of a specific intervention on which the two group samples differ. Propensity scores can be measured by using logistic regression, stratification, classification trees, or bagging for classification trees (Luellen et al., 2005). Among these techniques, logistic regression and stratification will be employed in this study since they are more common and representative methods for computing estimated propensity scores. There is evidence that subclassification based on five equal size strata can eliminate 90% of the bias (Jones, D'Agostino, Gondorf, & Heckert, 2004; Rosenbaum and Rubin, 1983). This study uses a stratification matching technique after calculating propensity scores in logistic regression (backward) as potential covariates which is most commonly used for balancing nonequivalent groups.

Since the AVRS program is designed to provide an increased level of contacts and supervision for high risk juvenile probationers, the covariates that indicate high risk can be factors in the judges' decision. Lullen, Shadish, and Clark (2005) said that potential covariates are key factors that might affect the likelihood of being selected for the treatment group. In this study, six high risk factors are used as potential covariates for calculating propensity scores: the number of prior convictions, the types of offenses, financial status, employment, gender, and age. These six predictors are known risk factors taken from previous studies of the effectiveness of the intensive supervision programs and electronic monitoring programs. All six risk factors are included in order to estimate propensity scores in this study even though some factors are not statistically significant covariates. The reason that all possible covariates are considered is that the statistical significance is not an essential requirement for estimating propensity scores, because it is a simple consequence substantially affected by sample size. Researchers should be careful not to consider only covariates that have significant differences between the intervention group and the comparison group (Lullen et al., 2005; Rubin & Tomas, 1992).

The next step for creating matching samples is to select subjects from the total number of participants who have the same propensity scores. A key issue here is missing data. If there is a variable that has numerous cases missing data, missing cases affect the estimates of the covariates. If the propensity scores resulting from incomplete data have a different distribution, the covariate will be treated very separately in estimates the missing values. Otherwise, the random missing cases can be simply omitted from the whole data set. When the SPSS package program is run with the random missing cases,

the program automatically deletes the missing cases from the full model, so the observed total cases may decline. This simple listwise deletion approach maintains estimated parameter power with the most unbiased data set. After the certain numbers of covariates are used to calculate propensity scores for all subjects, it is necessary to balance the nonequivalent groups by using the propensity scores. Lullen, Shadish, and Clark (2005) argued that "The idea is that people who have the same propensity score but who are in different experimental conditions are nonetheless comparable because the distributions of their covariates are in balance" (p. 532).

Finally, to validate the fact that the two nonequivalent groups are comparable, this study will use a two-way Analysis of Variance (ANOVA) based on stratification technique that Rosenbaum and Rubin (1983) recommended. The step is performed by a matched pair analysis for a subgroup of people who received the AVRS program matched one-to-one to juveniles who did not participate in the program. This final step is a statistical process by which a researcher can ensure the fact that the propensity scores are well balanced between the two groups. Rosenbaum and Rubin (1983) suggested that conducting a two-way ANOVA is the best way to examine the magnitude of the treatment group's main effect and any interaction effect.

In this study, if all six variables can be employed for estimating propensity scores, there will be fifteen combinations requiring a two-way ANOVA. If less than 5% of the tests of covariate balance are significant, the stratification on propensity score will be presumed to accomplish reasonable balance across groups on those covariates. This stratification technique is mainly based on the Rosenbaum and Rubin (1983) and Luellen, Shadish, and Clark (2005). After the propensity scores are created for all subjects, this

study assesses the magnitude of the balance achieved by the probability values. Rosenbaum and Rubin (1983) recommended that five subclasses (2X5 strata) are sufficient to reduce over 90% of the bias of each covariate. Hence, this study uses the subclassification strategy in order to minimize the bias and increase the group balance.

Based on Rosenbaum and Rubin's (1983) analysis, each of covariates will be subjected to a two-way ANOVA (2X5 factorial analysis). When a covariate is a continuous variable, such as number of prior conviction or age, a two-way ANOVA will be used. However, if a covariate is a categorical variable, such as gender or type of offenses, multinomial logistic regression will be employed to examine the balance accomplished by the original propensity scores. Although one single conditional probability variable makes the model more powerful, it does not necessarily indicate that the two groups are totally comparable. Propensity score is an aggregate indicator of the combined covariates. Therefore, the six variables' interactions and each variable's main effect should be included in the regression model. Stratification matching is used to test how the propensity scores are adequate to estimate the effect of the intervention group. Stratification matching is achieved by subclassifying the estimated propensity scores at the quintiles of the total distribution. The stratification is composed by five subclasses: minimum, lower quartile, median, upper quartile, and maximum groups.

4.4.2 Regression Analysis

The major analysis to assess the effectiveness of the AVRS program is to compare recidivism rates between the intervention group and the comparison group. Logistic regression analysis is employed to predict if the program participants would be

arrested one year after the completion of the program. The recidivism rate variable is recoded into a categorical variable to estimate the probability of committing crimes (yes=1, no=0). Where there is a dichotomous variable as a key dependent variable, this logistic regression analysis is appropriate because there is no need to follow the assumption of homoscedasticity. Logistic regression analysis can produce a regression equation that accurately assesses the probability of that specific factors affect the recidivism rates. In the model, risk factors and AVRS participation will be included as major predictors for the odds of recidivism, to see if program participation affects arrest rates controlling for risk and propensity.

Multiple regression analysis is conducted to find an association between relevant factors and number of rearrests. In multiple regression analysis, several variables are regressed onto the dependent variable. A standard regression model is composed of the sum of the products of weights and actual values on several predictor variables in order to predict the values on the criteria variable. The program-related factors and characteristic factors will be included in the model to find a predictor of the impact of the AVRS program on total number of arrests. This equation measures the actual components of AVRS, such as program duration and the level of phone call contacts.

4.4.3 Survival Analysis

One of the major statistical analyses in this study is to estimate the pace of recidivism. Survival analysis generally allows researchers to compare rates of recidivism over time. Survival analysis provides more precision than fixed-time interval analysis. A Cox proportional hazards model is used to estimate the time to rearrest of the juvenile

probationers. Although the survival analysis is beneficial to predict how soon a specific event will occur, there is an argument about which is the best model for the survival analysis (Gainey et al., 2000).

Following Allison's (1995) explanation, the proportional hazards model will be first assessed by inspecting the hazard rate across the AVRS program group and the comparison group. In using a proportional hazards model, problems resulting from right-censoring are taken into consideration carefully in this study. The proportional hazards model is supported by visual inspection.

In summary, the current research will use propensity scores in order to balance the comparison groups. A backward logistic regression method and stratification technique will be used for calculating propensity scores for all subjects and creating equivalent groups across time. Equation will be estimated both for any arrest and for the total number of arrests. The survival analysis will be employed for measuring the pace of recidivism.

Chapter 5 Data Analysis

5.1 Demographic Profile

Descriptive statistics (Table 7) show that the AVRS group and the comparison group are slightly different from each other in terms of their gender, age, the number of prior convictions, housing, employment, and types of offenses. The essential demographic profile also demonstrates that there are certain risk factors that youth court judges consider for referring juvenile offenders to the AVRS program.

Regarding gender, the proportion of males in the comparison group is a little higher than male offenders in the intervention group (86.1% > 80.8%). In terms of age, while most of the AVRS group is under 18, less than half of the comparison group is under 18 (AVRS=86.6%, comparison group=43.9%). The mean age of the AVRS group is 16.60, while the mean age of the comparison group is 17.10. Furthermore, both groups have large proportions of juveniles more than 16 years old (AVRS=60.2%, comparison group=78.6%). There were five juveniles who are 12 years old and three juveniles who were above 20 years old, and so the outliers are excluded from the analysis. Table 7 indicates that younger juveniles are more likely to be referred to the AVRS program than to regular probation supervision.

The number of prior convictions is one of the important factors in determining the risk level of offenders. The comparison group has a higher mean number of prior convictions, at 1.75, while the AVRS sample mean is 1.52. According to these basic descriptive statistics, youth court judges seem to have a tendency to refer the young

offenders with fewer prior offenses to the AVRS program. 45% of the AVRS group subjects do not have any prior convictions, compared to 37.4% of the comparison group.

Because the participants in this study are juvenile probationers under 20 years old, the type of housing can be one indication of the financial status of the juveniles' parents. Juveniles in the AVRS program are more financially disadvantaged than probationers in the regular probation supervision. The comparison group has a higher proportion of juveniles living in housing owned by a member of the household compared to the AVRS intervention group (46.6% and 23.8% respectively). Having owned a house is one crucial factor that reflects the financial stability of juveniles' parents. The proportion of long-term renters is also higher in the comparison group than in the AVRS group (25.1% and 14.0% respectively).

All subjects in this study are juvenile probationers under 20 years old, so their desirable employment status should focus on schooling rather than work, but should be one or the other. Juveniles in the AVRS program have a slightly lower unemployment rates than juveniles on regular probation (29.0% VS 33.3%). Unemployment implies that they are not students or employees. There are relatively more students in the AVRS intervention group than in the control group (64.0% VS 56.1%). Thus, the AVRS group has higher numbers of students and lower numbers of unemployed probationers than the comparison group does.

Furthermore, in both groups, property crime, specifically theft, represents a substantial proportion of offenses, even though the AVRS group has a higher proportion of property crime than the comparison group (54.2% VS 41.2%). In addition, the comparison group has a higher proportion of personal crime, such as robbery and

violence, than the AVRS group (48.3% VS 35.5%). From this perspective, offenders who are assigned to the AVRS program compared to those assigned to routine probation are more likely to be younger students who committed property crime, with parents who have financial difficulties.

Table 7. Characteristics of Samples

Variable		AVRS (N=214)		Comparison (N=294)	
		Frequency	**Percent**	**Frequency**	**Percent**
Gender	Male	173	80.8	253	86.1
	Female	41	19.2	41	13.9
	Missing	0	0	0	0
Age	12	2	0.9	3	1.0
	13	13	6.1	8	2.7
	14	35	16.4	15	5.1
	15	32	15.0	34	11.6
	16	0	0	0	0
	17	29	13.6	72	24.5
	18	76	35.5	136	46.3
	19	19	8.9	25	8.5
	20	5	2.3	1	0.3
	21	0	0	0	0
	22	2	0.9	0	0
	23	1	0.5	0	0
	Missing	0	0	0	0
	Mean	16.60		17.10	
Number of prior convictions	0	98	45.8	110	37.4
	1	41	19.2	68	23.1
	2	28	13.1	46	15.6
	3	19	8.9	19	6.5
	4	10	4.7	23	7.8
	Missing	0	0	0	0
	Mean	1.52		1.75	

Variable		AVRS (N=214)		Comparison (N=294)	
		Frequency	**Percent**	**Frequency**	**Percent**
Housing	Short term rent	53	24.8	71	28.3
	Long term rent	30	14.0	63	25.1
	Owned house	51	23.8	117	46.6
	Missing	80	37.4	43	14.6
Employment	No employment	62	29.0	98	33.3
	Student	137	64.0	165	56.1
	Missing	15	7.0	31	10.5
Current types of offenses	Property crime	116	54.2	121	41.2
	Personal crime	76	35.5	142	48.3
	Traffic law violation	18	8.4	23	7.8
	Missing	4	1.9	8	2.7

5.2 Differences between the AVRS Group and Comparison Group

5.2.1 Recidivism Rates

The basic descriptive statistics and simple comparison of the rearrest data show that the AVRS subjects are more likely than the comparison subjects to receive warning tickets, and have revocation one year after the completion of their sentence.

Table 8 shows that more than half of the participants in both groups are not arrested one year after the completion of their sentence (either the AVRS program or regular probation) (AVRS = 59.3%, comparison = 56.1%). However, 40.7% of the AVRS group is rearrested after the one-year follow-up period, while 43.9% of the comparison group is rearrested in the same period[5]. In addition, the majority of the AVRS subjects have received more than one warning ticket for violating the probation conditions, while 80% of the comparison group subjects do not have any warning tickets from probation officers. Finally, the AVRS group has a higher proportion of probation revocation than the comparison group (10.3% > 4.1%). The basic descriptive statistics and simple comparison of the rearrest data show that the AVRS subjects are more likely than the comparison subjects to arrest, receive warning tickets, and have revocation one year after the completion of their sentence. In order to investigate the factors that judges took into consideration when they determined the AVRS program assignment, logistic regression will be conducted. After finding the crucial predictors that affect the decision for the AVRS program

[5] There was an extreme outlier in the number of rearrest (44 times). Since this outlier may be due to erroneous data input processes, the case was eliminated from the dataset.

referral, a matching strategy based on propensity score will be used in order to control the risk factors between the AVRS group and the comparison group.

Table 8. Recidivism Rates between the AVRS Group and Comparison Group

Variable	Category	AVRS (N=214)		Comparison (N=294)	
		Frequency	**Percent**	**Frequency**	**Percent**
Number of rearrests	0	127	59.3	165	56.1
	1	45	21.0	67	22.8
	2	24	11.2	28	9.5
	3	10	4.7	12	4.1
	More than 4	8	3.8	22	7.4
Rearrest (dichotomous)	No	127	59.3	165	56.1
	Yes	87	40.7	129	43.9
Revocation (dichotomous)	No	192	89.7	282	95.9
	Yes	22	10.3	12	4.1
Number of warning tickets	0	-	-	237	80.6
	1	113	52.8	32	10.9
	2	37	17.3	14	4.8
	3	1	0.5	6	2.0
	4	24	11.2	1	0.3
	5	17	7.9	1	0.3
	6	10	4.7	2	0.7
	7	6	2.8	1	0.3

5.2.2 Factors that Affect the Decision of Referral to the AVRS Program

This study uses logistic regression analysis in order to investigate the factors that youth court judges might take into account when they refer young offenders to the AVRS program. Although descriptive statistics show that the AVRS group and the comparison group are composed differently in terms of their risk factors, it is necessary to examine the specific predictors that the judges truly consider when they determine the assignment of youth to the AVRS program. In the risk factor model (Table 9), six potential risk factors (age, gender, number of prior convictions, types of crime, housing and student status) are employed for predicting the likelihood of being referred to the AVRS program.

After investigating the risk factors that judges take into account when they refer juvenile offenders to the AVRS program, this study estimates propensity scores toward all subjects in order to balance the covariates between the AVRS group and the comparison group. Table 9 shows that the model predicting determination of the AVRS assignment is statistically significant (χ^2 (8)=15.622, p<.01). This model includes age, gender, number of prior convictions, types of offenses, housing and student status to predict the odds of being assigned to the AVRS program. The model for explaining the referral-related factors is created with the six variables as follow:

$$\text{Logit}(p) = \beta 0 + \beta 1(\text{age}) + \beta 2(\text{gender}) + \beta 3(\text{number of prior convictions}) + \beta 4(\text{types of offense}) + \beta 5(\text{housing}) + \beta 6(\text{student status}).$$

Among these predictors, only two variables, prior convictions and housing, are found to be statistically significant to predict the likelihood of being referred to the AVRS program after controlling for all the other variables in the model. On average, the odds of being assigned to the AVRS program for juveniles who committed personal crimes, such as violence or robbery, are approximately 42% lower than for juveniles who committed property crimes (Exp(B)=.581). In other words, the juveniles who committed property crimes, such as theft, are more likely to be assigned to the AVRS program than those who committed personal crimes.

The odds of being referred to the program are 45.2% less for juveniles who live in home-owned housing than for juveniles in short term rental housing after controlling for the other variables in the model (Exp(B)=0.548). In Korea, short term rental housing indicates accommodations that are relatively cheaper than long term rental housing and are paid for every month without a deposit fee. In contrast, long term rental housing requires the entire deposit and all rental fees to be paid at the beginning of the contract. Thus, living in long term rental housing indicates that the juveniles' parents are financially stable and can afford to pay one year's rental fee upfront.

Table 9. Risk Factors to Affect the Decision of AVRS Referral

			Program Referral	
Variable	**B**	**S.E**	**Sig.**	**Exp(p)**
Age	-.097	.069	.160	.908
Gender	.524	.323	.105	1.689
Number of Prior Conviction	.023	.057	.684	1.024
Personal Crime	-.544	.250	.030*	.581
Traffic Violation	.182	.428	.671	1.199
House (Long term renter)	-.449	.309	.146	.638
House (Owned housing)	-.602	.267	.024*	.548
Student status	.142	.260	.583	1.153
Constant	1.398	1.203	.245	4.045
R Square	0.044 (Cox & Snell R Square), 0.061 (Nagelkerke R Square)			
Chi-Square	15.622, p=0.048, df=8			

■ Reference group: male, property crime, short term renter

5.3 Effectiveness of the AVRS Program

5.3.1 Propensity Score

The main purpose of a propensity score is to estimate the conditional probabilities of being assigned the AVRS program, considering all potential risk factors in the AVRS group and the comparison group, using backward logistic regression. In order to control for the risk factors, the propensity scores are calculated for all subjects based on the covariates (age, gender, number of prior convictions, housing, types of crime, and student status). Rosenbaum and Rubin (1983) introduced the equation of propensity score and emphasized the sampling distribution of program referral by assuming the conditional probability of being assigned to a specific intervention group, ($e(x) = \text{pr}(z=1 \mid x)$).

$$\text{pr}(z_1,z_2,z_3\ldots,z_n \mid x_1,x_2,x_3\ldots,x_n) = \prod e(x_i)^{zi}[1-e(x_i)]^{1-zi}.$$

Although only two factors (types of offenses and housing) are statistically significant factors, this study retains all six variables for estimating propensity scores in order to create a model with stronger explanation power. This method adheres to Rosenbaums's (2002) warning against omitting covariates. Since the significance test is primarily associated with the sample size rather than the probability of being placed in a specific condition, all possible covariates should be included in the model to estimate propensity scores (Luellen et al., 2005).

In the housing status variable, it appears that cases have random missing data, so this variable will be included in the model. When a dichotomous variable regarding the

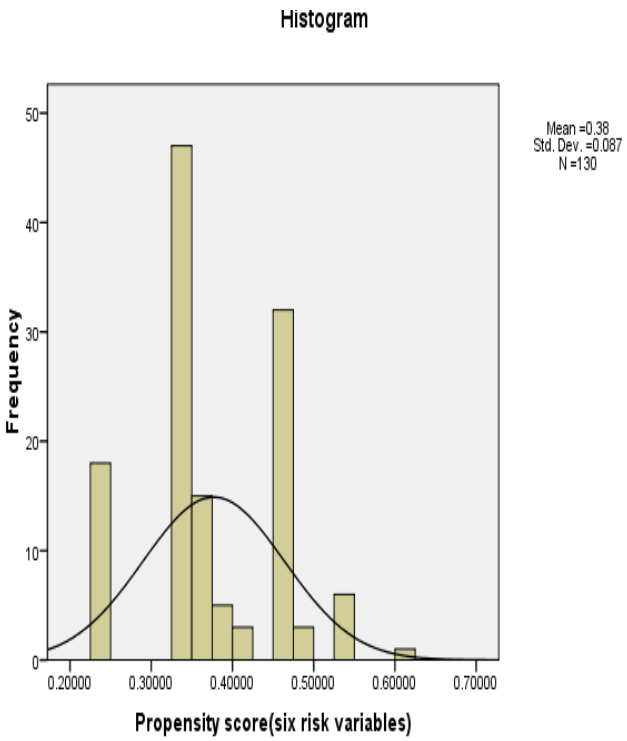
housing status (0=missing, 1=answered) is created to examine the nature of the missing cases, the result shows that there are no systematic patterns between the dichotomous variable and other variables[6]. Therefore, the cases with missing values in housing variable will be automatically excluded from the model in estimating propensity scores. In summary, six variables are used to estimate propensity scores: age, gender, number of prior convictions, type of offenses, housing and student status.

The range of the propensity scores is between 0.02 and 0.60. Among the 508 total sample subjects, 130 participants of the AVRS group and 245 participants of the comparison group are selected from the original samples. The two histograms (Figure 4) show that the propensity scores in the AVRS group and comparison group are similar to each other in terms of mean and standard deviation (AVRS mean=0.41, SD=0.11, comparison=0.46, SD=0.11).

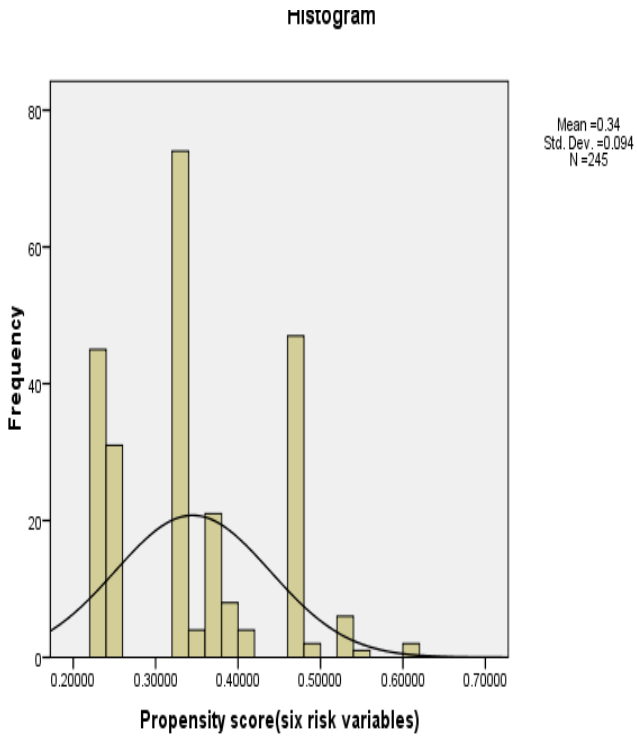
[6] When the housing variable was omitted, there were three significant factors (age, gender, and property crime) affecting the decision of referral ($\underline{x}^2(6)=26.519$, $p<0.01$). Since the missing cases were included in the model, the sample size was increased and the power of effect size was also increased. However, when ANOVA was used for comparing group difference of the two propensity scores over the AVRS group and the comparison group, the six covariates model had a smaller F ratio compared to the five covariates model ($F=10.328<22.602$). Thus, the propensity score based on six covariates made the AVRS group and the comparison group more equivalent.

Figure 4. Propensity Histograms of Two Groups

AVRS (N= 130)



Comparison (N=245)



- AVRS : N=130, Skewness=.105, Kurtosis=-.614
- Comparison Group: N=245, Skewness=.369, Kurtosis=-.764

5.3.2 The Odds of Rearrest

In this study, propensity scores are employed as an independent variable in the model estimating the effect of the AVRS program. The other independent variable, the AVRS program, tests whether there is an effect on recidivism of being assigned to that program, controlling for propensity score. When the propensity scores are included in the model as a predictor, the explanatory power for analysis increases so that the ultimate model for predicting the impact of the program is more reliable (Berk, 2004). Since there are only two independent variables in the model, the explanatory power is maximized, which can be an advantage of using the propensity scores.

Table 10 shows that the model predicting the probability of committing offenses is statistically significant ((χ^2 (2)=8.382, df=2, p<.01). The model explains approximately 3.0% of the variance of rearrest (Nagelkerke R Square is 0.030). In addition, the model correctly estimates 55.5% of the predicted values of rearrest after the one-year follow-up. This model includes only two variables: the propensity score and the AVRS sample (0=comparison, 1=AVRS). The logistic regression equation is utilized with the two explanatory variables.

$$\text{Logit}(p) = \beta 0 + \beta 1(\text{propensity score}) + \beta 2(\text{AVRS}).$$

Table 10 shows that on average, the odds of committing offenses after the one-year follow-up period are 25.5 times higher each time there is a one unit increase in the propensity score variable, given the AVRS program participation variable is held constant (Exp(B)=25.545). More importantly, the AVRS program is not statistically

significant in the model for predicting rearrest probability, while only the propensity score is a statistically significant factor for predicting the odds of committing crimes after a one-year follow-up period. This outcome demonstrates that the AVRS program does not significantly affect the odds of recidivism.

Table 10. Effectiveness of AVRS (Odds of Rearrest)

			Program Referral	
Variable	**B**	**S.E**	**Sig.**	**Exp(p)**
Propensity Score	3.240	1.160	.005*	25.545
AVRS sample	-.245	.225	.276	.783
(Constant)	-1.293	.422	.002	.275
R Square	0.022 (Cox & Snell R Square), 0.030 (Nagelkerke R Square)			
Chi-Square	8.382, p=0.015, df=2			

■ Reference group for AVRS sample is comparison group (0=comparison, 1=AVRS)

Although the AVRS program participation is not a statistically significant factor, it is useful to examine the influential risk factors, particularly characteristic elements in order to suggest better selection standards for the AVRS program referral. Table 11 shows that age, gender, number or prior convictions and type of offenses are all statistically significant predictors, while the AVRS program experience remains non-significant.

Logit(p) = $\beta 0$ + $\beta 1$(age) + $\beta 2$(gender) + $\beta 3$(number of prior convictions) + $\beta 4$(types of offense) + $\beta 5$(housing status) + $\beta 6$(student status) + $\beta 7$(AVRS).

Table 11. Predictors for Recidivism Rates

			Program Referral	
Variable	**B**	**S.E**	**Sig.**	**Exp(p)**
Age	-.197	.073	.007*	.821
Gender	-.911	.260	.013*	.402
Number of Prior Conviction	.247	.064	.000*	1.281
Personal Crime	-.814	.250	.001*	.443
Traffic Violation Crime	-.130	.459	.776	.878
Long Term Housing	-.403	.318	.204	.668
Owned Housing	-.217	.277	.433	.805
Student Status	-.483	.263	.067	.617
AVRS	-.333	.252	.185	.716
(Constant)	3.840	1.293	.003	46.548
R Square	0.153 (Cox & Snell R Square), 0.205 (Nagelkerke R Square)			
Chi-Square	57.549, p=0.000, df=9			

■ Reference groups: male, property crime, short term housing, non-students, and comparison group

First, the full model predicting the probability of committing a offense is statistically significant ((χ^2 (9)=57.549 df=9, p<.01). Second, the model explains approximately 20.5% of the variance of rearrest (Nagelkerke R Square is .205). Third, the model correctly estimates 66.8% of the predicted values of rearrest after the one-year follow-up. Finally, this model shows that age, gender, number of prior convictions, and type of offense are statistically significant factors to predict the likelihood of recidivism one year after the completion of the program (or regular probation) when other factors are controlled. The AVRS program participation is not a significant predictor in impacting the odds of recidivism, which is the same result as the previous short-version model (Table 10 and Table 11).

The logistic regression analysis shows that on average, the odds of committing offenses for juveniles are 17.9% less each time there is a one unit increase in the age variable, given other factors are held constant (Exp(B)=0.821). In other words, younger juveniles are more likely to commit new crimes than older juveniles. In addition, the data show that on average, the probability of committing crimes is 59.8% lower in female juveniles than male juveniles (Exp(B)=0.402).

Regarding the number of the previous criminal records, Table 11 shows that on average, for juveniles, the odds of committing offenses are approximately 1.3 times higher when there is a one unit increase in the number of prior convictions, given other variables are held constant (Exp(B)=1.281). In this context, the prior criminal history is a crucial element that affects the likelihood of recidivism.

In terms of type of crime, the probability of committing crimes is 55.7% lower in juveniles who committed personal crime (violence) than in juveniles charged with property crime (theft), given other factors are held constant (Exp(B)=0.443).

5.3.3 The Odds of Revocation

Table 12 shows that the model predicting the probability of revocation while subjects are in AVRS or regular probation is statistically significant ((χ^2 (2)=7.881, df=2, p<.01). This model includes two independent variables: the propensity score and the AVRS sample (0=comparison, 1=AVR), and it explains approximately 5.8% of the variance of revocation (Nagelkerke R Square is 0.058). The model correctly predicts 94.1% of the revocation rate during the AVRS program or the regular probation period. The revocation indicates youth court judges' decisions regarding probation termination because of repeated and serious violations of probation conditions or regulations.

$$\text{Logit}(p) = \beta 0 + \beta 1(\text{propensity score}) + \beta 2(\text{AVRS}).$$

The logistic regression analysis shows that on average, the odds of receiving revocation after the one-year follow-up period are about 2.6 times higher in the AVRS group than the comparison group after controlling the propensity scores (Exp(B)=2.642). The propensity scores are not statistically significant in the model predicting probation withdrawal, while only the AVRS sample is a statistically significant factor predicting the odds of revocation. This outcome demonstrates that when the risk factors are controlled,

the AVRS program increases the number of regulations and negatively affects the juveniles increasing the likelihoods that they will violate the probation conditions and, as a consequence, be sent to institutions due to violation of the conditions.

Table 12. Effectiveness of AVRS (Odds of Revocation)

			Program Referral	
Variable	**B**	**S.E**	**Sig.**	**Exp(p)**
Propensity Score	3.518	2.441	.150	33.703
AVRS sample	.972	.453	.032*	2.642
(Constant)	-4.532	.976	.000	.011
R Square	0.021 (Cox & Snell R Square), 0.058 (Nagelkerke R Square)			
Chi-Square	7.881, p=0.019, df=2			

■ Reference group for AVRS sample is comparison group (0=comparison, 1=AVRS)

5.3.4 The Number of Warning Tickets

To measure the effectiveness of the AVRS program, the number of warning tickets is also used as a dependent variable in this study. Warning tickets are generally given when there are minor violations of the probation or the AVRS program conditions occurred. Since the warning ticket variable is recorded as a continuous variable, regression analysis is conducted to predict the number of warning tickets that juvenile probationers might receive from probation officers by using propensity scores. The model is created with the two explanatory variables as follow:

Outcome measure = $\beta 0$ + $\beta 1$(propensity score) + $\beta 2$(AVRS).

The significant level for R is found in ANOVA test with F(2, 372)=104.614, p<0.05 in Table 13. The variability in the number of warning tickets (36.6%) is predicted by these two independent variables, propensity score and AVRS (adjusted R square is 0.360). On average, the AVRS group is about 2.1 times higher in the number of warning tickets than the comparison group (B=2.138, Beta=0.570, p=0.000). Also, the propensity score is a statistically significant variable for predicting the number of warning tickets (B=2.208, Beta=.115, p=0.007).

Table 13. Regression Analysis of the Number of Warning Tickets

Variable	**B**	**S.E**	**T**	**Program Referral Sig.**	**Beta**
Propensity Score	2.208	.809	2.729	.007*	.115
AVRS sample	2.138	.158	13.564	.000*	.570
(Constant)	.278	.276	1.008	.314	
R Square	0.360 (R square), 0.357 (Adjusted R Square)				
ANOVA	F(2, 372)=104.614, p=0.000				

■ Reference group for AVRS sample is comparison group (0=comparison, 1=AVRS)

5.4 Survival Analysis for the Prediction of Recidivism

5.4.1 Stratification on the Propensity Score

It is helpful to use stratification to make matched samples more comparable. In this study, the five equal–sized strata are created for all subjects on the propensity scores. This 2X5 stratification technique is the conventional method suggested by Rosenbaum and Rubin (1983) to reduce the bias of group difference by more than 90%.

Each subject is classified into five different groups and the groups have roughly equal sample size (Table 14): 56 (17.9%) to the first group, 56 (17.9%) to the second group, 45(14.4%) to the third group, 77(24.7%) to the fourth group, 78 (25.0%) to the fifth group. The points for the five subclasses consist of minimum, lower quartile, median, upper quartile, and maximum of the propensity score distribution. Groups with higher propensity scores are more likely to have a higher number of rearrests.

Table 14. Five Subclassification on the Propensity Score

	Frequency	Percent (Valid)	Cumulative	Rearrest Mean
Subgroup 1	56	17.9	17.9	.70
Subgroup 2	56	17.9	35.9	.38
Subgroup 3	45	14.4	50.3	.96
Subgroup 4	77	24.7	75.0	1.56
Subgroup 5	78	25.0	100.0	1.49
Total	312	100.0		1.09

Table 15 presents the number and percentage of rearrests over each of five subclasses for the AVRS group and the comparison group. In group 1, 2, and 5, the AVRS group has a smaller percentage of rearrests compared to the comparison group. However, in group 3 and 4, the AVRS group has a larger proportion of rearrests than the comparison group. When the mean number of rearrests is compared between the AVRS groups and comparison groups, in general, except group 5, the AVRS group has a smaller mean of rearrests than the comparison group. Thus, the AVRS group participants are basically less likely to commit crime than the comparison group participants when the means of rearrests are compared.

Table 15. Five Subclasses and Number of Rearrests

	Groups	N	Rearrest (%)	Mean
Group 1	Comparison	45	16 (35.6)	.78
	AVRS	11	3 (27.3)	.36
Group 2	Comparison	43	12 (27.9)	.49
	AVRS	13	0 (0.0)	.00
Group 3	Comparison	27	9 (33.3)	.96
	AVRS	18	9 (50.0)	.94
Group 4	Comparison	45	27 (60.0)	1.78
	AVRS	32	20 (62.5)	1.25
Group 5	Comparison	46	25 (54.3)	1.07
	AVRS	32	15 (46.9)	2.09

- Rearrest is the number of total arrests.
- Mean is the average score of the number of arrests in each group.

In order to understand the significance of the classification in covariates across the subclasses, additional statistical tests are conducted; 2X5 ANOVA is used for continuous variables and multinominal regression analysis for categorical variables. If the subclasses are statistically insignificant in their covariates, the results may indicate that the propensity score model is appropriate and the data are reasonably balanced within the five subclasses. For the age, the AVRS sample and the five subclasses have no statistical significance in their main effect and interaction effect. In addition, F ratio of age in group

difference is reduced after creating five subgroups.[7] More importantly, the factorial analysis and box plots for age show that the propensity score across the subgroups increases the balance between the two groups (Appendix A). Furthermore, the two groups are comparable in terms of their prior criminal histories since there is nothing significant in both the main effect and the interaction effect (Appendix B).

For the categorical covariates, such as gender, type of offense, housing, and student status, multinominal regression analysis is employed to see if the two groups are well matched in terms of those covariates across the five subclasses. The balance of categorical variables generally appears to be equivalent over the five subclasses. After stratifying on the propensity score at the quartile of the distribution, three variables (gender, type of offense, and housing) seem to be reasonably balanced in their propensity models because there are no statistical differences between the AVRS group and the comparison group in terms of both main effect and interaction effect (Appendix C).

However, only the student status variable involves statistical significance when the multinominal regression is used. Specifically, in group 1 and group 2, statistically significant differences are found in student status, comparing AVRS to non-AVRS (respectively p=.000, p=.042). In addition, there is a statistical interaction effect between AVRS and group 2 in the model for the difference of student status (p=.006) (Appendix D). Out of the total of 40 tests of six covariates for main effect, two tests are statistically significant (student status in subgroup 1 and subgroup 2). One test out of 24 tests is significant for the interaction effect (AVRS*subgroup 2 in student status). Thus, only

[7] When ANOVA is used to compare mean difference between two groups, there is statistical significance in the age variable F(1, 506)=9.426, p=0.002. When the 2X5 factorial analysis for age is conducted, there is no statistical significance and the F ratio for the main effect substantially decreased (F=2.701).

three significant results out of 64 tests of covariates represent 4.68% (0.05) in the statistical significance level. The propensity score model can make a reasonable assumption about the comparability of the two groups when there is less than 5% statistical significance. By convention, if the proportion is less than 5%, there is a statistical significance. Therefore, the four categorical variables seem to be marginally comparable between the AVRS group and the comparison group across the five subgroups.

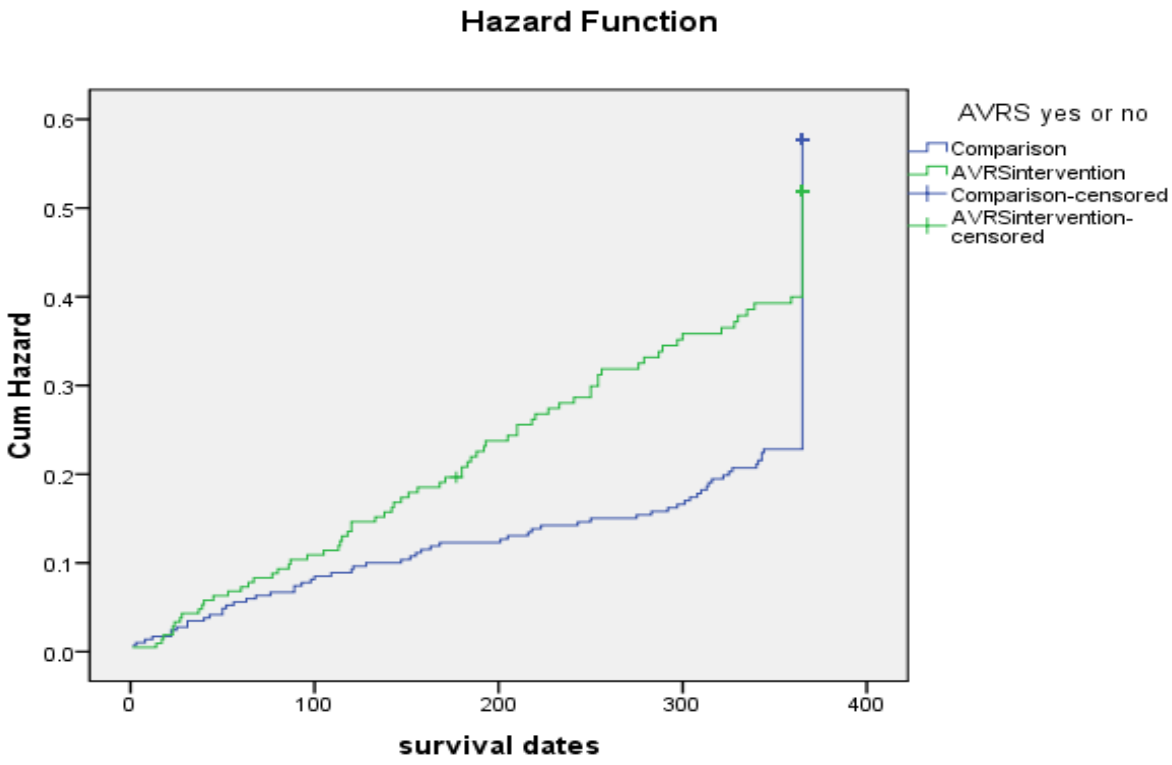
In summary, the continuous variables and categorical variables are reasonably equivalent across the five subgroups when the equal-size five strata technique is employed. Thus, stratifying on propensity scores establishes stable comparability on the six explanatory covariates. With these five subgroups, the survival analysis will be conducted in order to predict the duration of crime desistance comparing the AVRS group and the comparison group in the following section.

5.4.2. Survival Analysis

Kaplan-Meier estimation and Cox proportional hazard models are employed to investigate the impact of the AVRS program during the first year. Kaplan-Meier survival analysis is used to compare the survival curves of the two groups emphasizing a specific time that events occur, while Cox-regression analysis is helpful to examine the impact of particular potential covariates on the survival curves. The balanced five subclasses are used to estimate the effectiveness of the AVRS program in terms of the duration of crime desistance.

The cumulative hazard rate function from the Kaplan-Meier plot is shown in Figure 5. This hazard rate indicates the probability of rearrest (failure rate) at a specific time. The shape of the cumulative hazard function indicates that the juvenile's recidivism rates have a tendency to keep increasing after the completion of the sentence in both AVRS and comparison groups.

Figure 5. General Hazard Rate for Recidivism



Generally, the AVRS group (N=127, 59.6%) has a slightly higher percentage of total subjects who are censored for 365 days than the comparison group (N=165, 56.1%). In other words, the AVRS group has a higher number of juveniles who did not commit new crimes. However, when the AVRS group and the comparison group are compared in terms of their time to recidivism, the AVRS group has a shorter survival time than the comparison group (283.6 < 315.1). More importantly, although the failure rates are similar between the two groups (AVRS or regular probation), the AVRS group subjects dramatically increase the failure rate approximately 100 days after the completion of the program (Figure 5). This indicates that the juveniles in the AVRS group commit crimes sooner than the juveniles in the comparison group after approximately 100 days from the completion of the sentence. As soon as the intensive supervision by AVRS disappears, the juveniles get arrested at a higher rate, than juveniles in regular probation.

The AVRS group has a lower percentage of failure rates than the comparison group (AVRS: N=86 (40.4%) comparison: N=129 (43.9%)). However, the outcome of the log rank (Mantel-Cox) test shows that the estimated survival probabilities do not statistically differ between the two groups for a one-year follow-up period (log rank x^2=.080, p=.778). This outcome implies that the AVRS program may not effectively function in delaying the occurrence of recidivism.

Moreover, when all five subgroups are examined in terms of their hazard function, the outcomes of group 1, group 3, and group 5 are quite similar with Figure 5 (Appendix E). Although group 3 shows extremely different results due to the absence of rearrest in the AVRS group, the other subgroups are identical with the general hazard rate for recidivism. Thus, the cumulative hazard functions indicate that the discrepancy of the

failure rates between the AVRS group and the comparison group begins from the 100 day point.

Since the general hazard function based on Kaplan-Meier estimation does not control individual risk factors, the effectiveness of the AVRS program cannot be fully explained by the general hazard function. Cox-regression analysis is used to account for the individual differences in terms of the amount of passed time before committing a crime within one year after the completion of the sentence in the following section.

The Cox-regression analysis shows that the model for time to recidivism is statistically significant (Table 16). In this study, the Cox-regression analysis is established by two model-building processes. First, six independent variables are used as covariates in a forward stepwise algorithm method (Forward: LR). Second, the simple enter method is used by adding the AVRS group variable (0: comparison, 1: AVRS). When the step is to add the variable, the significance of the change is less than 0.05 (Appendix E).

Table 16. Coefficients for Recidivism (Cox-Regression)

Variable	B	S.E	Program Referral Sig.	Exp(p)
AVRS Sample	-.051	.175	.769	.950
Age	-.101	.046	.027*	.904
Gender	-.603	.284	.034*	.547
Number of Prior Conviction	.162	.034	.000*	1.176
Type of Crime (Personal Crime)	-.563	.180	.002*	.569
Type of Crime (Traffic Violation)	-.192	.284	.499	.825
-2 Log Likelihood	1707.820			
Overall Score	x^2=53.654, df=6, p=0.000			
Change from Previous Block	x^2=0.087, df=1, p=0.769			

■ Reference group for AVRS sample is comparison group (0=comparison, 1=AVRS)
■ Reference group: Gender (male), Type of Crime (property crime)

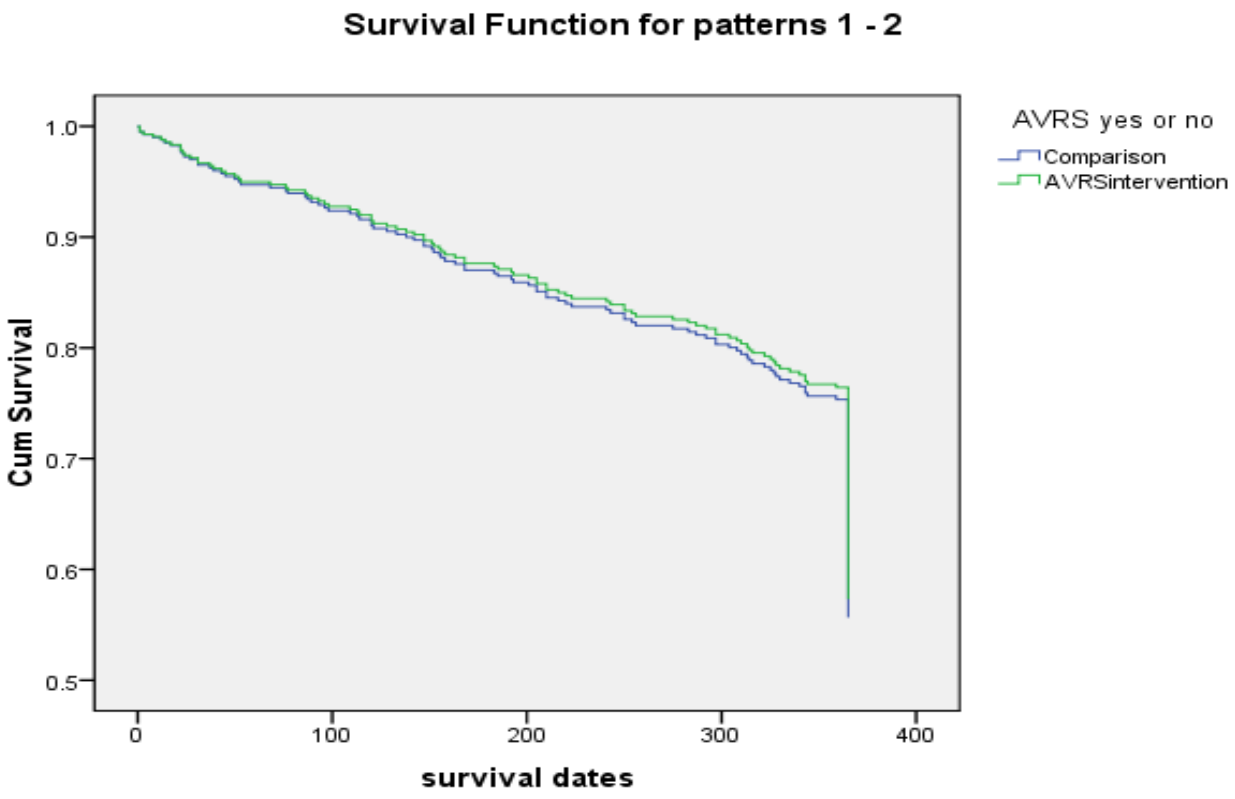
The results in Table 16 show that the AVRS program variable does not contribute to the survival time model (x^2=0.087, df=1, p=.769). In order to examine the effect of the AVRS program on time desisted from crime (or censored events), all six potential risk factors are included in the model. The results of the analysis, illustrated in Table 16, indicate there are only four statistically significant predictors that impact the time before committing a crime. The four crucial variables are age, gender, number of prior convictions, and personal crime.

In the age variable, the value of 0.904 (Exp(B)) means that every time one unit of age increases, the recidivism hazard for juveniles is reduced by 9.6%. The recidivism hazard for female juveniles is reduced by 45.3% (Exp(B)=0.547). In addition, the value of 1.176 for the number of prior convictions indicates that the recidivism hazard is 1.176 times higher each time one unit of the number of prior convictions increases. Regarding the type of offense, the recidivism hazard for juveniles who committed personal crimes is reduced by 43.1% less than juveniles who committed property crimes (Exp(B)=.569). As stated above, the hazard model for recidivism shows that AVRS is not a statistically significant factor to affect the time to commit crime.

In order to understand the relationship between the hazard and the survival, the cumulative survival plot is displayed visually (Figure 6). The value of the survival function points out the probability that the given event has not occurred in a year.

The Figure 6 shows that the survival curves both the AVRS group and the comparison group drop throughout the year. The shapes of the curve overlapped when covariates are controlled in the analysis. Thus, it is unclear how much the AVRS program is effective in delaying recidivism. However, when the plot of the survival curve is carefully examined, the AVRS group has a slightly higher survival curve than the comparison group 100 days after completing the program. This means that the comparison group has a shorter time to first arrest compared to the AVRS group. Nonetheless, the AVRS group and the comparison group are essentially similar when covariates are controlled, so we may not affirm the effectiveness of the AVRS program.

Figure 6. Survival Function for Recidivism



5.5 Impact of the AVRS Program-Related Factors

5.5.1 Descriptive Statistics of Program-Related Factors

Table 17 shows that more than 84% of the AVRS group subjects receive Type C. Since there are only 33 subjects receiving Types A, B, D, E, and F, the cell sizes of each type are too small to find group differences. In order to maximize the explanatory power of the sample size, those five different types of the AVRS program are combined into one variable, “Others.”.

When Type C and other types are compared in terms of rearrest rates, Type C has a higher proportion of rearrests than other types (43.5% VS 30.3%). It seems that at the pilot project period, youth court judges primarily relied on Type C, instead of using various types of the program, due to lack of knowledge of and confidence in the program. Regarding duration of the AVRS program, more than 71% of the subjects are sentenced to more than six-month periods. The group involved in the longer duration of the AVRS program has a slightly higher percentage of rearrest rates than those involved in the shorter duration of the program (41.1% VS 37.5%).

Table 17. Types and Duration of the AVRS program

	Category	N	Percentage	Rearrest (%)
AVRS Type	Type C	181	84.6	77 (42.5)
	Others	33	15.4	10 (30.3)
	Total	214	100	87 (40.7)
AVRS Duration	3 Months	56	28.4	21 (37.5)
	6 Months	141	71.6	58 (41.1)
	Total	197	100.0	79 (40.1)

■ Rearrest is the number of total arrests.

5.5.2 Predictors of the AVRS Group Recidivism

To investigate the impact of the program dosage factors, logistic regression analysis is conducted by including five potential predictors and two program-related factors. The effectiveness of the program in the recidivism rates might be related to the individual factors, such as age, gender, prior criminal history, type of offense, and student status. Also, the effectiveness might be associated with program factors, such as program duration and type of the AVRS program. Therefore, the model for predicting the probability of recidivism includes all of these aspects. In this model, the housing status variable is excluded since there are 100 missing cases of that variable, enough to negatively impact the explanatory power of the model.

$$\text{Logit}(p) = \beta 0 + \beta 1(\text{age}) + \beta 2(\text{gender}) + \beta 3(\text{number of prior convictions}) + \beta 4(\text{types of offense}) + \beta 5(\text{student status}) + \beta 6(\text{AVRS type}) + \beta 7(\text{AVRS duration}).$$

Table 18 indicates that the model is statistically significant (χ^2 (8)=18.777 df=8, p<.01). The model explains approximately 13.1% of the variance of revocation (Nagelkerke R Square is 0.131). Furthermore, the model correctly predicts 67.8% of the rearrest rates after a one-year follow-up period. This model includes a total of seven independent variables: age, gender, the number of prior convictions, type of crime, student status, type of AVRS, and duration of AVRS. Among those predictors, only type of AVRS variable is statistically significant in affecting the odds of rearrest. The logistic regression analysis shows that on average, the odds of committing crime after the one-year follow-up period are 3.433 times higher in the Type C program than other types (Exp(B)=3.433) after controlling the propensity scores, which imply the risk factors that affect the decision of program referral. This result shows that when individual characteristic factors are accounted for, the AVRS program dosage factor (program type) is a statistically significant predictor that affects the effectiveness of the AVRS program.

Table 18. Logistic Regression of the Recidivism

			Program Referral	
Variable	**B**	**S.E**	**Sig.**	**Exp(p)**
Age	-.032	.082	.698	.969
Gender	-.822	.451	.068	.440
Number of Prior Conviction	.079	.090	.382	1.082
Personal Crime	-.519	.357	.146	.595
Traffic Violation	-.125	.625	.842	.883
Student Status	-.584	.373	.118	.558
AVRS Type (C type)	1.233	.589	.036*	3.433
AVRS Duration (Six months)	.121	.371	.745	1.128
Constant	-.386	1.579	.807	.680
-2Log likelihood	228.932			
R Square	0.098 (Cox & Snell R Square), 0.131 (Nagelkerke R Square)			
Chi-Square	18.777, p=0.016, df=8			
N (Included=183)	N (Missing=31)			

■ Reference group: Gender (male), Student status (non-students)

Chapter 6 Discussion and Policy Implications

Although the AVRS program in Korea has been in effect for more than four years, the effectiveness of the program has not yet been fully tested. This study uses propensity scores and the stratification technique in order to assess the effectiveness of the AVRS program, controlling for potential risk factors. No prior AVRS evaluation studies have used matched samples or equivalent groups. In the following sections, the five research questions of the current study will be answered.

Question 1. Do the data show that the AVRS program reduces recidivism (or violation of program conditions) during a one-year follow-up period?

First, the current study data suggest that 40.7 percent of the AVRS group is rearrested after the one-year follow-up period, while 43.9 percent of the comparison group is rearrested in the same period. The AVRS program is not a statistically significant factor in affecting the probability of rearrest. Although six potential covariates were controlled by creating propensity scores, the result of the logistic regression showed that the AVRS program was not a significant predictor of the odds of recidivism for the one-year follow-up period. This result is consistent with other research findings, which show that intensive supervision and EM do not have any relationship to criminal recidivism rates (Bonta et al., 2000a; Courtright et al., 1997; Renzema & Mayo-Wilson, 2005).

Second, the AVRS group has a higher proportion of probation revocation than the comparison group (10.3% > 4.1%). This study shows that the AVRS program is a

statistically significant factor in increasing the likelihood of receiving revocation. The odds of receiving revocation after the one-year follow-up period are about 2.6 times higher in the AVRS group than the comparison group after controlling the propensity scores (Exp(B)=2.642). The propensity scores are not statistically significant in the model predicting probation withdrawal, while only the AVRS sample is a statistically significant factor.

Third, the majority of the AVRS subjects have received more than one waning ticket for violating the probation conditions, while 80 percent of the comparison group subjects do not have any warning tickets from probation officers. Thus, the variability in the number of warning tickets (36.6%) is predicted by the propensity score and the AVRS sample. On average, the AVRS group is about 2.1 times higher in the number of warning tickets than the comparison group (B=2.138, Beta=0.570). An increased level of supervision leads to a greater chance of being caught and punished. This is consistent with academic literature regarding "accumulative disadvantages" or "snowball effect," which occurred more frequently in juvenile delinquent cases (Schwartz & Skolnick, 1962; Corbett & Marx, 1991). Payne and Gainey (2004) also claim that the longer subjects are supervised by EM, the more likely they are to receive revocation because of their violation of program conditions. The present data demonstrate that when there are enhanced regulations, there is an increased likelihood of receiving warning tickets due to the violation of the conditions and regulations.

Question 2. Do the data illustrate that juveniles assigned to the AVRS program are higher risk offenders than juveniles referred to regular probation?

First, according to the basic descriptive statistics, 45% of the AVRS group subjects do not have any prior convictions, compared to 37.4% of the comparison group. The comparison group has a higher mean number of prior convictions, at 1.75, while the AVRS sample mean is 1.52.

Second, both groups have large proportion of juveniles more than 16 years old. However, the mean age of the AVRS group is 16.60, while the man age of the comparison group is 17.10. While the most of the AVRS group is under 18, less than half of the comparison group is under 18 (86.6% and 43.9% respectively).

Third, Juveniles in the AVRS program are more financially disadvantaged than probationers in the regular probation supervision. The comparison group has a higher proportion of juveniles living in housing owned by a member of the household compared to the AVRS group (46.6% and 23.8% respectively). The proportion of long-term renters is also higher in the comparison group than in the AVRS group (25.1% VS 14.0%).

Fourth, juveniles in the AVRS program have a slightly lower unemployment rates than juveniles on regular probation (29.0% VS 33.3%). There are relatively more students in the AVRS group than in the control group (64.0% VS 56.1%). More importantly, logistic regression analysis shows that only two variables, crime and housing, are statistically significant predictors that youth court judges might take into account when they refer young offenders to the AVRS program. The odds of being assigned to the AVRS program for juveniles who committed personal crimes, are approximately 42% lower than the juveniles who committed property crimes (Exp(B)=.581). In addition, The juveniles who live in short term rent housing are more

likely to be assigned to the AVRS program than juveniles who live in home-owned housing (Exp(B)=.548).

Question 3. Do the data illustrate that the AVRS program affects the durations of desistence from crime?

Survival analysis (Kaplan-Meier estimation) shows that the AVRS group has a shorter survival time than the comparison group (286.6 days VS 315.1 days). The AVRS group has a slightly higher percentage of total subjects who are censored for 365 days than the comparison group. Regardless of the duration of AVRS (six months VS three months), the hazard model by using Cox-Regression shows that AVRS is not a statistically significant factor to affect the time to commit crime. The four statistically significant predictors that impact the time before committing a crime are age, gender, number of prior convictions, and personal crime.

Question 4. Do the data demonstrate that the AVRS program dosages are statistically significant factors that affect the recidivism rates?

Logistic regression analysis for estimating the impact of the program dosage factors shows that only one variable (type of AVRS) is statistically significant in affecting the odds of rearrest. On average, the odds of committing crime after the one-year follow-up period are 3.433 times higher in Type C program than other types (Exp(B)=3.433) after

controlling the propensity scores. However, the duration of AVRS is not statistically significant in affecting the odds of rearrest.

Question 5. Do the data reveal that the outcomes of the AVRS program are affected by individual demographic factors?

The full model for predicting the probability of committing an offense is statistically significant even though the AVRS program participating is not a significant predictor. Age, gender, number of prior conviction, and type of offense (property crime) are statistically significant factors to predict the likelihoods of recidivism one year after the completion of the program when other factors are controlled.

In the current study, the rearrest cases attributed to simple violations of probation law were excluded from the total number of rearrests in order to estimate the true number of new crimes for a one-year follow-up period. The propensity scores were estimated in order to balance the AVRS group and the comparison group in the model. Again, the AVRS program does not prove to be a statistically significant factor in reducing recidivism.

This negative outcome is enormously critical in terms of the recent lenient circumstance of Korean juvenile justice system. One of the major reasons that Korean juvenile system was getting less punitive is due to the rapid decline of the total youth population. In fact, the most outstanding tendency in the Korean society is the correlation between low birth rate and deinstitutionalization movement since 2003 (Kim et al., 2007). If the Korean juvenile justice system keeps maintaining the lenient policy and

sentencing toward young offenders by using decriminalization, there is a risk of causing "hardened young offenders" who may repeatedly commit crime. Therefore, effective community sanction or alternative supervision programs such as AVRS or EM should be provided for the young offenders who have high propensity of being incorrigible offenders. In this sense, the intensive community correction programs must be reorganized and developed rather than be abolished. It is necessary for juvenile justice authorities to offer effective supervision or intensive intervention programs in community for high risk young offenders In order to maintain the certain level of security, the AVRS program should function as the most representative alternative to incarceration in Korea. Even though the AVRS program resulted in negative outcomes in the current study, Korean juvenile justice system has to prepare and develop different levels of supervision and individualized intervention in community.

According to the result of the survival analysis, the recidivism rates of the AVRS group are similar to those of the comparison group for a one-year follow-up period. Although it seems that there is a slight discrepancy between AVRS and comparison group survival curves after 100 days, the two curves are essentially similar in terms of their crime date trends. In other words, the situational crime prevention strategy of the AVRS program did not even work in short term perspective. If the AVRS program had short term effect, the program could have reorganized in order to maximize the AVRS program's short term effect. However, if the AVRS program does not show any deterrent effect- at least for one year-there is a need to rethink about the application of situational crime prevention strategy to the AVRS program. This pessimistic outcome may be due to the lack of concern on therapeutic aspects of supervision programs. Without any

emphasis on the treatment or intervention, there would be no attitude change by implementing supervision approach. In this context, some key recommendations should be followed.

First, to make situational crime prevention work in changing a juvenile's lifestyle, pure intensive supervision by using a random phone call system is not sufficient. As a result, a true intervention strategy should be merged into the AVRS program.

Second, when the predictors that youth court judges considered in their decisions regarding the AVRS referrals were assessed, only two factors (type of crime and housing status) were statistically significant predictors. Specifically, property crime (theft) and housing status (short term rental housing) were significant factors in increasing the likelihood of being assigned to the AVRS program by judges. This suggests that the AVRS program participants were not true high risk offenders who needed the increased power of technology for supervision. If juveniles have already experienced routine probation supervision several times before they are assigned to the AVRS program, the once-a-month contact would not be sufficient to deter their future crime. Therefore, when targets are screened for the AVRS program, their previous criminal histories should be seriously considered. However, if juveniles do not have any prior criminal records, it is better for them to be placed on regular probation. As a result, judges should expand the criteria of eligible targets for the AVRS program. Instead of focusing on relatively minor crimes (theft) and housing difficulty (short term rental housing), it would be more reasonable for judges to consider the direct risk-related factors, such as prior criminal history, particularly previous probation records.

Third, since the AVRS program is designed to supervise juveniles under 20 years old as a curfew tool, it is important to identify the student status of the targets. If juveniles are not students or employees and are not involved in productive day time activities, it is necessary to impose some aspect of sanction on them during the day. In summary, judges' criteria regarding program referral seem inappropriate for the AVRS program, which aims to supervise high risk juveniles in the community. In this context, the AVRS program is not an effective alternative to incarceration for high risk juveniles.

If the AVRS program had not been available, the juveniles referred to it would have been placed on regular probation, which requires only once-a-month contact with probation officers. To people who oppose intensive supervision programs or EM, this negative result of the AVRS program might be another reason to claim that the program has a "net-widening effect." However, there is no evidence that the negative outcomes of the AVRS program are due to the unnecessary overuse of supervision or because of an insufficient program effect, such as limited supervision and inappropriate situational crime prevention strategy which might result in a displacement effect. First of all, the random phone calls were not effective enough to manipulate the offenders' situations and challenge their conditions. Clarke (1980) suggested that "target hardening" is a crucial strategy to reduce the chance of committing crime. The intermittent phone calls by the automated computer systems, which were limited to night time, might not be enough to affect the offenders' decisions.

Furthermore, if most new crimes that the AVRS subjects committed had occurred during the day time, there would have been some displacement effect of the AVRS program. However, there is no information on the time of the new crimes that the AVRS

subjects committed in this study. In this regard, it is very important to figure out the true reasons that the AVRS group had a higher probability of committing crime than the comparison group, particularly when the comparison group was matched and the crime charged by violation of probation was excluded from the number of new crimes.

Situational crime prevention strategy and routine activity theory require specific elements that can positively influence the range of choices available to subjects. Although the AVRS program was designed to change juveniles' circumstances, it seems that the AVRS program did not greatly impact the offenders' problematic behavior and program outcome in the long term. One key factor impacting the decision to commit a crime is the subjective perception regarding the punitiveness of the sanctions and possibility of being caught and punished (Gainey & Payne, 2000). If the subjects in the AVRS program think that participating in the program is not difficult and believe that they can easily avoid the supervision of the automated phone calls, they may continue to commit crime. According to Tonry (2008), the deterrent effect of punishment is so complex that it should be accounted for in all variations and contexts that may affect offenders' reasoning.

Furthermore, the offenders' attitude toward crime and perception of punishment are related to their own personal experiences. Most juveniles in the AVRS program did not experience incarceration before they were referred to the AVRS program, and youth court judges did not significantly consider juveniles' prior criminal records when they determined whether to assign them to the AVRS program. Payne and Gainey (2004) suggested that only offenders, who had experienced incarceration and then were placed on EM, perceived that the electronically monitored supervision was not as controlling as

imprisonment. In this study, however, 45.8% of the offenders who were placed on the AVRS program were students who had never been incarcerated. It is possible that those who did not experience imprisonment do not see the AVRS program as preferable to incarceration. Regarding the policy perspective, it is crucial that the AVRS program subjects know the consequences if they do not follow the conditions and regulations of the AVRS program. The juveniles should be told that the AVRS program is a replacement for incarceration; therefore, the sanction will be perceived as more controlling, which requires additional compliance. But they must also perceive AVRS as a replacement for incarceration. Regarding the practical perspective, orientation and education for the AVRS program subjects and their parents, should be emphasized in order to ensure that the program be seen as an alternative to incarceration. More importantly, it is imperative to use appropriate program selection criteria to screen out high risk juveniles. One of the major reasons is that the unnecessarily intensive supervision may lead to the waste of criminal justice expense in terms of cost benefit analysis. Public safety can be threatened by the offenders who are assigned to the intensive supervision program. Furthermore, the unclear standards to select high risk offender may result in net widening problem.

Table 16, the model for estimating the predictors of the recidivism rates, showed that individual factors (age, gender, number of prior convictions, and type of offenses) were more influential than the AVRS program variable in affecting the likelihood of recidivism. Therefore, these factors should be used as desirable selection standards for eligible targets for the AVRS program. When targets are selected by judges, the risk factors should be considered in order to achieve the effectiveness of the AVRS program.

For example, if male juveniles, aged 16 and under, are more likely to commit new crimes after a one-year follow-up period regardless of the AVRS program participation, it is better to assign those young male juveniles than older female juveniles to the AVRS program.

The AVRS program was basically designed to decrease the opportunity for juvenile probationers to leave home at night and commit crimes in the community. Increasing the threat of punishment can deter offenders' future crimes, and increasing time at home can influence offenders' attitudes and routine lifestyle (Ball & Lilly, 1986). Thus, the intensive supervision based on automated random phone calls was expected to deter high risk juveniles' recidivism and to encourage them to learn self-discipline in the long term perspective. However, as stated earlier, effectiveness of the AVRS program for reduction of recidivism and modification of behavior could not be supported by the present data. While the AVRS program was not a statistically significant predictor that affects the likelihood of recidivism, the AVRS program was a significant predictor for revocation and number of warning tickets in the current study. Nonetheless, some people might say that the AVRS program is still beneficial to reduce the cost of imprisonment and expense of the correction offices in the community. However, this argument would not be supported if selection criteria for eligible targets are biased. The results of this present study showed that juveniles in the AVRS program were not dangerous enough to demand the intensive supervision at night when the characteristics of the AVRS group were compared to that of the comparison group. Basic descriptive statistics indicated that the AVRS group subjects had fewer prior convictions than the comparison group subjects (AVRS 1.52 < compared to 1.75). In addition, 45.8% of the AVRS group subjects did not

have any prior criminal records, compared to 37.4% of the comparison group subjects. Results regarding the predictors of the AVRS referral showed that when the juveniles were students, they were more likely to be assigned by youth court judges to the AVRS group than the comparison group (AVRS 64.0% VS 56.1%).

Fourth, if the offenders were students and did not have repeated criminal histories, it was reasonable for judges to think that they presented a relatively lower risk of committing crimes compared to juveniles with repeated prior offenses who dropped out of school. In this regard, a particularly strict screening process for the AVRS program referral decisions is required to improve the effectiveness of the AVRS program. If the AVRS program is not aimed at appropriate targets, the AVRS program can not provide promising results in terms of recidivism rates and cost-benefits. In other words, if there were no AVRS program, the low risk offenders would have been placed on regular probation. When an intensive sanction such as EM targets low risk offenders, the low recidivism rate might be due to their low risk nature instead of the impact of the program (Bonta et al., 2000). Besides, the intensive supervision of low risk offenders may cause contrary results, such as increased strain, family stress, and criminal behavior including family violence or drug abuse (Doherty, 1995; Rogers & Jolin, 1989). As a result, the inappropriate selection of participants for the AVRS program can cost more due to "net-widening" if the AVRS program targets lower risk juveniles.

Fifth, regarding the housing status, the juveniles who lived in short term housing were more likely to be placed in the AVRS group than the juveniles who lived in owned houses. If the AVRS program was designed to decrease the opportunities for high risk juveniles to be associated with other delinquent peers at night, judges should consider

specific crime-related risk factors, such as age, student status, gender, and prior conviction histories, instead of relying on minor crime and financial difficulty.

With respect to number of rearrrests, the juveniles who committed property crime, such as theft, were more likely to be referred to the AVRS group than the juveniles who committed personal crime, such as violence. In addition, the simple descriptive statistics show that juveniles in the AVRS group committed slightly fewer crimes than the comparison group (40.7% < 43.9%). However, when potential risk factors are controlled by creating a propensity score for all 508 subjects, the AVRS program was not a statistically significant factor in affecting the recidivism rate. This result is actually consistent with previous literature regarding intensive supervision programs or EM. The general findings are that correctional programs that are purely focused on supervision, without any concern for intervention or treatment, are not sufficiently effective in reducing recidivism (Gendreau & Goggin, 1996; Bonta et al., 2000; Andrews & Bonta, 1998; Turner & Petersilia, 1992).

Sixth, it is conceivable that if the intensive supervision approach did not include any intervention or treatment components, it might be difficult to affect juveniles' true attitude changes or cognition modifications in a long-term perspective. In fact, Bonta, Wallance-Capretta, and Rooney (2000b) suggested that when there are strong treatment or intervention components in alternative sanctions, the programs can show a clear deterrent effect. In terms of policy perspective, it is necessary to find a way to combine the AVRS program with other community-based sanctions in order to improve the efficacy of the AVRS program. In Korea, traditionally, several treatment programs have been available for juveniles in the community attendance orders: sex offense prevention

programs, individual counseling programs, anger management programs, domestic violence programs, drug treatment programs, and drunken driving prevention programs. If true intervention elements can be used effectively in conjunction with the AVRS program, the deterrent effect of the program might positively affect the outcome of the program as well as strengthen the treatment effect.

Seventh, the AVRS program should be used in a more diverse context. In Korea, the AVRS program is employed primarily by youth court judges as an alternative to incarceration for juveniles. However, it is required that the AVRS program is used as a second chance to maximize the deterrent effect of the program. For instance, if the AVRS program is offered as a prerelease condition for the offenders after incarceration, the offenders may think that this program is being offered as a second chance.

In summary, this study has three implications in terms of theory and practice perspectives. First, in terms of a situational crime prevention approach, this study demonstrated that the theory can only be applied in specific situations. Limited supervision only by automated random phone calls at night might not be sufficient enough to deter future crime. In addition, the power of advanced biotechnology cannot always be an answer addressing the increased financial burden occurring in the correctional department. Second, with regard to judges' decision for the AVRS program referral, age, gender, number of prior convictions, and types of offense factors should be reconsidered to select an appropriate target group for the AVRS program (Table 16). Third, it is important to devise better program dosage in both program types and program duration in order to improve the effectiveness of the AVRS program. Although Type C was statistically significant in decreasing the likelihood of recidivism, more studies on

the efficacy of other types are required. In the current study, there were so few subjects who were assigned to the Type A, B, D, E, and F that the cell sizes were too small to examine the variation of each type of the program. In spite of the limited data, the current study is still promising because Type C is a significant factor in decreasing the odds of recidivism. Types A and B could perhaps be used for juveniles who need a higher level of supervision as a graduated sanction.

Furthermore, as the numbers of subjects who are referred to the AVRS program have dramatically increased since 2004, future studies are expected to collect enough samples for different types of the program and examine the effects of each program. In the current study, program duration was not statistically significant in affecting the recidivism rates. Although the present study did not show any significance in the duration of the AVRS program, the survival analysis results showed that recidivism rates of the AVRS group substantially increased after the 100 day point. In other words, regardless of the duration of the AVRS program, the recidivism rate of the AVRS program began to increase noticeably from 100 days after they finished their program sentence. Since the AVRS program has only two types of duration, three months and six months, it is not clear whether more than six months can decrease the recidivism rates. This result implies that juveniles in the AVRS program commit new crimes soon after their sentence completion. This finding indicates that the AVRS program is not powerful enough to change juveniles' awareness or attitudes toward their routine. Improved self-discipline or self-control capacities do not seem to be modified by the three months or six months of intensive supervision. In future studies, the longer duration of the AVRS program (more than six months) should be examined in order to expand the short term dependency effect

of the AVRS program. Moreover, program duration should be more diverse to find out the impact of different amount of time on recidivism rates in future studies.

Chapter 7 Conclusion

7.1 Strengths and Limitations

This study investigated the effectiveness of the AVRS program by using propensity scores and a stratification technique to make the most comparable matching groups. The results of the current study showed that the AVRS program was not a statistically significant factor in reducing recidivism rates, and the study also addressed important methodological, intellectual, and policy-related questions. This study has several strengths, compared to prior work.

First, in order to minimize sampling bias, six potential risk factors (age, gender, prior criminal history, housing, student status, and type of offense) were controlled for in the AVRS group and in the comparison group. Therefore, methodologically, the matched sampling technique based on propensity scores made it possible to establish similar groups for comparing program outcomes.

Second, this study used multiple dependent variables in order to examine the effectiveness of the AVRS program in a comprehensive way. Arrest rates were used as the most important outcome measurement. The follow-up period was one year after the completion of the AVRS program. The current study also used the number of rearrests as a major program outcome factor, in order to capture a true picture of juvenile recidivism since most juveniles in Korea are likely to be dismissed by police or prosecutors with only informal warnings. In addition, the study included the number of revocations and the number of warning tickets during the AVRS program or regular probation periods, as additional outcome measurements. These measures of failure rates in completing the

AVRS program were important to gauge program effectiveness. Thus, multi-dimensional outcomes in the current study enrich the implication of the findings.

Third, this study used the duration of time up to when a new crime was committed. The results of survival analysis (Cox-regression) showed that recidivism rates in the AVRS group are essentially identical with the comparison group in terms of their elapsed time before committing new crime within one year after the completion of the sentence. In terms of policy perspective, the duration of desistance from crime can offer significant information regarding critical timing until the AVRS program deterrent effect disappears. If there is only a short term effect after the AVRS program, it is necessary to expand the temporal deterrence while preventing net-widening or labeling effects.

More importantly, when the covariates are controlled in the Cox-regression analysis, the duration of desistance from crime in the AVRS group was almost identical to the comparison group. This finding indicates that although the AVRS program was no worse than the regular probation, it is no better than the routine probation either.

Despite the strengths of equivalent sampling, multifaceted outcome variables, and research methodology, there are some limitations in the current study. First, there is no information regarding how the AVRS subjects perceived the program. It is unclear whether or not the negative outcome is due to insufficient deterrent effect or overuse of supervision. Understanding how the AVRS program was perceived and experienced by the program participants is helpful in examining the effectiveness of the program and reorganizing the program's processes. Therefore, a follow-up survey or qualitative research would be a good next step to this study. Although this study showed that the AVRS program was not a statistically significant factor in decreasing the likelihood of

recidivism, it might have increased other useful outcomes, such as reliance on social interaction with significant others. Extra attention from authority may bring about extra attention from family members, which would also increase family involvement with the program participants. These kinds of outcomes might suggest longer term benefits.

Second, this study used only a one-year follow-up period in order to measure recidivism rates. Because the AVRS program pilot project began in 2003 and the data collection for the current study was conducted in 2006, it was actually impossible to analyze more than one year of recidivism data. Indeed, a one-year follow-up period may not be enough time to estimate the true effectiveness of the AVRS program. Accumulative data should be tested and analyzed by using longitudinal research design.

Third, the number of program-related factors was limited in the current data, so the effectiveness of program dosage was not fully examined. Specifically, the sample in each program type (A, B, D, E, and F) was too small to develop conclusive results. In addition, the duration of the AVRS program was limited to two categories: three months and six months. Renzema and Skelton (1990) found that if offenders were in electronic monitoring programs for more than 180 days, they were more likely to successfully complete their sentence without any violation of program conditions. To measure the actual effect of program duration, it might be necessary to include the sentence lengths exceeding 180 days (six months) or longer.

7.2 Future Research

As noted earlier, it is imperative to conduct a qualitative study in order to investigate how juvenile probationers experience their participation in the AVRS program. Although the AVRS program was not a significant factor in reducing recidivism rates, it may prove helpful in order to understand why the program did not work. AVRS program might be beneficial in establishing positive peer association or a desirable schooling attitude. It could also be helpful in improving relationships between family members and juvenile probationers although the AVRS program was not a direct factor in impacting the recidivism rates. Therefore, in future studies, interviews with the AVRS program participants would be advisedly in order to understand their experiences and report on their satisfaction with the program. It would also be useful to know the perception of juveniles' parents regarding the AVRS program.

In addition, if program participants generally think that the AVRS program is not challenging or punitive, the sanctions based on automated random phone call supervision may seem too lenient to impact their behavior. In other words, if the AVRS program is not strong enough to reduce the opportunities to commit crimes, new situational crime prevention strategies, which are more punitive and strict, will be required in order to increase the deterrent effect. In fact, Gainey and Payne (2000) reported that offenders generally did not view house arrest with electronic monitoring as being equally punitive as the incarceration experience. If, on the contrary, juveniles think the AVRS program is overly punitive and shameful, it may be good to modify the program to minimize the family members' strain, unnecessary privacy intrusion, stress, pain and other negative effects. If the program participants experience the AVRS program as excessively punitive

and controlling, they may release their strain right after completion of the program. Therefore, it will be necessary to find ways to counteract the suppression components. In this context, understanding personal perception about the AVRS program is significant.

Furthermore, a longitudinal research design will help examine the effectiveness of the AVRS program in future studies. The data for the current study were from a 2003 pilot project, which was in effect for only one year. Since the pilot project of 2003, the AVRS program has noticeably developed and changed in order to meet the original goals of the program. If the AVRS program could be operated as intended with the help of evidence-based findings, the program might be effective, at least for certain types of juveniles, in changing their problematic behavior and reducing their future crimes with a minimal increase of costs.

APPENDIX

Appendix A – Age Difference in Five Subclasses

Tests of Between-Subjects Effects

Dependent Variable:age

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	16.577[a]	9	1.842	.598	.798	.018	5.385	.295
Intercept	69236.544	1	69236.544	22490.487	.000	.987	22490.487	1.000
AVRS	8.315	1	8.315	2.701	.101	.009	2.701	.374
Five	6.474	4	1.619	.526	.717	.007	2.103	.176
AVRS * Five	3.658	4	.915	.297	.880	.004	1.188	.116
Error	929.701	302	3.078					
Total	90605.000	312						
Corrected Total	946.279	311						

a. R Squared = .018 (Adjusted R Squared = -.012)

b. Computed using alpha = .05

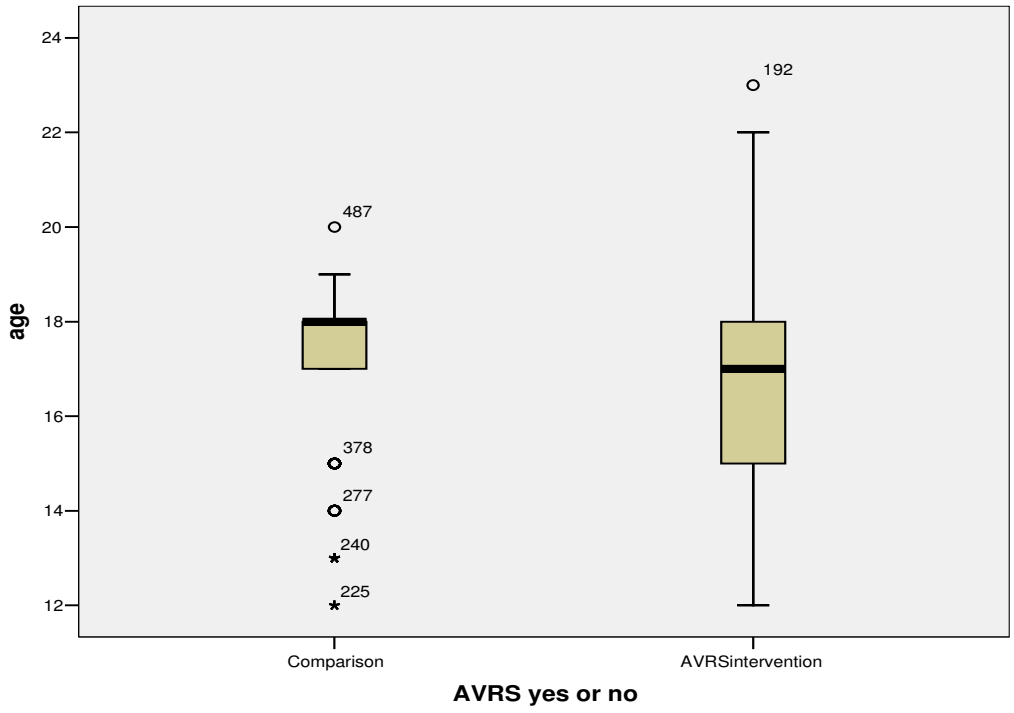
Parameter Estimates

Dependent Variable:age

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval		Partial Eta Squared	Noncent. Parameter	Observed Power[a]
					Lower Bound	Upper Bound			
Intercept	16.781	.310	54.104	.000	16.171	17.392	.906	54.104	1.000
[AVRS=.00]	.023	.404	.057	.954	-.772	.818	.000	.057	.050
[AVRS=1.00]	0[b]	.	.	.	.	.	.	.	.
[Five=1.00]	-.418	.613	-.681	.496	-1.624	.789	.002	.681	.104
[Five=2.00]	-.166	.577	-.287	.774	-1.301	.970	.000	.287	.059
[Five=3.00]	.330	.517	.638	.524	-.687	1.347	.001	.638	.097
[Five=4.00]	-.094	.439	-.214	.831	-.957	.769	.000	.214	.055
[Five=5.00]	0[b]	.	.	.	.	.	.	.	.
[AVRS=.00] * [Five=1.00]	.702	.715	.982	.327	-.705	2.109	.003	.982	.165
[AVRS=.00] * [Five=2.00]	.501	.687	.730	.466	-.850	1.852	.002	.730	.112
[AVRS=.00] * [Five=3.00]	.199	.669	.297	.766	-1.118	1.517	.000	.297	.060
[AVRS=.00] * [Five=4.00]	.334	.572	.583	.560	-.793	1.460	.001	.583	.090
[AVRS=.00] * [Five=5.00]	0[b]	.	.	.	.	.	.	.	.
[AVRS=1.00] * [Five=1.00]	0[b]	.	.	.	.	.	.	.	.
[AVRS=1.00] * [Five=2.00]	0[b]	.	.	.	.	.	.	.	.
[AVRS=1.00] * [Five=3.00]	0[b]	.	.	.	.	.	.	.	.
[AVRS=1.00] * [Five=4.00]	0[b]	.	.	.	.	.	.	.	.
[AVRS=1.00] * [Five=5.00]	0[b]	.	.	.	.	.	.	.	.

a. Computed using alpha = .05

b. This parameter is set to zero because it is redundant.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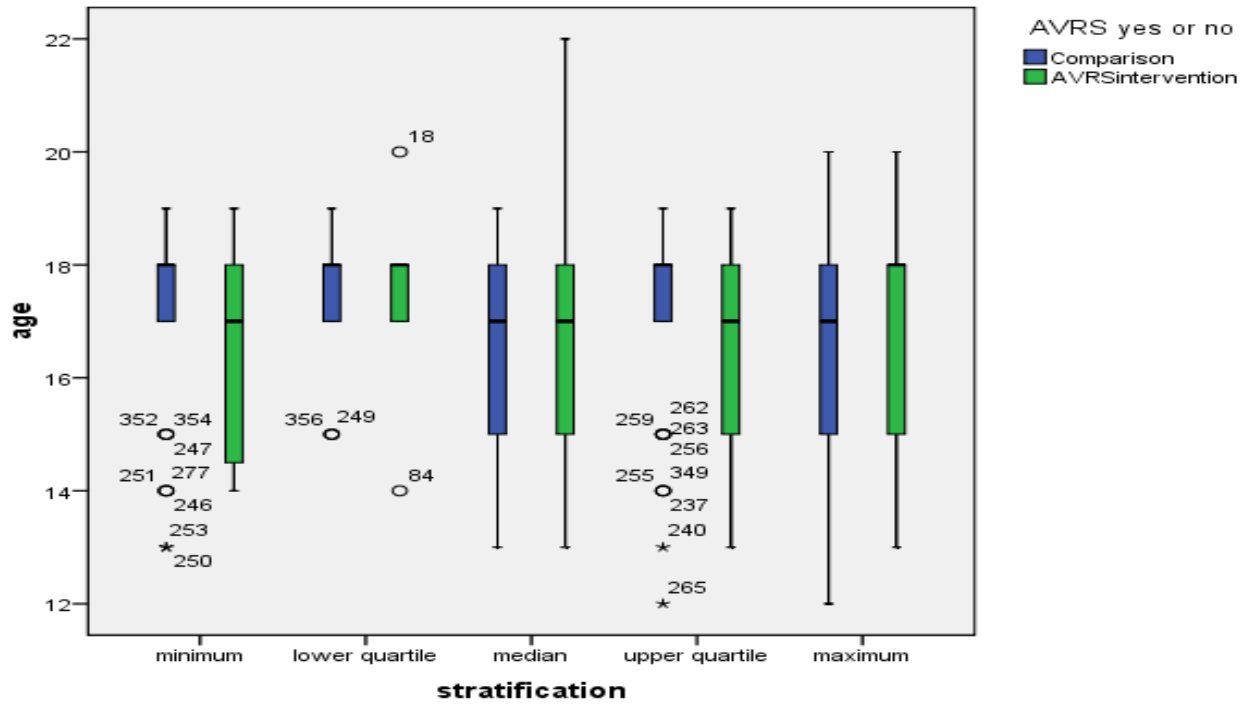
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Comparison
AVRSintervention
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minimum
lower quartile
median
upper quartile
maximum
stratification

Appendix B - The Difference of the Number of prior convictions in Five Subclasses

Tests of Between-Subjects Effects

Dependent Variable:number of pre-conviction

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	50.784[a]	9	5.643	1.196	.297	.034	10.766	.588
Intercept	721.219	1	721.219	152.891	.000	.336	152.891	1.000
AVRS	2.441	1	2.441	.518	.472	.002	.518	.111
Five	24.256	4	6.064	1.286	.276	.017	5.142	.401
AVRS * Five	11.721	4	2.930	.621	.648	.008	2.485	.203
Error	1424.600	302	4.717					
Total	2410.000	312						
Corrected Total	1475.385	311						

a. R Squared = .034 (Adjusted R Squared = .006)

b. Computed using alpha = .05

Parameter Estimates

Dependent Variable:number of pre-conviction

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval		Partial Eta Squared	Noncent. Parameter	Observed Power[a]
					Lower Bound	Upper Bound			
Intercept	2.063	.384	5.372	.000	1.307	2.818	.087	5.372	1.000
[AVRS=.00]	-.106	.500	-.212	.832	-1.090	.878	.000	.212	.055
[AVRS=1.00]	0[b]	.	.	.	.	.	.	.	.
[Five=1.00]	.119	.759	.157	.875	-1.375	1.613	.000	.157	.053
[Five=2.00]	-.832	.714	-1.164	.245	-2.237	.574	.004	1.164	.213
[Five=3.00]	-.507	.640	-.792	.429	-1.766	.752	.002	.792	.124
[Five=4.00]	.031	.543	.058	.954	-1.037	1.100	.000	.058	.050
[Five=5.00]	0[b]	.	.	.	.	.	.	.	.
[AVRS=.00] * [Five=1.00]	-1.031	.885	-1.165	.245	-2.773	.711	.004	1.165	.213
[AVRS=.00] * [Five=2.00]	.410	.850	.482	.630	-1.263	2.083	.001	.482	.077
[AVRS=.00] * [Five=3.00]	-.042	.829	-.051	.959	-1.673	1.589	.000	.051	.050
[AVRS=.00] * [Five=4.00]	.190	.709	.268	.789	-1.205	1.585	.000	.268	.058
[AVRS=.00] * [Five=5.00]	0[b]	.	.	.	.	.	.	.	.
[AVRS=1.00] * [Five=1.00]	0[b]	.	.	.	.	.	.	.	.
[AVRS=1.00] * [Five=2.00]	0[b]	.	.	.	.	.	.	.	.
[AVRS=1.00] * [Five=3.00]	0[b]	.	.	.	.	.	.	.	.
[AVRS=1.00] * [Five=4.00]	0[b]	.	.	.	.	.	.	.	.
[AVRS=1.00] * [Five=5.00]	0[b]	.	.	.	.	.	.	.	.

a. Computed using alpha = .05

b. This parameter is set to zero because it is redundant.

Appendix C – Differences of Gender, Type of Offenses, Housing in Five Subclasses

Parameter Estimates

gender[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp (B)	
								Lower Bound	Upper Bound
male	Intercept	1.466	.453	10.482	1	.001			
	[AVRS=.00]	.638	.655	.947	1	.330	1.892	.524	6.837
	[AVRS=1.00]	0[b]	.	.	0	.	.	.	.
	[Five=1.00]	21.372	.000	.	1	.	1.913E9	1.913E9	1.913E9
	[Five=2.00]	-1.312	.717	3.346	1	.067	.269	.066	1.098
	[Five=3.00]	1.367	1.124	1.478	1	.224	3.923	.433	35.530
	[Five=4.00]	-.678	.592	1.311	1	.252	.508	.159	1.620
	[Five=5.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=.00] * [Five=1.00]	-.638	.000	.	1	.	.528	.528	.528
	[AVRS=.00] * [Five=2.00]	.157	.924	.029	1	.865	1.170	.191	7.164
	[AVRS=.00] * [Five=3.00]	-1.722	1.335	1.664	1	.197	.179	.013	2.446
	[AVRS=.00] * [Five=4.00]	-.415	.830	.250	1	.617	.661	.130	3.359
	[AVRS=.00] * [Five=5.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=1.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=2.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=3.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=4.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=5.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: female.

b. This parameter is set to zero because it is redundant.

Parameter Estimates

current crime types[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp (B)	
								Lower Bound	Upper Bound
Property Crime	Intercept	1.466	.453	10.482	1	.001			
	[AVRS=.00]	.251	.611	.169	1	.681	1.286	.388	4.260
	[AVRS=1.00]	0[b]	.	.	0	.	.	.	.
	[Five=1.00]	-.253	17568.405	.000	1	1.000	.776	.000	.[c]
	[Five=2.00]	-.253	16160.582	.000	1	1.000	.776	.000	.[c]
	[Five=3.00]	-.253	13733.854	.000	1	1.000	.776	.000	.[c]
	[Five=4.00]	-.713	.624	1.305	1	.253	.490	.144	1.665
	[Five=5.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=.00] * [Five=1.00]	-.251	19598.377	.000	1	1.000	.778	.000	.[c]
	[AVRS=.00] * [Five=2.00]	-.251	18442.373	.000	1	1.000	.778	.000	.[c]
	[AVRS=.00] * [Five=3.00]	-.251	17730.329	.000	1	1.000	.778	.000	.[c]
	[AVRS=.00] * [Five=4.00]	-.123	.822	.022	1	.881	.885	.177	4.428
	[AVRS=.00] * [Five=5.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=1.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=2.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=3.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=4.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=5.00]	0[b]	.	.	0	.	.	.	.
Personal Crime	Intercept	-18.563	2847.681	.000	1	.995			
	[AVRS=.00]	.160	.775	.043	1	.836	1.174	.257	5.365
	[AVRS=1.00]	0[b]	.	.	0	.	.	.	.
	[Five=1.00]	40.248	15685.216	.000	1	.998	3.017E17	.000	.[c]
	[Five=2.00]	40.248	14471.470	.000	1	.998	3.017E17	.000	.[c]
	[Five=3.00]	40.248	12389.626	.000	1	.997	3.017E17	.000	.[c]
	[Five=4.00]	18.429	2847.681	.000	1	.995	1.009E8	.000	.[c]
	[Five=5.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=.00] * [Five=1.00]	-.160	17206.805	.000	1	1.000	.852	.000	.[c]
	[AVRS=.00] * [Five=2.00]	-.160	16191.867	.000	1	1.000	.852	.000	.[c]
	[AVRS=.00] * [Five=3.00]	-.160	15566.714	.000	1	1.000	.852	.000	.[c]
	[AVRS=.00] * [Five=4.00]	-1.125	.000	.	1	.	.325	.325	.325
	[AVRS=.00] * [Five=5.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=1.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=2.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=3.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=4.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=5.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Traffic Law Violation.

b. This parameter is set to zero because it is redundant.

c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

Parameter Estimates

Types of house[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp (B)	
								Lower Bound	Upper Bound
Short term rent	Intercept	19.481	2190.550	.000	1	.993			
	[AVRS=.00]	.260	.938	.077	1	.782	1.296	.206	8.151
	[AVRS=1.00]	0[b]	.	.	0	.	.	.	.
	[Five=1.00]	-39.592	7353.456	.000	1	.996	6.390E-18	.000	.[c]
	[Five=2.00]	-37.998	4811.994	.000	1	.994	3.145E-17	.000	.[c]
	[Five=3.00]	.290	3604.856	.000	1	1.000	1.336	.000	.[c]
	[Five=4.00]	-19.615	2190.550	.000	1	.993	3.031E-9	.000	.[c]
	[Five=5.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=.00] * [Five=1.00]	-.260	7830.693	.000	1	1.000	.771	.000	.[c]
	[AVRS=.00] * [Five=2.00]	-.010	5050.718	.000	1	1.000	.990	.000	.[c]
	[AVRS=.00] * [Five=3.00]	-.527	1.395	.143	1	.705	.590	.038	9.086
	[AVRS=.00] * [Five=4.00]	-1.512	1.042	2.107	1	.147	.220	.029	1.698
	[AVRS=.00] * [Five=5.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=1.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=2.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=3.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=4.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=5.00]	0[b]	.	.	0	.	.	.	.
Long term rent	Intercept	17.795	2190.550	.000	1	.994			
	[AVRS=.00]	-.717	.535	1.793	1	.181	.488	.171	1.394
	[AVRS=1.00]	0[b]	.	.	0	.	.	.	.
	[Five=1.00]	-38.169	8301.129	.000	1	.996	2.652E-17	.000	.[c]
	[Five=2.00]	-17.640	2190.550	.000	1	.994	2.182E-8	.000	.[c]
	[Five=3.00]	-.857	3604.856	.000	1	1.000	.424	.000	.[c]
	[Five=4.00]	-17.041	2190.550	.000	1	.994	3.974E-8	.000	.[c]
	[Five=5.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=.00] * [Five=1.00]	.717	8932.056	.000	1	1.000	2.047	.000	.[c]
	[AVRS=.00] * [Five=2.00]	1.512	.843	3.211	1	.073	4.534	.868	23.682
	[AVRS=.00] * [Five=3.00]	1.533	.000	.	1	.	4.631	4.631	4.631
	[AVRS=.00] * [Five=4.00]	.409	.000	.	1	.	1.505	1.505	1.505
	[AVRS=.00] * [Five=5.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=1.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=2.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=3.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=4.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=5.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Owned house.

b. This parameter is set to zero because it is redundant.

c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

Appendix D – Difference of Student Status in Five Subclasses

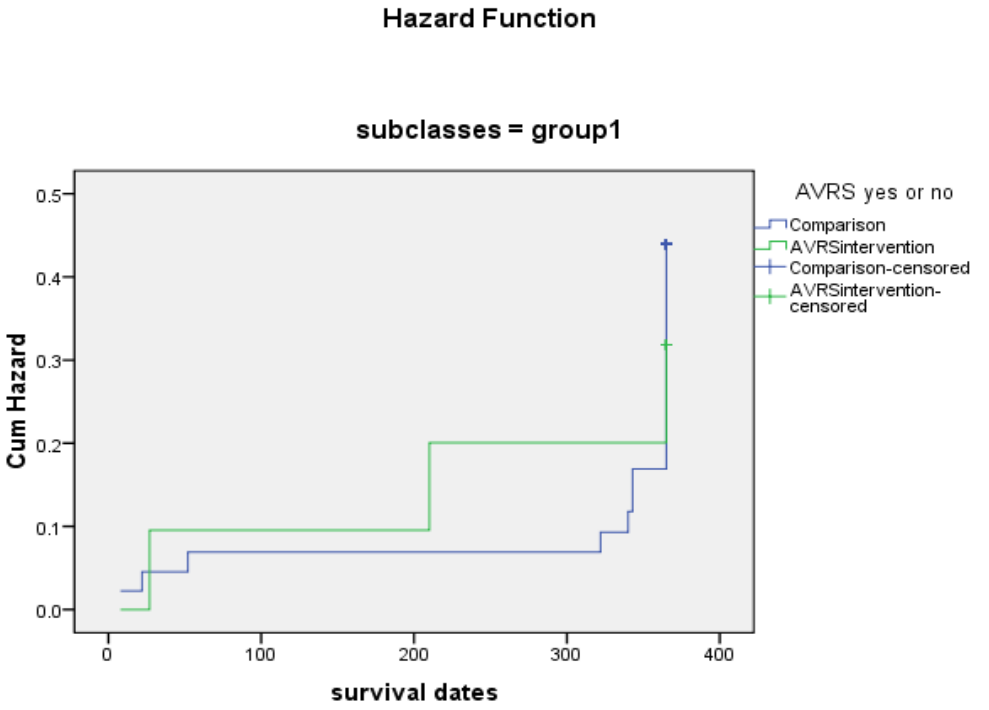
Parameter Estimates

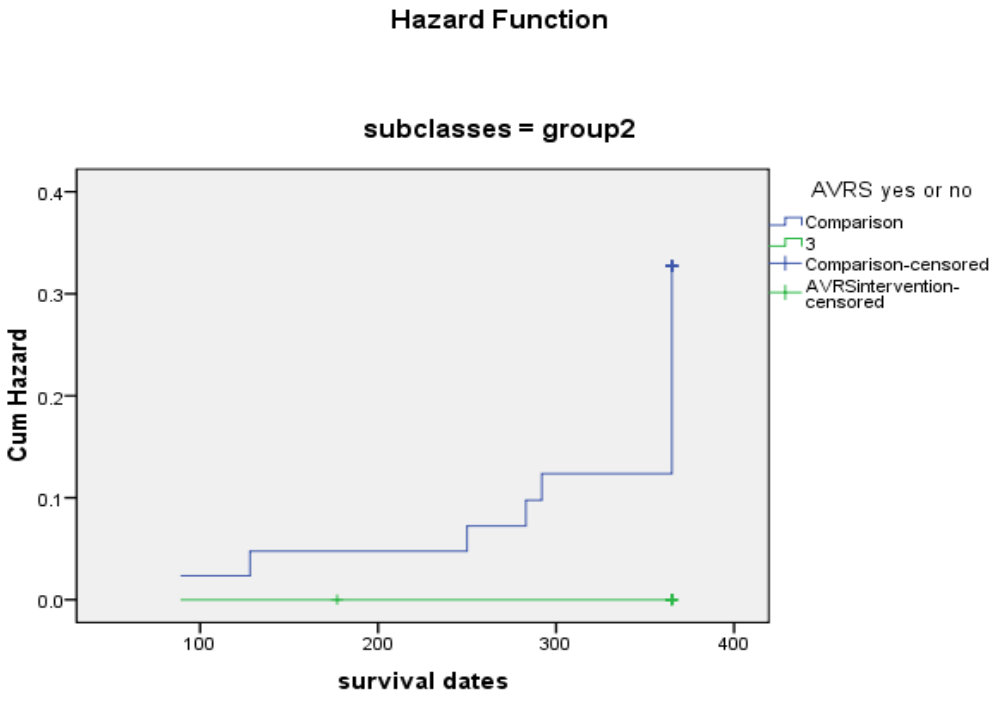
types of employment[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp (B)	
								Lower Bound	Upper Bound
Student	Intercept	.325	.364	.799	1	.371			
	[AVRS=.00]	-.325	.482	.456	1	.500	.722	.281	1.858
	[AVRS=1.00]	0[b]	.	.	0	.	.	.	.
	[Five=1.00]	18.974	.470	1627.496	1	.000	1.739E8	6.919E7	4.373E8
	[Five=2.00]	-1.529	.752	4.134	1	.042	.217	.050	.946
	[Five=3.00]	-.074	.622	.014	1	.905	.929	.275	3.140
	[Five=4.00]	.522	.540	.935	1	.334	1.685	.585	4.853
	[Five=5.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=.00] * [Five=1.00]	-17.876	.000	.	1	.	1.725E-8	1.725E-8	1.725E-8
	[AVRS=.00] * [Five=2.00]	2.427	.891	7.423	1	.006	11.329	1.976	64.944
	[AVRS=.00] * [Five=3.00]	1.019	.828	1.515	1	.218	2.769	.547	14.021
	[AVRS=.00] * [Five=4.00]	-.321	.702	.210	1	.647	.725	.183	2.869
	[AVRS=.00] * [Five=5.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=1.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=2.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=3.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=4.00]	0[b]	.	.	0	.	.	.	.
	[AVRS=1.00] * [Five=5.00]	0[b]	.	.	0	.	.	.	.

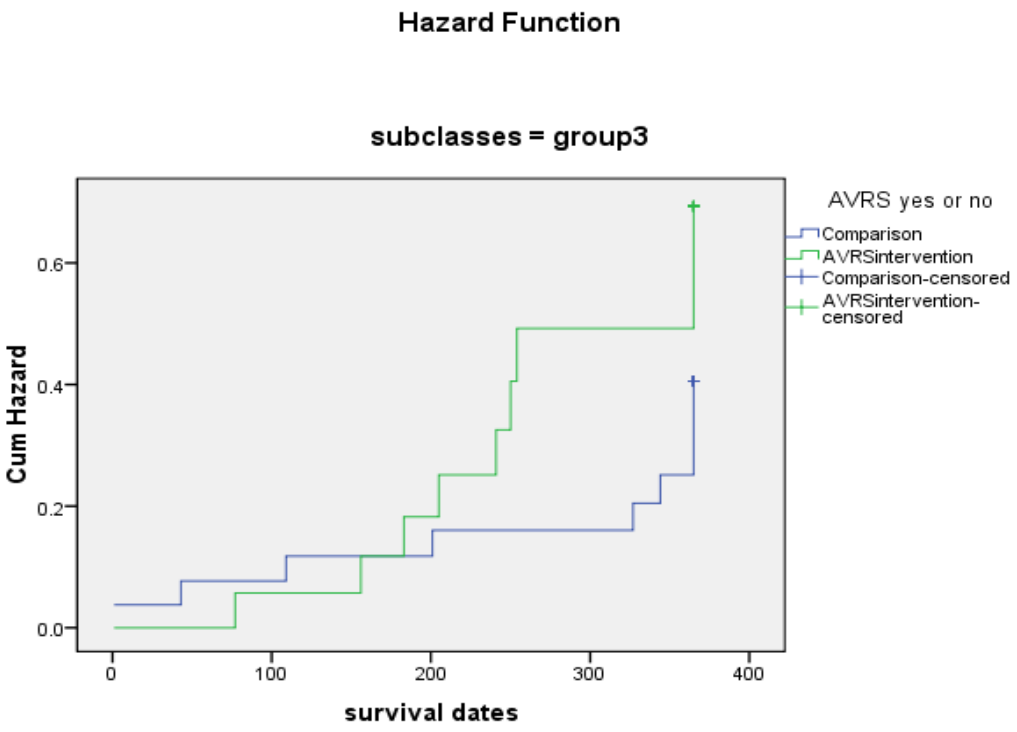
a. The reference category is: No Employment.

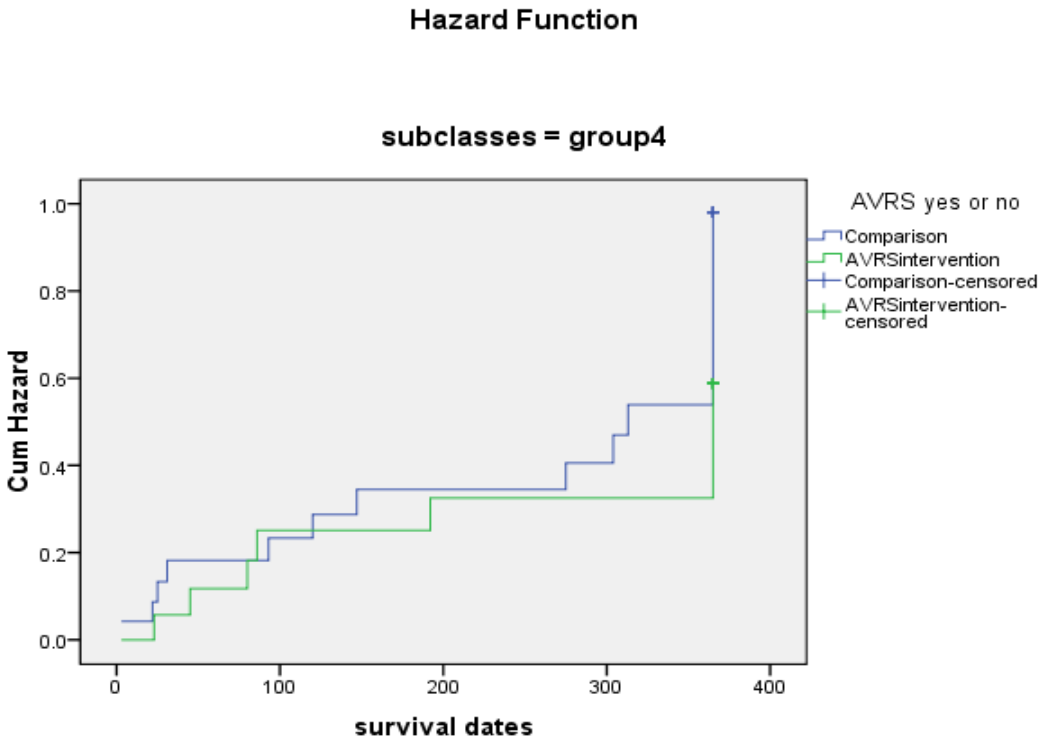
b. This parameter is set to zero because it is redundant.

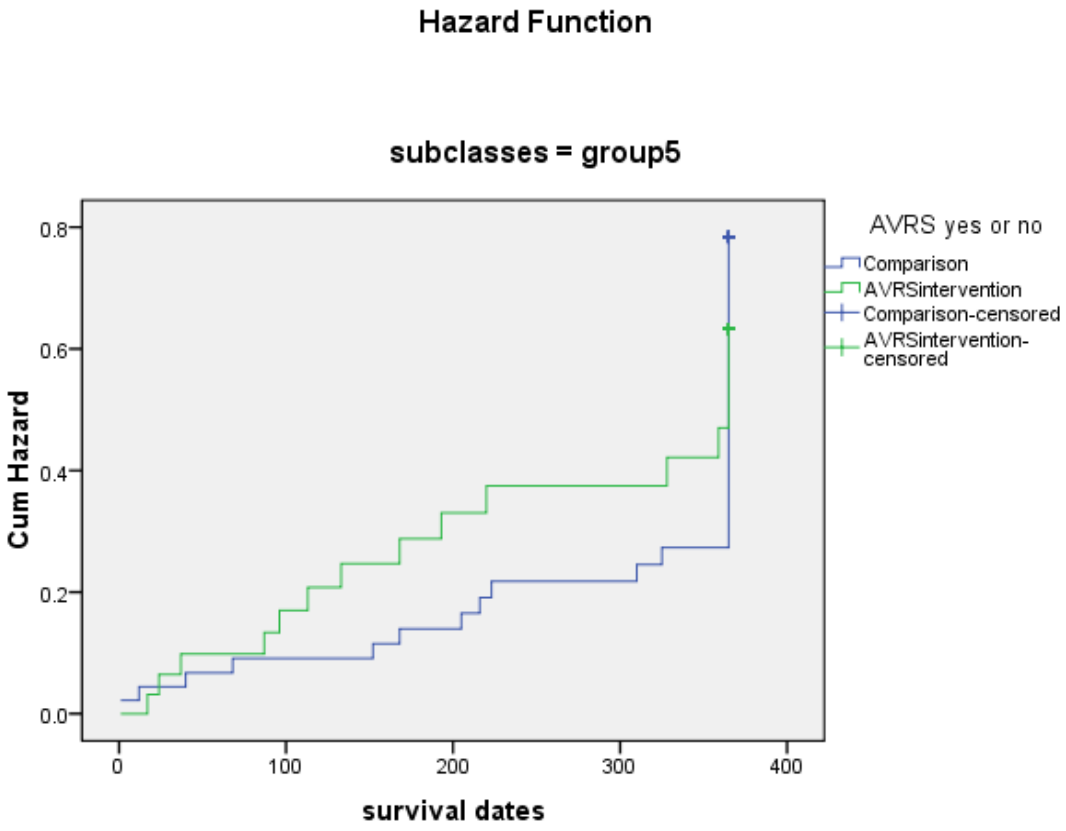
Appendix E - Hazard Rate for Recidivism in Five Subclasses






Hazard Function
subclasses = group3
Cum Hazard
0.0
0.2
0.4
0.6
0
100
200
300
400
survival dates
AVRS yes or no
Comparison
AVRSintervention
Comparison-censored
AVRSintervention-censored


Hazard Function
subclasses = group4
Cum Hazard
0.0
0.2
0.4
0.6
0.8
1.0
0
100
200
300
400
survival dates
AVRS yes or no
Comparison
AVRSintervention
Comparison-censored
AVRSintervention-censored


Hazard Function
subclasses = group5
Cum Hazard
0.0
0.2
0.4
0.6
0.8
0
100
200
300
400
survival dates
AVRS yes or no
Comparison
AVRSintervention
Comparison-censored
AVRSintervention-censored

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