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Dual-System Youth and Emancipating from Foster Care: Examining the Relations Between
Delinquency, Independent Living Services, and Criminal Justice Involvement

by

Dylan Monahan Jones

A dissertation presented to the Brown School of Washington University in St. Louis in partial
fulfillment of the requirements of the degree of Doctor of Philosophy

May 2024

St. Louis, Missouri

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Abstract

Youth who touch both the child welfare system (CWS) and juvenile justice system (JJS), termed dual-system youth, represent a particularly high needs population at risk of poor outcomes into adulthood. Among CWS involved children, youth aging out of foster care are particularly high risk of dual-system status. To help these teenagers in foster care prepare for adulthood, states offer independent living services (ILS). Despite the high risk of JJS involvement of these youth, we know very little of the association between ILS receipt and dual-system involvement.

This dissertation has two aims, the first focusing on ILS and delinquency onset during foster care, and the second on their association relating to outcomes after foster care. Aim 1 asks: Does ILS receipt change as teenage youth move between placements and become involved with the JJS? Aim 2 asks: How do JJS involvement and ILS predict incarceration in young adulthood? Multiple datasets are merged from the National Data Archive on Child Abuse and Neglect (NDACAN) repositories. Aim 1 fits a multistate model, predicting transitions between different states representing combinations of ILS receipt and delinquency status. Aim 2 fits Bayesian generalized linear mixed models predicting the occurrence of incarceration in two time periods: 17-19 years of age and 19-21 years of age.

Aim 1 finds that ILS receipt and delinquency onset are significantly associated with placement type and demographics (gender, race/ethnicity, rurality), but the degrees of association depends on the particular combinations of ILS receipt and delinquency status. Aim 2 finds that early receipt of ILS is associated with decreased risk of incarceration between the ages of 17-19, with some evidence that ILS receipt after age 17 is associated with decreased risk of incarceration between 19-21. Implications for policy, practice, and future research are discussed.

Introduction

Problem Statement and Significance

Each year, the child welfare system (CWS) and juvenile justice system (JJS) touch the lives of a wide segment of American children. In 2019, about 3,500,000 children were investigated for abuse or neglect (DHHS, 2021), and about 450,000 children were arrested (FBI UCR, n.d.). While many American children's experience with these systems stop at these entry points, many experience deeper involvement. In 2019, about 250,000 children entered foster care. In 2019, almost 60,000 children were incarcerated (Hockenberry & Puzzanchera, 2021).

The social significance of these systems is compounded when understanding the unique characteristics of those involved. The youth served in these systems are at significant risk of later adverse outcomes. Child maltreatment has been linked to a wide array of adverse outcomes, including physical and mental health, drug and alcohol abuse; physical health; risky health behaviors; cognitive development and employment (National Research Council 2014; Norman et al. 2012; Widom 2014). Similarly, juvenile justice involvement has been linked to high mental, developmental, and physical health needs (Committee on Adolescence, Paula K. Braverman, Pamela J. Murray, 2011).

By the time they turn 18, an average American has about a one-in-three chance of having a child maltreatment report and about a one-in-five chance of being arrested (Kim et al. 2017, Brame et al. 2012). Note that, given that many youth are in foster care without a report and delinquent without an arrest, these probabilities serve as underestimates for system involvement. For example, between 8-35% of children in foster care never had a child maltreatment report (Drake et al. 2022), and 18% of children have delinquency cases that did not begin with referrals from law enforcement agencies (Hockenberry & Puzzanchera, 2021).

Significantly, these probabilities are not independent. Extensive research has documented a substantial overlap between these two systems. Said another way, involvement in one system significantly increases the probability of involvement in the other, regardless of order. Youth who experience both of these systems are termed crossover youth or dual-system youth. The vast majority of dual-system youth experience child welfare system involvement prior to juvenile justice system involvement (Herz et al. 2019). This is expected as the median age for child welfare involvement (about 6) is necessarily younger than juvenile justice involvement. As the vast majority of research focuses on these youth, this dissertation will only examine dual-system exercises that begin in the child welfare system.

As children experience involvement in multiple systems, i.e., from the CWS to the JJS, they move via a pathway, defined as an ordered sequence of system events. There are many pathways that exist between these systems, depending on the level of system involvement. For example, a child might experience a child maltreatment report at an early age and then get arrested in late adolescence. Another child might spend years in foster care, and then be adjudicated delinquent. Although both youth had child welfare experience prior to juvenile justice experience, their specific pathways were very different, implying different risk factors and needs. The literature has typically studied dual-system youth as one, homogenous, population (Herz et al. 2019). Each study generally examines one pathway at a time, limiting the ability to compare the risk factors and predictors of pathways with comparable measures and samples. The result is a literature that is broad, but spread thin across the various pathways. Recent efforts by Herz et al. 2019, 2021, and 2022, break down dual-system involvement into a set of distinct pathways using a sample of youth with a juvenile petition from four different metropolitan areas. While a necessary advance in the field, the studies only identify pathways at

the system level, i.e., child welfare to juvenile justice, not the system-event level, e.g., foster care placement for neglect to delinquency petition.

Understanding the pathways of dual-system youth is important on at least two fronts. First, knowledge of predictors of future juvenile justice involvement given child welfare involvement can allow practitioners to optimize interventions to divert youth away from system involvement in the first place, i.e., preventing future dual-system involvement. Second, knowledge on outcomes of pathways can shed light on the specific needs of dual-system youth, as to prevent given outcomes. For example, research has observed that dual-system youth represent a uniquely high-risk population (Dauber & Hogue, 2018). While more research needs to be conducted to clearly differentiate these youth from their single system peers, crossover youth have been observed to have higher rates of mental health issues, substance use (Halemba et al. 2004; Herz, 2016) and more educational needs (Gallegos and White 2013). Crossover youth have also been observed to have worse young adult outcomes across multiple dimensions, including physical health and economic wellbeing (Culhane et al. 2011; CIDI 2015).

This dissertation examines the risk and outcomes of dual-system involvement beginning with a specific population of child welfare involved youth: adolescents in foster care who are at high risk of aging out. Policies and interventions for these youth are particularly important, as research has documented poor outcomes, regardless of dual-system experience. At the cusp of emancipation, they are frequently provided independent living services (ILS), which refer to a broad array of supports provided by foster care agencies. Despite research examining outcomes of ILS receipt, few, if any, studies have examined how these services play a role in the risk and outcomes of dual-system experiences.

Aims

This dissertation has two aims, the first focusing on experiences during foster care, and the second on outcomes after foster care.

Aim 1

Understand how placement type and juvenile justice involvement are associated with the receipt of ILS.

Research Question 1A: Does ILS receipt vary for kids by placement type and juvenile justice involvement status?

Research Question 1B: Accounting for child demographics and child welfare system history, does ILS receipt change as youth move between placements and become involved with the juvenile justice system?

Aim 2

Understand if and how ILS receipt predicts criminal justice involvement for dual-system youth.

Research Question 2A: How do receipt of independent living services predict incarceration at age 19, and does it interact with incarceration at or before age 17?

Research Question 2B: How do receipt of independent living services predict incarceration at age 21, and does it interact with incarceration between ages 17 and 19?

Literature Review

This section will describe existing research examining the literature on predictors of dual-system involvement and independent living services. Dual-system literature is reviewed first, followed by ILS. Because these two topic areas have rarely intersected, both are generally reviewed independently. At the end of the section reviewing ILS, however, there is a short part reviewing the few studies that have examined both.

Dual-System Youth

This section describes existing literature on the predictors of JJS involvement, conditional on CWS involvement. The first set of predictors reviewed are gender and race/ethnicity, which are chosen because they are by far the most studied. For these predictors, each study is categorized according to the system indicators used to operationalize system pathways, e.g., using CMR reports to identify CWS involvement and juvenile court petitions to identify JJS involvement. The association between predictors and dual-system involvement will likely vary based on the system indicators used to operationalize a pathway. As is made clear throughout this section, studies vary widely in this respect. Because different system indicators can be indicative of very different life experiences, predictors need to be interpreted in the context of these pathways.

The second set of predictors are CWS system indicators predicting JJS involvement. They are categorized into the following two categories: CPS reports and foster and group home placement. For findings regarding how variation in CWS involvement predicts JJS involvement, findings are not broken out by pathway as the literature is too sparse. Knowledge of how a child's experience in one system predicts later system involvement can inform proactive case

management practices that can prevent such later system involvement from occurring in the first place.

This section concludes with a review of the literature that examines pathways between the CWS and criminal justice system (CJS). Many youth with JJS involvement grow up to have CJS involvement. The goal for effective services for dual-system youth is not simply to improve outcomes during adolescence, but also through the entirety of their life course. In order to do this, it will be critical to understand not just the connection between CWS involvement and JJS, but also CWS and CJS.

Before detailing the literature, however, the three methods of sampling in the dual-system literature are described. An inherent problem with examining pathways between the systems is that all potential paths are rarely observed in any one study. For example, studies typically condition the sample on a specific criterion of system involvement (e.g., only children with CPS records). Because the relationship between predictors and dual-system involvement vary by sampling approach, it is critical to consider the relevance of each predictor in the context of the sampling methodology.

Sampling Methodology

Studies measuring pathways from the CWS to JJS use one of three sampling designs. The first I refer to as “full cohort”. Researchers conducting a full cohort design sample youth regardless of CWS or JJS involvement, and measure if or when they experience either CWS or JJS involvement.

The second are prospective designs. Because Aims 1 and 2 use these designs, these studies are the main focus of this literature review. For a prospective design, the researcher selects a sample of youth conditional on CWS involvement, and follow them forward in time,

and measure if they have JJS involvement. This approach cannot inform the researcher of how CWS impacts the risk of JJS involvement, as all youth have some CWS experience. It can only inform the researcher of variation within the CWS experience predicts risk of future JJS experience.

The third are retrospective designs. These studies are not included in this literature review. However, reviewing their methodology is important as they are integral to the dual-system literature in general. Researchers sample a cohort of youth with JJS involvement, and match the JJS records to prior (if existent) CWS records. For example, a researcher interested in how often youth that are arrested have prior CWS would sample all youth with an arrest and match CWS records. With no matched record, the researcher assumes the youth did not have CWS involvement. Similar to prospective designs, it only offers part of the story. It cannot tell the researcher how much having an arrest changes the probability of having had a CWS involvement, as all youth have an arrest.

Ideally, the full cohort approach would always be used, as it allows the approximation of the full distribution of pathways. However, it is rarely used due to the resource intensiveness of the data collection. Some researchers include comparisons to a similar population alongside a prospective sample, i.e., JJS involvement rates of kids in the population that do not have prior CWS involvement. Retrospective samples are not discussed in detail in this review because by assuming JJS involvement, the studies are not able to provide information needed to divert children away from JJS involvement, a focus of this dissertation.

Predictors of Dual-System Involvement- Gender and Race/Ethnicity

In this section, studies with a full cohort sampling design are reviewed first, followed by those with a prospective design. Studies with the latter are organized by the specific pathways measured. At the end of this section, the key findings are summarized.

Full Cohort. Very few studies have utilized a full cohort design to measure pathways between the child welfare and juvenile justice systems. There are only three full cohort samples I am aware of: those studied in Widom (1989), Jonson-Reid et al. (2008) and Kelly et al. (1997). Maxfield and Widom (1996) used the sample from Widom (1989), which was a sample of 908 individuals with child maltreatment histories and a demographically comparable set of 667 without maltreatment histories. Juvenile and criminal justice involvement was measured on each. The average age at end of observation period was 32.5 years old. Twenty-seven percent of the maltreated group had a juvenile offense, compared to 17% of the control group. In the control group, 23% of males had a juvenile arrest, compared to 35% of males with maltreatment history. Eleven percent of females in the control group had a juvenile arrest, compared to 20% of females in the maltreatment group. Although males were more likely to get arrested in both groups, the increased risk of arrest in the maltreatment group for females was larger than for males. In the maltreatment group, females had almost a 100% higher rate of arrest than the female controls. The males in the maltreatment group had approximately 50% higher arrest rate than the male controls.

A pattern can be observed between Black and White youth, with the risk of JJS involvement increasing more with CWS involvement for Black youth than White youth. The rate of JJS involvement for Black youth was almost 100% higher for youth with CWS experience

compared to their controls, whereas the rate of JJS involvement was less than 50% higher for White youth with CWS experience compared to their controls.

Bright and Jonson-Reid (2012) followed a cohort of 3,453 children with and without maltreatment reports and a history of poverty who were born in 1982-1986. They measured the risk of status and delinquent petition for females and males, by child maltreatment history and poverty. They find that while the combination of poverty and maltreatment increases the risk of both status delinquent petition for males, but only status offense for females.

Kelley et al. (1997) used longitudinal data from the Rochester Youth Study of 1000 youth. Despite reporting child welfare involvement by gender and race, they do not report the joint distribution of child welfare and juvenile justice by gender or race.

Despite the potential value for a full cohort design to measure the full joint distribution of the CWS to JJS pathways, this sampling method has rarely been implemented. It requires greater set sampling resources than a prospective or retrospective design.

Prospective: CPS Report – Incarceration. Jonson-Reid and Barth (2000a) followed 159,549 children to age 18 who were born between 1974 and 1983 and were reported for abuse and neglect after 1990. The earliest a child could be recorded as having a CPS report was at age 7. Males and Black youth were at increased risk of incarceration, with Black youth averaging almost twice the rate of incarceration than White youth.

The authors compare the incarceration rates of their sample to those of the broader population rates. Although males in their sample had higher rates of incarceration, the increase in incarceration rate between the general population and their sample was greater for girls than boys. The proportion of females entering CYA with child welfare histories was almost three times higher (.2 per 1,000) than that from the general county wide population of females of that

age range (.07 per 1,000) as compared to the proportion of males entering CYA with child welfare histories—two times higher (2.9 per 1,000) than that of the general male population (1.4 per 1,000). While they also measured receipt of in-home services and foster care, it is unclear of each's respective rate into juvenile incarceration (see Figure 2).

Jonson-Reid and Barth (2000a) measured three race/ethnicities: White, Hispanic, and Black. They found that Black youth had the highest rates of juvenile incarceration. However, they report that the rate of entry into CYA among children with investigated abuse reports compared to children in the general population doubles for all three race/ethnicities, implying that race does not moderate the impact of CPS reports on juvenile justice involvement.

By comparing the incarceration rates of their sample to those of the general population, Jonson-Reid and Barth (2000a) provide evidence that the effect of having a CPS report increases the probability of incarceration more for girls than boys.

Prospective: Substantiation – Petition. Ryan and Testa (2005) followed a cohort of 18,676 people born in 1983 and 1984 who had at least one substantiated report before age 18. They also follow a subset of kids with at least one placement to predict delinquency (see below). The authors break their results into female and male samples, allowing only gender specific analyses of race. They also do not estimate the odds ratio between males and females petition rates. However, they do report that females had a lower rate (4%) of delinquency than males (14%). In logistic regression models, being Black increased risk for petition for both males and females, in relation to White youth. Both Black boys and girls had over twice the odds of receiving a petition than White boys and girls, respectively. Being Hispanic increased the risk only for males, and not for females. They provide evidence that being Black increases the risk of having a petition among youth with a substantiated petition, regardless of gender.

The authors also compare yearly delinquency rates of their sample to yearly aggregate county level delinquency rates of youth without CWS involvement (though it is unclear how they sample youth without CWS involvement). They report that, from 1995 through 2000, CWS involved youth averaged a 47% higher delinquency rate than youth without a CWS history. However, they do not report gender or race specific rates between the CWS and non-CWS populations.

Kurpiel et al. (2024) used a sample of 7,787 children with substantiated CPS investigation between the ages of 9 and 13. These records were matched with JJS charges, analogous to court petitions, i.e., children were referred to the juvenile court, the referral was accepted, and the youth was charged with an offense. The charges may or may not have been adjudicated after the charge was filed. The authors examined whether the type of maltreatment was associated with the type of offending. They found that certain types of maltreatment predicted offending in general, more than other types of maltreatment. Maltreatment type was not specific to offending type. Female youth had close to half the odds of any offending. Both non-Hispanic Black youth and Hispanic youth had almost 50% higher odds of offending than non-Hispanic White youth.

Prospective: CPS Report-Arrest. Bogie et al. (2011) used a sample of 3,566 children with CPS investigations between April-December 2005 between the ages of 7-15 in Los Angeles, with a 3 year follow up timeframe. Five-percent of females had a subsequent arrest, while 9.4% of males did. Regarding race, they find 6.6% of Hispanic, 10% of Black, and 6.8 % of White children had subsequent rearrests.

Prospective: CPS – Adjudication. Bogie et al. (2011) also track whether the youth with CPS reports were subsequently adjudicated as delinquent after arrest. Three percent of females

were subsequently adjudicated, and 6% of males were. Regarding race, 3.8% of Hispanic, 7% of Black, and 5.3 % of White children had adjudications. The distributions mirror those of the CPS-Arrest pathway cited directly above, implying that the distributions of gender and race do not change as youth get deeper into the JJS system.

Vidal et al. (2017) used a sample of 10,850 kids with maltreatment incidents report for the period from 2000-2007 who were 10-13 in 2007, and matched them with juvenile justice records identifying adjudication subsequent to their CPS reports. For the whole sample, 2.5% (275) had an adjudicated record. The dual-system youth was more male than the CWS only group, 75% vs 53% males, and more Black (27% vs 14%) and less White (45% vs 60%).

Prospective: Foster Care – Arrest. Ryan et al. 2010 follow a group of 13,396 youth placed in foster care and use propensity score matching to examine differences in arrest rates between those placed in kinship and non-kinship care. In order to classify spells as either kinship or non-kinship, they used an 80% time in care cut-off rule; if a youth spent more than 80% of their spell in a kinship home, they were classified as kinship. They did not select a cohort, instead matched kids with ongoing or open CPS case from 2002 – 2008 (from which they subset down to those with a foster care episode) to delinquency records. They measured delinquency as having an arrest between 2002-2008. The sample was selected so that all youth are at risk for at least one year.

The authors present all results by kinship vs non kinship placements by gender. Being Black increased the risk by 1.66 and 1.68 for girls and boys. Via Table 5, averaging over kinship vs non-kinship, about 24% of Black males had a subsequent rearrest, while 13% of Black girls did. Twenty percent of Hispanic males vs 8% of Hispanic females, and 16% of White males vs

8% of White females. Given the male arrest rate is about double the female arrest rate, these distributions mirror the marginal distributions.

Huang et al. 2012 selected a cohort of 1,148 youth who were arrested in 2003 while receiving in-home services or in foster care. Because the majority of the sample (92%) had foster care before their arrest, I summarize these findings by simply assuming the results are of only the foster care – arrest pathway. Following the cohort from 2003 to 2008, Huang et al. 2012 then tracked subsequent re-reporting and re-arrest. They do not present distributions of the sample by gender or race, but do present the hazard ratios from a cox regression model predicting rereport and recidivism. Males had a 30% higher risk of recidivism, and White youth had a 30% lower risk than Black youth. Hispanic youth had a 20% lower risk than Black youth.

Huang et al. 2015 selected a cohort of first-time offenders arrested for a violent offense between 2003 and 2005 in LA, limited to youth 16 and under, excluded those whose arrest resulted in a residential placement, and limited to youth in child welfare out of home placement at time of arrest. The final sample consisted of 213 youth. Thirty-five percent of the sample was female, and 68% was Black, 25% Hispanic, and 5 % White. They followed them and measured recidivism (subsequent arrest) until turned 18, also breaking the sample down by type of child welfare placement change within 90 days of arrest. Males were 50% more at risk of recidivating, and White youth were 70% less and Hispanic youth 2% less than Black youth. Moving from a family-like setting to group home setting increased risk significantly (although only 6 youth). This study uses a small sample, and so is underpowered. Representativeness for such a small sample is also a question, threatening generalizability. They also restrict their sample to only foster care youth who were arrested while in care.

Ryan et al. (2007) follow a cohort of 294 male youth between 16 and 18 who exit a large midwestern foster care agency, and follow them between the ages of 16 and 22, using arrests as their measure of juvenile justice involvement. They use cluster analysis on the offending trajectories of the youth in foster care. The authors find three groups: non-offenders, desisters, and chronic offenders. The non-offenders had no arrests, desisters had some arrests between 17 and 19 but desisted by age 20, and the chronic offenders had arrests throughout. The distribution of race/ethnicity across the three groups varied little. Because they sample only males, this study cannot analyze gender as a predictor.

Ryan et al. 2008 follow a cohort of youth with at least one placement between 7 and 16 years of age in LA, from all CPS reports between 2001 and 2005. Arrest records were matched for arrests in LA occurring between 2001 and 2005. They excluded those with arrests prior to their first out of home placement. Using PSM, their final matched sample was 8,226. They compare the differences in arrest rates between those in group homes (26%) and foster care (74%). Sixteen percent of males had an arrest, and 11 % of females had an arrest. Sixteen percent of Black youth, 14% Hispanic youth and 9% of White youth had an arrest.

Ryan (2012) examines whether the reason for foster care placement, i.e., maltreatment, or child behavioral problems, is associated with subsequent risk of arrest. He used a sample of 5,528 youth with their first episode in substitute care between 2000 and 2003. The youth were at least 8 at the start of the study period, and were followed for five years. Ryan (2012) also includes indicators if youth had prior arrest before first placement. He breaks the sample into six groups by combinations of type of placement and prior arrest (which includes + 2 mixed groups.) Boys had a 20-27% increased risk of arrest. Black youth only had an increased risk (30%) relative to White youth if they had a prior arrest. Hispanic youth did not have an increased risk.

Prospective: CPS Report- Petition. Bright and Jonson-Reid (2008) followed a cohort of 3,453 children who either had a CPS report in 1993-1994, experienced poverty, or both. They found that the experience of maltreatment and poverty had additive effects in the risk of juvenile petition for boys, but did not have additive effects for girls. Specifically, the risk of delinquent petition did not increase for the maltreatment and poverty group compared to the maltreatment only group for females.

Prospective: Foster Care – Petition. Cutinili et al. (2016) tracked birth cohorts in three counties: Cuyahoga County (n= 10,284), Cook County (n=26,003), and New York, (n=13,065). All youth had at least one foster care placement. The authors matched the foster care records with JJS records, and followed each cohort up until age 18. The birth cohort years ranged from 1990 through 1995, 1990 through 1995, and 1994 through 1995 in Cuyahoga County, Cook County, and New York, respectively. The sample was subset to by age at first placement (0-1, 1-2, 2-8, and 9+ years of age). Males consistently had higher hazards than females (HR range: 1.57-4.60) across counties and age groups. White children consistently had lower hazard ratios compared to Black children across all sites and age categories (HR range: 0.21–0.69). Hispanic youth also had consistently lower hazard ratios than Black children (HR range 0.36-0.80). These distributions highlight that males and Black youth placed in foster care are at increased risk.

Prospective: Foster Care – Incarceration. Jonson-Reid and Barth (2000b) tracked 79,139 children in California born between 1970 and 1984 with at least one foster care spell after 1988 and measured rates of incarceration for serious violent offenses. Similar to Jonson-Reid and Barth (2000a), they compare the sample's incarceration rates to the general populations. They find that the increase in risk for females in foster care compared to females in the general population was higher than the increase in risk for males in foster care compared to males in the

general population (10 times the risk vs. five times the risk). Regarding race, they report that there were very few non-Black or “other” children in the sample, which makes their incidence rate difficult to interpret. This article is unable to provide evidence of race as a predictor for this pathway.

Kolivoski et al. (2014) followed a group of 794 youth with at least one year of foster care placement. Note the same comes from a larger group of 9,273 children who experience placement born between 1985 and 1994. Incarceration was operationalized as whether a youth spent time in detention and/or juvenile placement, and for the adult justice system, this was indicated whether time was spent in the county jail, from ages 12 to 22 in three-month increments. They used trajectory analysis on justice system trajectories, and found that a five-group model presented the best fit. The five groups were no/low involvement, early age, late adolescent-early adult, short-term high, chronic. Females were more likely to be in the non-offending group (60.4 vs 39.6) and less likely to be in every other group. Black children were less likely to be in the non-offending groups than White youth, and more likely to be in every other.

Goodkind et al. (2013) used a birth cohort of 42,735 youth born between 1985 and 1994 whose families received in-home services or were placed OOH. Twenty percent of the sample had OOH placement. Juvenile justice involvement was defined as experiencing at least one placement in a detention or residential facility. Youth with prior juvenile justice involvement were discarded, which accounted for one percent of the original sample. Black youth had 60% higher odds of JJS involvement, boys had 4 times the odds. Interestingly, the interaction term of race*gender was significant, which implied that the increase in risk of placement for Black youth was largely due to the increase in risk of placement for Black boys. Males are at a 4-5 times

greater risk of placement than girls. It is unclear with regards to race however, due to the interaction term.

Jonson-Reid (2002) followed a cohort of 37,479 children reported for CPS in 1993-1994, and investigated the moderating role of in-home service receipt on risk of juvenile incarceration. The author found that gender moderates the association between race/ethnicity and juvenile incarceration rate. While race/ethnicity predicted incarceration for males, it did not for females.

Summary of Findings-Gender and Race. The above studies examine how gender and race differentially predict JJS involvement, conditional on CWS involvement. The prospective samples exhibit significant variation in the sample distributions, as the samples vary on a number of parameters, e.g., sample selection, follow up time, and demographics of the specific population sampled. The vast difference in samples makes direct comparison of the study findings difficult. The studies also differ by statistical modeling approach, further complicating comparisons.

In all of the studies, male and Black youth are consistently more likely to have JJS involvement than females and White youth, respectively. This finding is not surprising, as these findings hold regardless of prior CWS experience (Cernkovich and Giordano, 1979; McCoy & Pearson, 2019). Generally speaking, the risk of later JJS involvement was around 50-100% higher for males, relative to females, and 50-100% for Black youth, relative to White youth. The magnitudes of the differentials varied across studies, which is also to be expected. The system pathways differ according to depth of system involvement, i.e., incarceration being deeper than arrest. Prior literature has documented that rates by gender and race vary by the “depth” of such involvement. For example, in 2019, Black youth represented a larger share of the overall detention caseload than of the overall delinquency caseload, indicating that racial

disproportionality increases with increasing severity of delinquency (Juvenile Court Statistics, 2022). Males also are increasingly overrepresented with increasing depth of system involvement (Juvenile Court Statistics, 2022).

The main drawback of prospective studies is, by conditioning on CWS involvement, they are not able to reveal moderating influences of gender or race. For interventions and policies to be effective at preventing further system involvement, they must be targeted to the specific needs of the youth. Knowledge as to how or if predictors like gender may moderate these processes is critical to achieve a targeted approach. For example, if females and males are both similarly “affected” by CWS involvement, with regard to risk of future JJS involvement, then interventions may not need to be guided by theoretical frameworks that explain differences in developmental between boys and girls. If, on the other hand, females tended to be more “affected”, then the evidence would suggest incorporating such theoretical frameworks in the design of interventions.

One approach to estimate these moderating influences in prospective studies is to compare the sample rates to population level rates estimated outside of the sample. This approach is generally taken when full cohort sampling is infeasible. In the studies detailed above, two studies do this. They compare the JJS involvement rates to JJS involvement rates of the general population from which they sampled. Jonson-Reid and Barth (2000a, 2000b) find that the difference in the rates of JJS involvement between the general population and CWS sample is greater for females than males. They do not find significant differences between race/ethnicities, however. Testa and Ryan (2005) also use a population level control, but do not include race and gender in their findings.

One of the primary advantages of full cohort studies is that they allow for the direct measurement of these moderating processes. By observing all pathways between systems, regardless of prior involvement, they can compare youth with no involvement in any system, to youth with involvement in any one system, and to youth with involvement in both systems. The full cohort studies outlined prior to the prospective studies provide evidence that gender and race are associated with moderating effects. The sample used in both Maxfield and Widom (1996) and Widom (1989) observed that the increased risk in JJS associated with CWS experience was higher for female youth and Black youth, relative to male and White youth (respectively). In the maltreatment group, females had almost a 100% higher rate of arrest than the female controls. The males in the maltreatment group had approximately 50% higher arrest rate than the male controls. This same pattern held in comparison to the Black vs White youth. The rate of JJS involvement for Black youth was almost 100% higher for youth with CWS experience compared to their controls, whereas the rate of JJS involvement was less than 50% higher for White youth with CWS experience compared to their controls. This finding provides partial support for the finding in the prospective samples in Jonson-Reid and Barth (2000a, 2000b), which find that the difference between the population level JJS rates vs the JJS rates in the sample is greater for females than males.

Another perspective would be to examine these predictors in the context of retrospective studies, which could shed light on gender and race as moderators. Baidawi et al. (2021) conducted a scoping review of gender differences of the maltreatment-youth offending relationship. Of the total 180 studies reviewed, 24 studies used retrospective samples conditioned on JJS involvement. The authors note that these studies consistently found that females in the JJS population consistently had more CWS involvement, and that of the dual-system youth identified

in the studies were more female. This review, along with the findings from Jonson-Reid and Barth (2000a, 2000b) and Maxfield and Widom (1996) provide strong evidence that gender does moderate the relationship between CWS and JJS involvement.

However, more research must be conducted to see an analogous relationship for race. Despite one-third of children in the US identify as Hispanic, the literature on Hispanic dual-system youth specially is sparse. While some studies above included Hispanic specific measures, there is also variability in how it is combined with race, making the already sparse literature even more heterogenous. This issue also extends to the JJS literature in general. For example, it is currently not possible to compare arrest rates between White/Black youth and Hispanic youth. The FBI's Uniformed Crime Reporting (UCR) database, the primary data source involving arrests across the United States, does not aggregate race and ethnicity. The findings from Maxfield and Widom (1996) provides some evidence that Black youth are overrepresented in dual-system populations, as compared to JJS alone or CWS alone populations. However, more studies with more current samples are needed to confidently establish a connection. The lack of literature makes culturally competent policies and interventions difficult.

What is also missing from this discussion of race as a factor in predicting dual-system involvement is the tremendous state variation that almost certainly needs to be considered. States vary according to the race/ethnicity composition of youth, and according to rates and policies for CWS and JJS involvement. With the exception of Cutinili et al. (2016), who used samples in Ohio, Illinois, and New York, all the studies outlined above used samples specific to individual states. They are also not evenly distributed across different states. A large portion of the studies use California data. Given the differences in racial/ethnic composition and social policies

between states, it is possible that moderating effects might be observed in one state but not another.

In summary it appears that race predicts the likelihood that CWS populations will enter the JJS, with Black youth at around double the risk of White youth. There is some evidence that CWS experiences increases the risk of JJS involvement more for females and Black youth relative to males and White youth. The majority of this evidence regarding female youth comes from the retrospective design literature. Unfortunately, prospective designs provide us with limited capacity to directly study how CWS experience differentially impacts the risk of JJS involvement across gender and race.

Predictors of Dual-System Involvement: CWS Experiences

This section presents literature on the second most common set of predictors in the dual-system literature: CWS system indicators. Studies will no longer be broken down by specific system pathway. First, findings regarding how variation in CPS reports predicts JJS involvement are presented. Second, the finding on how out-of-home placement, and variation within out-of-home placements, predict JJS involvement are presented. Because these studies were presented above, details regarding sample descriptives are not reviewed. I include a summary at the end of each section.

CPS Reports. Bright and Johnson-Reid (2008) find that age at first maltreatment report significantly predicts status and delinquent petitions, with older youth more likely to become dual-system youth. Jonson-Reid et al. 2012 found that the risk of juvenile justice violent delinquency petition generally increased with increased numbers of CPS reports. Those with no reports had an 8% rate of violent delinquency petition. Having 1, 2 or 3 increased to about 15, 19

and 21%. Ryan and Testa (2005) found that youth with more than one report were at increased risk of delinquency petition.

Jonson-Reid and Barth (2000a) found that youth who were initially referred for neglect were more likely to be incarcerated than those referred for sexual or physical abuse. They find that age at first report (indicator of being 14 and older) was one of the strongest predictors of incarceration (along with being male). Using a sample of youth with at least one OOH placement, Jonson-Reid and Barth (2000b) found that neglect was not more likely than physical abuse to lead to incarceration.

Vidal et al. 2017 found similar findings. Youth with a neglect case were more likely to transition (adjudication) than those without one. Crossover youth were also older at first CPS investigation, with every year increase. Lastly, they find report chronicity increased the likelihood of transitioning. Those who experienced repeat maltreatment were almost twice as likely to enter the JJS. Goodkind et al. 2012 found that having a case open after age 13 increased the odds of juvenile justice placement by four times.

Jonson-Reid (2002) followed a cohort of 37,479 children reported for CPS in 1993-1994, and investigated the moderating role of in-home service receipt on risk of juvenile incarceration. The author found that in-home service receipt decreased the risk of juvenile incarceration for non-White youth.

Cho et al. (2019) found that youth with three or more child maltreatment reports were at increased risk of being adjudicated delinquent. Specifically, the hazard of being adjudicated delinquency was double for youth with three or more, as compared to youth with one or two. The decision to use a cut off at three reports is unclear.

Kurpiel et al. 2024 found that maltreatment type predicted the probability of being a juvenile offender. Youth who were in a report with a physical abuse allegation were at increased probability of being charged by the juvenile court than youth without a physical abuse allegation. Note that the sample was from Pennsylvania. Because they are an outlier in how they process child maltreatment reports, reports with neglect allegations were underrepresented.

Herz et al. (2019) uses a retrospective sample of youth with a juvenile petition, but uses population level CWS data to compare to the CWS involvement characteristics of the dual-system youth in the sample. The authors find that the dual-system youth in the sample has more CPS reports and a later age at first report, on average, than the population level “controls”.

Summary of Findings- CPS Reports. The most consistent findings are that number of reports and age at first report predict later JJS involvement. The findings as to whether maltreatment type predicts JJS involvement are mixed. Kurpiel et al. (2024) provides some evidence, however the sample is taken from Pennsylvania, which has an aberrational CWS. Neglect cases are significantly underrepresented, making it mostly about physical abuse vs sexual abuse cases. Kurpiel et al. (2024) find no particular link between the specificity of maltreatment type and offending.

That both number of CPS reports and age (older) at first report are both predictive is expected. As a youth experienced multiple reports, the probability that they are experienced chronic maltreatment increases. Chronic maltreatment has been linked to various maladaptive outcomes (Jonson-Reid et al. 2012). Being older at first report can also be an indicator of chronic maltreatment. It is possible that youth reported at older ages have been experiencing maltreatment longer than their counterparts who were reported at younger ages.

Out-of-Home Placement. Jonson-Reid and Barth (2000a) found that having in-home services and foster placement reduces likelihood of incarceration for Black and Hispanic youth, but not White youth. Jonson-Reid and Barth (2000b) observed that multiple foster placements increased risk of incarceration, and that returning home after first spell reduced risk for White youth, but increased for Black and Hispanic youth between ages 11-14 at first placement had higher risk of incarceration than younger than 11 and those older than 14.

Ryan and Testa (2005) followed a cohort of 18,676 youth with at least one substantiated report born in 1983 and 1984. They included a measure of foster care placement (indicator of at least 1) in their sample of kids with one substantiated report to predict a petition. They found that being in foster care almost doubled the risk of petition for both boys and girls.

Goodkind et al. (2012) used a subset who experience at least one OOH to model additional CPS experience indicators. Of those who were placed, having a congregate care placement increased the odds by 3.6 times. Each year in placement decreased the odds by almost 10%. They also found that the odds increased by 10% per each placement.

Ryan 2012 included measures of placement reason, maltreated or behavioral. Twenty-three percent of the sample was placed for behavioral reasons, but accounted for 31% of arrests. They were at 20-50% higher risk of arrest than those placed for just maltreatment. Youth with no group home placements had about 80% the risk of arrest, and those with 2 or 3 placements had 120% and 160% the risk as those with only one placement (which only applied to youth with no prior arrest).

Ryan et al. 2008 used PSA and found that group home placement increased risk of arrest by 140%. They also find that placement changes and length of stay increase the odds of arrest. This finding regarding length of stay is counter to the findings by Goodkind et al. (2013).

Ryan et al. 2010 found that being placed in a group home increased risk between 50-70%, and found that type of maltreatment only mattered for females, neglect and sexual abuse. They found that kin placement does not predict juvenile justice involvement, but length of stay increases it. This finding regarding length of stay runs counter to those of Goodkind et al. (2013). Note that Ryan et al. (2008) and (2010) drew similar samples from the same population based in Los Angeles.

Culhane et al. (2011) found that crossover youth had more DCFS out-of-home placements (i.e., distinct instances of out-of-home placement during which an individual might experience one or more placement changes) and more placement locations (i.e., changed placements more frequently) during their last out of home placement than CW exiters. Second, the majority of CW exiters aged-out from the CWS, while only about one-third of crossover youth aged- out, and a far greater share of crossover youth exited the CWS due to incarceration in either the juvenile or adult correctional system. Third, more CW exiters than crossover youth were residing in a foster home placement or in a relative's home at the time of their exit from DCFS care, while more crossover youth were residing in group homes at their time of exit from DCFS care.

Doyle (2007) and (2013) used a sample from the Illinois Integrated Database (George, Van Voorhis, & Lee, 1994), which includes all children investigated for abuse or neglected between 1990 and 2000 in Illinois. The sample was further restricted to those who were at least 15 in 2000. Fifty percent of the children were at least 5 at initial investigation. The final samples vary slightly, and are 15,039 and 15,681. He uses an instrumental variable approach to estimate causality between placement and delinquency petition, exploiting the 'random' assignment of investigators to children. Doyle (2007) and (2013) present similar analyses and results and are

summarized jointly here. Doyle finds that children assigned to case managers with high removal rates are more likely to be placed in foster care, and have higher delinquency rates.

Importantly, these interpretations are valid only for the subset of foster children who are “at the margin” of placement. They are not applicable for children who are at a moderate to high risk of either being or not being placed in foster care. It is crucial to interpret Doyle’s findings with this caveat. After all, it is reasonable to expect that, between two children who were “at the margin” of being placed, the child who did not might have better outcomes. The majority of developmental theory would predict that, all else being equal, being displaced from a home has a net negative impact on one’s developmental trajectory. One cannot take these findings and assume that a child removed for chronic and severe physical abuse would be better off if they had never been placed. The “efficacy” of foster care must take all youth placed into account. A more robust analysis would compare two children not at the margin. However, due to obvious ethical constraints, such an analysis is infeasible.

Bald et al. (2019) uses an approach similar to Doyle, specifying removal tendencies of child protection investigators as an instrument through which to infer causality. While focusing primarily on school outcomes of a sample of younger (0-6 at investigation), they also include juvenile justice involvement as an outcome in a sample of older (6-18) children. They do not find any effect of foster care on juvenile justice court conviction.

Yoon et al. conducted a systematic review on the association between OOH placement and offending behavior among maltreated youth. They found 15 articles meeting their criteria, though not all used administrative data, looked at juvenile justice specifically, and took place in the US. Seven of these are referenced in this section. They find that there are mixed findings regarding being placed in OOH care and offending behavior. They find consistent findings that

being placed in more restrictive settings, higher number of placements, and placed at a later age are associated with a higher probability of offending behavior.

Summary of Findings - Out-of-Home placement. The literature review conducted by Yoon et al. (2018) effectively summarizes the existing literature between out-of-home placements and JJS involvement. The main findings in Yoon et al. (2018) also align with the findings presented here. In general, literature consistently finds that restrictive settings, number of placements, and late age at placement all predict an increase in likelihood of JJS involvement.

The finding that being placed in a group home is associated with JJS involvement is to be expected. Because national foster care standards require that youth be placed in the least restrictive setting possible, youth are typically only placed in group homes when they are not able to be feasibly housed in a foster home. This generally indicates that youth in group homes tend to have behavioral problems that are associated with delinquent behavior. It could also be possible that being in a group home increases JJS involvement, relative to foster care, due to a surveillance bias, but the research is scant in that regard. One could also predict a peer contagion effect (McGloin & Thomas, 2019). Youth without behavior problems associated with delinquency might adopt such behavior from other youth who they live alongside.

Number of placements predicting JJS involvement could have at least two explanations. One is that it self-selects for children with behavioral problems that are associated with delinquency, similar to group homes. However, developmental theory would predict that continually being displaced, with no consistent caregivers, would lead to a host of mental and behavioral problems. Late age at entry also has at least two explanations. The first could be that it is an indicator of experiencing chronic maltreatment, in the same way that first age at report predicts JJS involvement (discussed above). Second, youth enter the foster care system for issues

other than child abuse or neglect, and a common reason is for behavioral problems. It is possible that the behavioral issues resulting in placement could be the same underlying cause of delinquency.

These system predictors offer particular use because they are data that is always collected by CWS in all states. For example, they allow for the use of real time case management practice to incorporate special services upon detection of one of the given system indicators. A problem with risk assessment surveys is that it may not always be feasible to conduct the assessments due to lack of time on the case manager's behalf. Also, they come with extra costs that state agencies might not be able to afford. The findings from Yoon et al. (2019) provide support that state agencies have the potential to leverage out-of-home placement indicators to use as predictors of JJS involvement and as markers through which to guide and implement interventions and services.

Criminal Justice Involvement

The prospective studies reviewed above can inform policies and interventions aimed at preventing future JJS involvement. However, only focusing on future JJS involvement is inadequate to ensure long term positive outcomes for children with CWS experience. While less common than studies examining the CWS-JJS link, studies have found that CWS involvement also predicts criminal justice system (CJS) involvement in adulthood. JJS involvement has been consistently found to be highly predictive of CJS involvement as well. These two associations make the study of CWS to CJS, with and without JJS involvement, all the more critical to inform effective policies for dual-system youth. This section details the studies that have examined these links. These studies also directly inform the development of Aim 2, which examines the association between dual-system involvement and CJS involvement in young adulthood.

CWS and Criminal Justice Involvement. Maxfield and Widom (1996) found that 55% males in the maltreatment group had at least one adult arrest, compared to 49% of the male controls. Twenty-eight percent of females in the maltreatment group had an adult arrest, compared to 16% of the female controls. This result mirrors the JJS involvement, that the increase in risk due to maltreatment is greater for females than males. Black youth with CWS experience were more likely than White youth to experience CJS involvement, 59% vs 33%.

The Midwest Evaluation (Courtney et al. 2007) followed 732 youth in foster care at age 17, not placed for delinquency, up until age 21. They find that over 56 and 79% of women and men had ever been arrested, respectively. These rates are compared to 4% and 20% of a nationally representative non-foster care peers (Add Health).

Berger et al. 2016 uses data from Wisconsin to examine the proportion of CPS-involved adolescents who became incarcerated as young adults. The authors find that 29 percent of CPS-involved adolescents in Wisconsin spent time in either county jail or state prison between the ages of 18-21. Black, male and youth with out-of-home placement were at increased risk of CJS involvement in young adulthood.

Goodkind et al. 2020 followed a cohort of individuals born between 1985 and 1994 whose families received in-home or OOH services in one Pennsylvania county, consisting of 42,735 children, of whom 9,273 had at least one OOH placement. They used path models to related child welfare experiences and criminal justice (spent time in a county jail), with juvenile justice involvement (as measured by detention/placement) as a mediator. They find that juvenile justice involvement is a mediator of criminal justice involvement. Specifically, it mediates the effects of out of home placement, and age at OOH placement (older at first placement more likely to have juvenile justice involvement). Black youth in the system longer and with fewer

placements were less likely to have a juvenile justice placement. For youth with at least one placement, the only variable not mediated by juvenile justice involvement was age at case closure.

Font et al. (2021) examined how variation in foster care exits predict future criminal imprisonment between the age of 18 and 23 by following a cohort of youth who entered foster care between the ages of 10 and 17. They find that reunifying increased the hazard of imprisonment by over 50% in comparison to those emancipated. Black youth had 128% higher hazard of imprisonment, relative to white youth. Hispanic youth has a 30% higher rate.

While the evidence suggest CJS involvement is relatively common among CWS involvement individuals, CJS involvement conditional on JJS involvement is more common. Studies agree that 40 to 60 percent of justice-involved youth continue offending into early adulthood (NIJ, 2014). Two studies examined the relationship between JJS and CJS involvement using NYTD data. Gibbs et al. found that JJS involvement increased the odds of CJS involvement by 2.5, and Prince et al. 2019 found it to increase the odds by 2.8, albeit with a different measure of JJS involvement.

Summary of Findings: CWS and Criminal Justice Involvement. The above studies present evidence that CWS experience increases the likelihood of future CJS involvement. The findings generally mirror those found regarding gender and race in the prospective studies above. Black youth were between 50-100% more likely to experience CJS involvement. One question future literature should examine is whether the moderators that are associated with female and Black youth risk of JJS involvement are the same as those associated with risk of CJS involvement.

The studies also present evidence that future involvement in CJS varies according to CWS experience, such as being placed in out-of-home placement and, of those with out-of-home placement, permanency type. The association between out-of-home placement and CJS involvement also mirrors the findings regarding JJS involvement. It remains unclear whether the association exists due to factors preceding the out-of-home placement, or experiences occurring as a result of the out-of-home placement.

Font et al. 2021 presents findings that have implications for reunification and its role in returning youth to unstable households, presenting evidence that reunification is associated with incarceration, relative to emancipation. This study is particularly novel, as most studies that have examined outcomes between different permanency types have not focused on CJS involvement. Assuming the study adequately controls for factors such as income and neighborhood characteristics, the findings could imply that youth are being reunified into environments where behavior leading to CJS is encouraged or necessary.

Independent Living Services

This section discusses independent living services, what they are and what we know about them, why they should be examined as an intervention for dual-system youth, and how existing literature describes them relative to JJS and CJS involvement.

ILS: Policy and Existing Literature

Approximately 10% of youth who exit foster care exit to emancipation (AFCARS 2021), meaning they age out of care. These youth have consistently been shown to have a myriad of poor outcomes (Courtney et al. 2011). Independent living services (ILS) refer to a broad set of services offered by foster care agencies to help and support youth aging out of the foster care

system. ILS include post-secondary support programs, tuition waivers, employment training programs, and life skills training programs.

Federal funding for independent living services began with changes made in 1986 to Title IV-E of the social security Act which created the Independent Living Program (ILP) (GAO, 2004). Currently, federal funds for ILS are primarily provided through the Chafee program, which was created through the Foster Care Independence Act, the most significant change to ILP upon its passage (GAO, 2004). The Chafee program provides states funding under Title IV-E, for support services intended to assist eligible youth transitioning to adulthood. Chafee program services include help with education, employment, room and board, and supervised independent living arrangements (GAO, 2019). Eligible youth include youth in foster care ages 14 and older and are likely to age out of foster care. These criteria were expanded to youth aged 16 or older exiting to adoption or kinship guardianship (GAO, 2014).

Studies have shown that not all youth eligible for services receive them, though rates of receipt have differed. The rates of ILS receipt of eligible youth varies by study. Using NYTD and AFCARS data, Okpych (2015) found that about half of eligible youth received ILS. Secondary education supports were the most common, at 30%. Chor et al (2017), using similar data, implemented a latent-class analysis and found three clusters of ILS service receipt: higher service receipt (~22%), limited service receipt (~28%), and independent living assessment and academic support receipt (~50%). They find that older youth over age 18 were highly likely to be in the limited service receipt, which was characterized by financial support but little else. Studies using different data (non NYTD) found higher rates of receipt, however. For example, using data from the Midwest evaluation, Courtney et al. 2004) found 54% receive adamic supports.

Courtney et al. 2014, using CalYouth survey data, found 95% received education support services.

The efficacy of ILS is still being studied. Doucet et al. (2022) conducted a systematic review of 64 studies. They conclude that ILS are not yielding the intended impact on transition outcomes. A common finding was that the longer youth spent time receiving ILS, the better the outcomes. A study not referenced in the review, due to timeframe constraints of the systematic review period, used propensity score matching with NYTD data to estimate the effect of ILS on young adult outcomes. Using a single binary indicator of receiving any or not, they found that ILS receipt predicted HS and post-secondary education and employment. Huang et al. 2021 used NYTD data and found financial assistance services receipt in young adult hood decreased risk of homelessness and incarceration. Using NYTD data, McCauley (2022) found that, among children with disabilities, academic supports and post-secondary supports increased the probability of full-time employment.

ILS and Dual-system Youth: Theoretical Perspectives

Few studies have directly examined how ILS impacts the system trajectories of dual-system youth. Nevertheless, while it remains unclear empirically if these services play any role in interventions for these youth, theory from criminology indicate how they might play a role, and why research is warranted to investigate. At least three theories can inform this connection.

First, ILS has the potential to moderate what Agnew (1992, 2006) refers to as criminogenic strains. According to Agnew's (1992, 2006) general strain theory, criminogenic strains are negative affective states. People respond to these strains by resorting to crime in an attempt to diminish their presence. Key categories are failures to achieve one's goals (Agnew &

Brezina, 2018). Research has documented youth in foster care struggle academically. The academic supports in ILS could help.

Second, ILS could increase the connectedness that foster youth feel and experience to social supports, either through direct mentorship or via community networking. Social control theory would posit that youth are less likely to engage in delinquency if they have connections or social investments that might be compromised as a result of delinquency. ILS programming can facilitate opportunities for youth to make these connections through a variety of means. For example, these connections could come about from increased access to employment opportunities resulting from employment training programs. Similarly, they could come about through community ties formed in post-secondary education networks.

Third, associations made via ILS participation can lead to reinforcement of values, beliefs, and behaviors that disincentivize or are not conducive to delinquent behaviors. The social learning theory developed by Akers (1985) identifies how delinquency is learned or unlearned. A key component in the theory is differential association, which refers to direct social interactions with members of a primary group and less frequent identifications with more distal groups. The time spent participating in ILS services, such as mentorship, is time spent around supportive adults and peers. These interactions reinforce psychological processes that desensitize delinquent behavior. For example, academic supports might internalize beliefs that delinquency behavior is unacceptable as it increases the risk of being suspended from school, making academic success less probable.

Because of the breadth of theory and generality of ILS, specifying a finite set of causal paths between ILS and delinquent or criminal behaviors is challenging. However, because so many potential paths exist, research investigating a connection is greatly warranted. The

following sections reviews the general policy context of ILS, their efficacy, and existing literature regarding connections to delinquency and criminality.

ILS - Delinquency

Very little is currently known about the role of ILS for dual-system youth and their outcomes. Regarding delinquency, Lee and Ballew (2018) used NYTD data to estimate ILS receipt and adjudication status on risk of being homeless or incarcerated in young adulthood (which they term social exclusion). However, they do not estimate how the two interact, or co-occur over time.

The scarcity of studies on ILS and dual-system youth should be understood in terms of the subset of dual-system youth that would be eligible for ILS. It is reasonable that research on the relationship between ILS and dual-system pathways is limited, as ILS youth are necessarily in foster care, and the majority of dual-system youth experience JJS involvement after CWS/FC involvement. We can estimate the proportion of dual-system youth who would be eligible for ILS using findings from Herz et al. 2019, who categorize distribution of system-level pathways.

Using terminology from Herz et al. 2019, ILS youth could fall into dual contact youth (non-concurrent) – juvenile justice pathway, or dually-involved youth (concurrent) - any pathway. In their findings, more youth fell into the latter, i.e., had concurrent contact. Using samples of youth with a juvenile justice petition, Herz et al. measured the frequency of these pathways in Cook County, Cuyahoga County, and NYC. Of the full samples, about 12%, 24%, and 32%, respectively, fell into these categories. Herz et al. 2021 replicated the studies in LA, and found 30% fell into these categories.

These studies were retrospective, in that they first chose a sample of youth with juvenile justice experience, and looked backways (with the exception of the juvenile justice-CWS

observed pathways). Using a prospective sample, i.e., starting with a sample of CWS involved youth, the frequencies of these pathways would likely be smaller, as the proportion of JJS involved youth with a CWS history is larger than the proportion of CWS involved youth who go on to be JJS involved.

ILS - Criminal Justice Involvement

Several studies have examined the relationship between ILS and criminal justice system involvement using NYTD data. However, these studies have used varying control variables, different sample subsets, and models (multilevel vs fixed effects) which makes establishing a relationship difficult. Most of these studies have controlled for placement history, but not CPS history. The studies have also varied in the Wave (2 or 3) and how ILS receipt was coded (e.g., categorically/numerically).

Huang et al. (2021) created services categories, and found that financial services significantly decreased incarceration, with an OR of 0.22. Watt and Kim (2019) total services OR 1.05. Prince et al. (2019) also created service categories, and found that wellbeing and financial services did not significantly predict incarceration. They used a broader set of control variables, as well as a multi-level model, which could explain their null results compared to Huang et al. (2021). McCauley (2021) notes that services do impact incarceration but does not give specifics.

A few other studies have examined adult criminal justice involvement as an outcome of ILS receipt using data other than NYTD (Doucet et al. 2022). Center for Innovation Through Data Intelligence (CIDI) (2014) compared ILS participants with a comparable control group unable to participate due to program availability. They found ILS youth were 55% less likely to go to jail during observation period. Valentine et al. (2015) used a random assignment design for

an evaluation of transitional living ILS for youth with foster care or juvenile justice histories. Youth who participated in transitional living ILS had no different outcomes in the area of criminal involvement.

In summary, there is some evidence that ILS receipt may be associated with decreased risks of CJS involvement, but the findings are mixed. State variation must be considered when examining these relationships. Factors like specific ILS programing and model fidelity are important to consider when understanding state variation. It is also possible that eligibility around ILS receipt might vary depending on prior JJS and CJS involvement, particularly regarding financial supports. Unfortunately, the literature documenting such eligibility requirements is scant.

Methods

This section reviews the methods used to complete Aims 1 and 2. These include a description of the data sources, how the data were managed, and how the measures were operationalized. I break each down by Aim 1 and Aim 2 separately.

Data Sources

The analyses in this dissertation will leverage data from three databases within the National Data Archive on Child Abuse and Neglect (NDACAN): National Child Abuse and Neglect Data System (NCANDS) Child File, the Adoption and Foster Care Analysis Reporting System (AFCARS), and the National Youth in Transition Data (NYTD). All three data sources are linkable via an AFCARS ID.

The NCANDS Child File is an annual census of all screened-in child maltreatment reports in all 50 states including DC and Puerto Rico. Each record is a child-report combination. These data include measures of child maltreatment report frequency, type, and disposition.

AFCARS is a child-level data set identifying information on all youth with foster care involvement. Data represent the foster care caseload status of each child served by each state as of the last day of the fiscal year (September 30th). This database offers an annual and a biannual report. The annual report reflects yearly caseload activity as of the last day of the fiscal year. The biannual report reflects caseload activity as of the last day of the first and second 6th month intervals of the fiscal year. I will be using both the AFCARS annual (1-year) and biannual (6-month) files.

The NCANDS and AFCARS 1-Year files (from FY 2006-2021) are merged into a single longitudinal file using the Report and Placement Integrated Data Set (RAPIDS). Both datasets are referred to as RAPIDS throughout this paper.

NYTD is a product of the Chafee Foster Care Independent Program (CFCIP), which provides states funding to provide independent living services to youth who are currently in foster care and are identified as aging out, and to individuals who have recently aged out of foster care. States that receive federal funding from CFCIP are required to 1) track independent living services provided, and 2) identify a cohort of youth aging out who recently turned 17 and collect outcomes data on them over four years. NYTD comprises these two data collection processes, yielding the two components of NYTD: the services data and outcomes data.

The services file comprises data on the provision of independent living services (ILS), which states are required to track upon receipt of CFCIP funding. Each record identifies a youth and the ILS services received during a reporting period. Like the AFCARS 6-Month file, the NYTD services reporting periods are biannual, occurring at the start and middle of each fiscal year.

The outcomes files are a set of longitudinal surveys. There are three finalized outcomes surveys, each sampling a different cohort: youth who turned 17 in care in 2011, 2014, and 2017. Each survey has three Waves. Wave 1 is collected at baseline, i.e., when the youth turns 17. Wave 2 data are collected when they turn 19, and Wave 3 data when they turn 21. Each Wave collects information on various outcomes, such as whether the youth has experienced homelessness, incarceration, employment, or substance abuse referral. States are responsible for collecting the data. Each state is required to identify and collect outcomes data on a subset of youth aging out of care, as per CFCIP.

The NYTD outcomes are survey data that states are mandated to collect upon receipt of CHCIP funding, and socioeconomic outcomes from ages 17-21. CFCIP provides states funding to provide independent living services to youth who are currently in foster care and are identified

as aging out, and to individuals who have recently aged out of foster care. States that receive federal funding from CFCIP are required to 1) track independent living services provided, and 2) identify a cohort of youth aging out who recently turned 17 and collect outcomes data on them over four years. NYTD comprises these two data collection processes, yielding the NYTD Services data and Outcomes data.

Dataset Construction

Aims 1 and 2 require the construction of two datasets, Dataset 1 and 2, respectively. Dataset 1 pulls from the following data sources: RAPIDS, AFCARS 6-Month FY2010-FY2022, and NYTD Services. Dataset 2 uses RAPIDS, NYTD Services, and NYTD Outcomes.

Aim 1

Aim 1 is focused on understanding how receipt of ILS varies as youth transition from placement types. In order to capture this information, dataset 1 must comprise longitudinal data, with records jointly identifying ILS receipt, JJS involvement, and placement type. The longitudinal structure of the data come directly from the NYTD services file and AFCARS 6-month files, which record youth system involvement at the same time scale: each at the 6-month FY reporting period level.

The construction of dataset 1 has three steps. First, the AFCARS FY2010A - 2016B and FY2016A-2022B 6-Month files are appended. Together, they identify all children with a stay in foster care in the US from FY2010-FY2022 (3,294,259 kids), which serves as the population from which the sample of Aim 1 is drawn. Each record identifies the foster care status of each child as of the end of the first or second half of each FY. Second, AFCARS 6-month records are merged with NYTD service file records. Similar to the AFCARS 6-month file, the unit of observation for NYTD services file is the ILS service receipt status of each child as of the end of

the first or second half of each FY. The common data structure allows for a one-to-one merge. Third, RAPIDS data are added. These data are longitudinal, jointly identifying child maltreatment report and foster care involvement over time. However, for this analysis, these data only provide historical system controls, and do not vary by time. To accomplish this, these data are aggregated to the child-level, measuring aggregated system involvement up until age 15, which is when the observation period begins for this analysis. With each child represented by only one row, these data are merged (one-to-many) onto the AFCARS 6-month/NYTD Services file.

The sample was specified by keeping one spell per child based on the following two primary criteria: they turned 15 during it, exited to emancipation. The age of 15 was chosen as it is the age when a non-trivial number of youth begin to receive ILS. The sample was limited to those exiting to emancipation to align with the sample in Aim 2, i.e., the NYTD outcomes cohort. Additionally, spells were removed if they had logically implausible or missing records, no RAPIDS match, any placement as pre-adoptive placement type. Children were also removed if they were in states with implausibly low (<1%) delinquency rates (AL, CT, IL, KS, MA, MO, MS, MT, NC, NJ). The final dataset comprises 31,095 kids over 223,784 records.

All records in AFCARS were kept regardless of a NYTD services match. The services file lists 14 possible ILS services, each coded as a {0,1} if the youth received them in a given 6-month FY period. The following services are identified: academic support, budget and financial management, career preparation, education financial assistance, employment programs or vocational training, family support and health marriage education, health education and risk prevention, housing education and home management training, independent living needs

assessment, mentoring, other financial assistance, post-secondary educational support, room and board financial assistance, and supervised independent living.

Aim 2

Aim 2 is focused on understanding how variation in foster care, ILS, and JJS involvement predicts CJS involvement in young adulthood. A secondary focus is concerned with investigating if and how ILS moderates the relationship between JJS and CJS involvement. While Aim 1 focuses on experiences during foster care, Aim 2 extends the scope to outcomes after discharge. It is separated into two parts, *A* and *B*, with *A* concerning the analysis at Wave 2, and *B* the analysis at Wave 3.

Information regarding outcomes after foster care is taken from the 2017 NYTD Cohort Outcomes data, which tracks the occurrence of events, e.g., incarceration, homelessness, at ages 17 (Wave 1, still in foster care), 19 (Wave 2) and age 21 (Wave 3) for youth who turned 17 in 2017 while in foster care. Similar to Aim 1, ILS data are taken from the NYTD services file, and RAPIDS is used for historical system involvement measures. These three datasets are at different levels. The process of merging is broken into three steps.

First, NYTD outcomes data are reshaped and merged onto RAPIDS. The three outcomes files (one for each cohort) are all at the child-wave level. All children have a Wave 1 record, but not necessarily a Wave 2 or 3. For part A, I keep all children with a Wave 2 response, and part B I keep all children with a Wave 2 and Wave 3 response. This outcomes file is then widened from the child-Wave level to the child-level, with new variables indicating outcomes at either Wave 1 or 2. The widened outcomes file is merged onto RAPIDS, keeping only kids with an outcomes record.

Second, services data are merged. As discussed above, it has a record for each reporting period (6-month) a youth received ILS. To merge it onto the RAPIDS and outcomes data, it must be aggregated to an age-specific child level. For part A, numbers of services up until age 17 are counted. For part B, services are counted up until 19. These correspond to the number of prior services received at the ends of Wave 1 and Wave 2, respectively.

Third, the data is aggregated to the child-level. This is done by calculating variables that summarize prior child welfare and foster care experience to 17, i.e., the end of Wave 1. Additionally, records after age 17 were examined to measure if they had extended care or not, but only used in part B. The final dataset for part A has 6,668 youth, and the dataset for part B has 4,916 youth.

Measures

This section details how measures were operationalized. A focus that needs constant consideration throughout this section is the decision on how to code variables, e.g., choosing to make a continuous variable dichotomous, or choosing to aggregate a categorical variable into less categories. In both Aims 1 and 2, the covariables related linearly to the outcome. The various decisions on how to code underlie hypotheses of whether the variables indeed have a linear relationship with the outcome, as different coding schemes allow for different, potentially non-linear, relationships.

Aim 1

Dependent Variable. ILS receipt was measured as a binary indicator for each 6-month period. The presence of any ILS service was calculated as 1. Delinquency was measured as 1 if the youth had ever been identified as being delinquent (*DelinqntSv* variable in NYTD services file) in the current or in a previous services record. These binary indicators were combined,

yielded a four level factor variable with the following levels: not receiving ILS and not delinquent, receiving ILS and not delinquent, not receiving ILS and delinquent, receiving ILS and delinquent, and discharged from care.

Independent Variables. The primary independent variable is the placement status of the youth for a given FY 6-month period. This variable is a 6-level factor variable taking the following levels (taken from the AFCARS variable *CurPlSet*): non-relative foster family home, relative foster family home, group home/institution, runaway, and trial home visit. Several control variables were also used. Female, White, Black, Hispanic, an indicator of having more than six child maltreatment reports, an indicator of entering foster care for reason of child behavioral problem or relinquishment, and an indicator of being in a rural county.

Aim 2

Dependent Variable. The dependent variable for part A and B was incarceration in young adulthood. Part A measured incarceration from 17-19, and Part B measured incarceration from 19-21. The variable was taken from the NYTD outcomes file, which gives following definition: “A youth is considered to have been incarcerated if the youth was confined in a jail, prison, correctional facility, or juvenile or community detention facility in connection with allegedly committing a crime (misdemeanor or felony).”

Independent Variables. Because the exact time of incarceration was unable to be identified for the 17-19 and 19-21 intervals, Part A independent variables measured system involvement and ILS receipt up until age 17, and Part B up until age 19.

Independent Living Services. Using a similar measurement scheme from Prince et al. (2019), ILS were categorized into two groups, wellbeing, and financial services. Wellbeing services broadly refer to those that target wellbeing without providing direct financial support,

which included the following: Independent Living Needs Assessment, Academic Support, Post-Secondary Educational Support, Career Preparation, Employment Programs Or Vocational, Budget and Financial Management, Housing Education And Home, Family Support And Healthy Marriage, and Mentoring. Financial services are those that directly provide financial supports, which include the following: Supervised Independent Living, Room And Board Financial Assistance, Education Financial Assistance, and Other Financial Assistance.

In Part A, only wellbeing services were included, as the financial services are generally not applicable to youth younger than 17. Additionally, Post-Secondary Educational Support and Employment Programs Or Vocational were removed. Counts of ILS receipt were calculated up until age 17 by counting the number of individual services received across ages 14-16. Assuming nonlinear relationships in the number of services and probability of future incarceration, aggregated counts were coded into the following three ordinal categories: 0 services, 1-6 services, and seven or more services. The final group cutoff, seven, was decided by running the final model with cutoffs ranging from 3-9, and choosing the cutoff that maximized the $elpd_{waic}$.

In Part B, measures of ILS receipt from 17-19 were included. Aggregate wellbeing and financial services counts were calculated by counting all wellbeing and financial services received between 17-19. Similar to above, wellbeing counts between 17 and 19 were coded into a binary categories, receiving between 0-7, and receiving 7 or more. A binary cutoff was chosen, instead, because vanishingly few youth received zero wellbeing services. This cutoff was chosen in the same way as the cutoff from services prior to ages 17, by running models with cutoffs ranging from 2-9, and choosing the cutoff which maximized the $elpd_{waic}$. Financial services were coded as binary, either receiving none or receiving one or more. A binary cutoff was reasonable, as just over half received any.

Prior Justice System Involvement. In Parts A and B, an indicator of incarceration prior to age 17 was used to measure prior juvenile justice involvement. In Part B, an indicator of incarceration between 17 and 19 (the dependent variable for Part A) was added to control for prior system involvement between those ages. Interaction terms were included between prior justice system involvement and independent living services. These measures allow for the estimation to which ILS receipt might moderate this association.

It is important to note that the term “incarceration” generally refers to confinement in the criminal justice system, and does not apply to the juvenile justice system. Hockenberry & Puzzanchera (2021) use the term detention to refer to confining youth during court processing, and the term out-of-home placement to refer to confining youth as a result of case disposition. The NYTD Outcomes codebook uses the term incarceration, regardless of age, to refer to mean that the youth “was confined in a jail, prison, correctional facility, or juvenile or community detention facility in connection with allegedly committing a crime (misdemeanor or felony).” In order to make it as clear as possible that the measure used in this analysis comes from the NYTD Outcomes data, I still use the term incarceration to for youth below 18 years of age.

Prior CWS Involvement. Extensive literature has documented the association between various measures of CWS involvement and criminality. The following measures were used: an indicator if the youth had seven or more child maltreatment reports, indicator if first placement was aged 15 or older, an indicator if the youth was ever placed in a group home or institution, an indicator if the youth had a FC spell with more than seven placements, and an indicator if the child was placed in foster care for reasons other than can (behavioral problems, relinquishment). For Part B, an additional measure was used as an indicator of having extended care, in foster care after age 19.

Demographics. Indicators of female, White, Black, and Hispanic were used. Additional interactions between female and the race/ethnicities measures were also used, as prior literature has found that trajectories through the juvenile and criminal justice literature depends on the joint distribution of both variables.

Analysis

This section details the statistical models used in Aims 1 and 2. As in the previous section, the analyses for Aims 1 and 2 are detailed separately. In both aims, the modeling approaches have not been applied in the dual-system literature. They offer unique insights into the complicated relationships of the variables under study.

Aim 1

In order to examine how service receipt varies as a function of placement and JJS involvement, a statistical model must incorporate time, as youth can transition from receiving to not receiving them. While survival analysis, such as a Cox regression model, could be used to determine how long a give youth receives a service for, or how long it takes until it is received, as a function of placement and JJS involvement, these models typically only model the time until a single event occurs. Due to how varied ILS are, a variable encoding service receipt will have to be able to take on more than one value. A competing risks approach could be used instead, which allows for the occurrence of more than one type of event, however, it only allows for one event to occur per record. The status of a youth's service receipt can change multiple times, however, so a competing risks approach would not suffice.

As an alternative, I fit multi-state models (Meira-Machado et al. 2009), which can be understood as an extension of a typical survival analysis approach with an arbitrary number of events and states. For a given state at a given time, a multistate model estimates the distribution of transition probabilities to all states at the following time step. The states and "allowed transitions" are defined before fitting the model. The probabilities of transitioning from one state into another assume the Markov property, meaning that the probability of transitioning from one state into another is independent of all prior states and times.

Children could be in one of the following five states: not receiving ILS and not delinquent, receiving ILS and not delinquent, not receiving ILS and delinquent, receiving ILS and delinquent, and discharged from care. The state “discharged from care” is encoded as an “absorbing state,” meaning that once a youth enters that state, they will be unable to transition to any of the other three states.

Figure 1 illustrates the multistate model. The allowed transitions are specified in part due to limitations in the data. The variable measuring delinquency in the services file indicates if the child has ever been adjudicated delinquent. In the model, the two states encoding delinquency do not lead back to either state encoding non-delinquency. A critical limitation in the data is that delinquency is rarely identified without services. To account for this, transition from non-delinquency state without services to a delinquent state with services is not allowed.

Multistate models allow the transition probabilities to be modeled with covariates. Similar to Cox regression, the “effect” of each covariate can be interpreted as a hazard ratio on the hazard of transitioning into a given state at a given time. These covariates will encode the time varying variable of placement type, as well as time-invariant variables such as child demographics and system experience.

Multistate models are particularly advantageous to Aim 1 because they can provide useful estimates given the limitations of the data. The NYTD services data are interval-censored, meaning that it is unknown of the day when the youth received the services, only that they received it within a given 6-Month interval. The *msm* package in *R* allows for multistate models to be fit with interval-censored data. The package also allows multistate models to be fit under time-inhomogeneous Markov chains, i.e., the transition probabilities between states change over

time. This is a critical modelling assumption, as the receipt of ILS will likely change as youth age and approach discharge.

Aim 2

The probabilities of incarceration between ages 17-19 (Part A) and 19-21 (Part B) are modeled using a generalized linear mixed model (GLMM) framework. The GLMM will incorporate random effects at the state level. Sampling weights will be incorporated into the model fit. Models are fit using a Bayesian framework with the R package BRMS. A Bayesian model is chosen because of its utility in modeling the posterior distribution of the GLMM parameters, which allows for directly examining the posterior predictive distribution.

Non-Response Weights

The NYTD outcomes surveys for all three completed cohorts have struggled with poor response rates for Waves 2 and 3. Assuming that youth who did not respond to Waves 2 and 3 were out of reach, this could bias the later Waves to youth less at risk of certain outcomes than those who were able to be contacted. Failure to incorporate weights then leaves these youth not represented in the later Wave data. No studies using NYTD data have stated that weights have been incorporated in analyses. The incorporation of them in Aim 2 represents a novel addition to methodology of these data.

Non-response weights were calculated based on youth's demographics and system history (as of age 17). The following variables were used: gender, identifying as Black or Hispanic, entering foster care for the first time as a teen, having at least one group home or institution placement, entering foster care for reasons of child behavioral problems or relinquishment, and having at least one runaway placement. These measures were used as they were the only ones that significantly varied between the NYTD 2017 Cohort population and

Waves 2 and 3 analytic samples. RAPIDS data were used to calculate these measures for the whole NYTD 2017 cohort population. Weights were then calculated separately for the Wave 2 and 3 analyses. Weights are estimated using the R package *twang* (Cefalu et al., 2023). See Table 2 for the balance diagnostics.

Results

This section will review the empirical findings for Aim 1 and Aim 2. All statistics are presented in Tables 3-5 for Aim 1 and Tables 2-5 for Aim 2. First, the descriptive statistics for each analysis are presented. Second, model validation measures are presented. These are critical steps to assess the degree to which parametric assumptions are met, and examine the degree to which model reproduces the data. Third, final model parameters are reviewed.

Aim 1

Descriptives

Descriptive results are presented in Table 1. The percentage of children ever experiencing each state (columns) conditioned on ever experiencing each placement (vary over time) and control variables (all time fixed). For example, of the 23,286 children with at least one non-relative foster home placement, 74% experienced state 2 at least once. The majority of youth, regardless of placement or demographic profile, experienced state 1, which is where most youth start at age 15. Children who experienced group home/institution, runaway, trial home visits, or were male, had the highest observed rates of experiencing a delinquency state. Youth who experienced a supervised independent living had the highest rate of experiencing an ILS state. Youth who had a trial home visit placement or runaway placement had the highest rates of being emancipated by study end (92 and 90%).

Figure 2 illustrates the distribution of states for each of the eight 6-month FY periods. The number of kids remaining in care (not yet emancipated) is given at the top of each bar. The left most column shows the states where kids start (the 6-month FY period when they turn 15). At the first 6-month FY period, about 80% do not receive ILS and are not delinquent. The other 20% or so receive ILS. With each consecutive period, the percent of youth who begin receiving

ILS increases. By the 5th and 6th periods, approximately 50% are receiving ILS. The numbers of children who are delinquent steadily increases, but relatively few youth still ever become delinquent. By the seventh, when youth turn 18, most emancipate. The last bar comprises youth who remain in care after turning 18. Note the sample size greatly reduces.

Table 2 identifies the number of instances (consecutive 6-month FY periods) each state led to each other state, with rows designating starting states and columns designating finishing states. The cells with zeros, or asterisks, indicate unobserved (unmodeled) transitions. The numbers on the main diagonal represent the instances where the states do not change between consecutive 6-month FY periods. There were 74,513 instances where youth began with no ILS and delinquency and remained with no ILS and delinquency. Similarly, there were 56,483 instances where youth began with ILS and no delinquency and continued to receive ILS and remain non delinquent.

The numbers in bold, off the main diagonal, identify state changes, or transitions. Figure 3 shows these numbers superimposed on the multistate model. The most common transitions were of non-delinquent youth to either being receiving (21,460 instances) and stop receiving (10,957 instances). Entering delinquent states was much less common than non-delinquent states.

Model Validation

Like all parametric models, the multistate model makes assumptions as to how the data were generated. Assessing the degree to which the model meets these assumptions is critical to have confidence that the model is producing unbiased estimates. The multistate model fit is a time-inhomogeneous Markov model. It is Markovian in that the probabilities distribution overstates is only conditional on the state currently occupied. It is time-inhomogeneous because the probabilities are allowed to change. However, the transition probabilities are piecewise

constant, in that they change at 1 year and 2.5 years, allowing for three distinct periods with varying transition intensities. The parameters defining these piecewise constant transition probabilities are incorporated linearly alongside the covariates.

In general, goodness-of-fit assessment is difficult for multi-state survival models when censoring is present or when there is variation in observation times between and within individuals (Hout, 2017). Instead of implementing a parametric goodness of fit test, Hout (2017) recommend comparing the expected and observed frequencies of each state over time as an effective heuristic to assess goodness of fit. Figure 4 plots the observed and expected from ages 15 through 18. The sudden change in slope in each plot at age 17.5 is due to the piecewise constant model fit. While the expected frequencies tend to closely track the observed, three areas of slight divergence should be noted. In the first year, the model tends to expect more non-delinquent youth beginning to receive ILS, and, from 1 to 2.5 years, expect slightly less non-delinquent youth to be receiving ILS. From about 3 years onward, it tends to underestimate the frequency of emancipation.

Final Model Fit

Tables 3-5 presents the HR's for the predictors for each transition where the state changes. The tables separate transitions not involving delinquency nor emancipation (Table 3), those involving delinquency and not emancipation (Table 4), and those leading to emancipation (Table 5). Hazard ratios are exponentiated transition intensities, and they can be interpreted in the same manner as HR's in Cox models. The only difference is that instead of the hazard being a measure of instantaneous risk of transitioning from alive to dead, as in a Cox, it is the instantaneous risk of transitioning from the given start to finish state.

Getting and Losing ILS - Non Delinquent Youth. Table 3 presents the HR s for the two most common transitions [NO ILS / NO DEL -> YES ILS / NO DEL] and [YES ILS/NO DEL -> NO ILS/NO DEL]. These identify non-delinquent youth starting and losing ILS. For starting ILS, the HR's for all but the SIL placements are significantly below one, indicating that a non-delinquent youth not receiving services have lower probability of starting to receive services in those placements compared to youth in non-relative foster homes. Children in runaway and trail home visit placements have under 50% the rate of starting ILS. For stopping, children placed with a relative and runaway have heightened risk of having their services end. The hazard for runaway youth is twice that of nonrelative foster care.

The controls yielded some significance. In general, males were less likely to begin to start to receive services, relative to females. Hispanics tended to demonstrate inconsistency with regard to ILS receipt. They were more likely, relative to Whites, to begin to receive services, However, they were also more likely to stop receiving. Children who entered for reasons other than CAN tended to have an inverse pattern. They were less likely to start to receive, but once they began receiving, they were less likely to stop.

Transitions Involving Delinquency. Children could transition into delinquency via [No ILS / No Del -> Yes ILS / Yes Del] or [Yes ILS / No Del -> Yes ILS / Yes Del], i.e., when they are not receiving ILS and when they are receiving. The former was more common (Figure 3). For those not receiving ILS, being in a group home or institution over doubled this risk, relative to non-relative foster homes. Being in a runaway status and trail home visit placement also heightened this risk, 79% and 78 %, respectively. For those already receiving ILS, the risk was heightened dramatically by trail home visit and runaway placement, by about 4 times. Group home placement was also a risk factor, increasing the risk by almost 50%.

For transitions which begin with delinquent youth, youth could transition via [Yes ILS / Yes Del -> No ILS / Yes Del] or [No ILS / Yes Del -> Yes ILS / Yes Del], i.e., delinquent youth stop receiving ILS or starting to receive ILS. For delinquent youth that stop receiving ILS, only runaway youth had significant association, with an 81% increased risk of transition. The reverse direction, delinquent youth who begin receiving ILS, group home/institution and runaway were at decreased risk.

The covariates similarly yielded mixed results in terms of significance for transitions involving the onset and continued delinquency. Males had heightened risk of transitioning into delinquency, regardless of receiving or not receiving ILS. Once delinquent, males were at reduced risk of losing ILS (HR=0.89), but also reduced risk of starting (HR=0.84). The risk of transitioning to delinquency varied for Hispanic youth, conditional if they were or were not receiving ILS. If not receiving ILS, Hispanics were more likely than Whites. However, if receiving, they were less likely. Youth who entered for reasons other than CAN and youth in rural settings were at increased risk of transitioning to delinquency.

Emancipation. Most youth emancipated during the study period. Youth in group homes/institutions, runaway, and trial home visits all tended to emancipate faster than youth in non-relative foster homes. Being in supervised independent living consistently decreased the risk of emancipation. The controls predicting emancipation were mixed. Hispanics were at decreased risk of emancipation for most states.

Aim 2

Descriptives

Table 1 presents descriptives for the demographics and child welfare system measures for the full NYTD Outcomes Survey 2017 cohort (first column), respondents the Wave 2 analysis

(second), and respondents in the Wave 3 analysis (third). Youth not White, Black or Hispanic are not included, and are also taken out of the population column. With the samples presented side by side, we can investigate how the sample changes as those who do not respond to Wave 2 and Wave 3 are filtered out. The most substantial change is with regard to the proportion female, which starts at 50% and then increases to 60%. Wave 2 and Wave 3 are slightly less Black and White, and slightly more Hispanic. Three measures do not change by more than one percent: percent with 7 or more CMRs, 2 or more FC spells, and 6 or more placements. The percent of children with a group home/institution placement decreases by almost 5 points and those without a CAN CMR by 3 points. Table 2 presents the balance diagnostics of the non-response weighting. Only variables with significant differences from the population (left column) are used. The bottom half of Table 2 shows that the calculated weights yield the same proportion as the population.

The two measures of incarceration included in both Waves 2 and 3, incarceration before 17 and between 17 and 19, decreased from Waves 2 to 3, each by approximately two points, from 28 to 26 and 18 to 16. Prior to turning 17, those receiving 1 to 6 wellness services increased by 2 points while the proportion who received 7+ stayed largely the same. Note that state composition is not included in Table 1 across the columns. Due to the variation in response rates across states, it is likely that the composition changes substantially. So, while the measures included in Tale 1 do not change markedly, the non-response weights are still important to account for state variation in response rates.

In Wave 3 analysis, about 15% were incarcerated between the ages of 19 and 21. Over half (58%) received at least one financial service between 17-19 years of age. Of the (4482 –

2610) kids who did not receive financial services, received between 0-6 wellbeing services, and just over 500 received 7 or more. About one quarter of youth stayed in care after age 19.

Model Selection

One of the motivations for Aim 2 is to explore the degree to which not only the young adult incarceration vary by state, but also the relationship between ILS receipt and young adult incarceration vary by state. The degree to which these relationships have been explored with multilevel models has been limited to just assuming variation in outcomes by state, i.e., random intercept models. Because it remains unclear if or how the relationship between ILS and young adult incarceration varies by state, a series of models with increasingly number of parameters were fit and compared. The final model was chosen by whichever proved to most adequately reproduce the data without overfitting.

Models were fit with four different parameterizations for both Wave 2 and 3 models: a random intercepts only model without interactions, a random intercepts and slopes on ILS main effects with no interactions, a random intercepts and slopes on ILS main effects with interactions, and a random intercepts and slopes on ILS main effects and interaction terms. Goodness of fit was measured using the expected log pointwise predictive density estimated with the widely applicable information criterion ($\text{elpd}_{\text{waic}}$), with higher values indicating improved model fit (i.e., predictive accuracy) (Vehtari et al. 2017). This measure is similar to AIC but used with Bayesian models.

Table 3 provides the $\text{elpd}_{\text{waic}}$ for the four models in the Waves 2 and 3 analyses. In inclusion of random slopes on the main effect improves the model fit for both (row 2). Adding the intercept terms does not improve the model fit and makes it slightly worse for each. However, when adding the random slopes on the intercept terms, the model fit does improve for both.

Final Model Validation

While the final model produced the most ideal fit of the candidate, it remains unclear as to how well calibrated it is to the data. In order to assess model calibration, calibration plots can be used as a visual guide. Generally speaking, a calibration plot depicts how well the model assigns probabilities to observations. This is done by binning all observations by the predicted probabilities assigned by the model into groups with equal cut offs. I used cut offs at 0.10. For each group, the number of observations incarcerated is counted, and calculated as a percent. If the model is accurately assigning predicted probabilities, then the percent of observations with an incarceration in each group will align with the values defining each bin. For example, for observations that had predicted probabilities between 0-0.10, about 5% should have an incarceration.

Figures 2-3 show the calibration plots for the final models for Waves 2 and 3 analyses. Confidence intervals are calculated using an exact binomial test. Figure 2 shows that the final model in the Wave 2 analysis is well calibrated. The large confidence interval for the last bin is because only two observations had predicted probabilities of above 0.9, both of which were incarcerated. The calibration plot for the Wave 3 analysis shows that the predicted probabilities for those between ~40-75 tend to be underestimated. Ramifications of this will be discussed below.

Final Model Fit

Table 2 presents the posterior means (OR's) for the final models for Wave 2 and 3 analyses. Youths' gender and race significantly predicted incarceration in young adulthood, with females have around 50% the odds and Black youth having almost 50% higher and 25% higher at ages 17-19 and 19-21, respectively. Hispanic youth were at an increased odds only in the

Wave 2 analysis. However, the interaction terms by gender provide evidence that the increase in risk was only generally associated with boys. However, for Hispanics, this only applies to Wave 2.

Child welfare history also significantly predicted incarceration in both analyses, with results frequently aligning with prior literature. However, numbers of CMRs was not significant. In the Wave 3 analysis, being in care at age 20 was associated with reduced odds of incarceration. In the Wave 2 analysis, placement instability was particularly large, with an expected increased odds of incarceration by over double. Runaway status was highly predictive in the Wave 2 analysis, but not significant in the Wave 3 analysis. This was reversed with two or more foster spells indicator, which was not significant in Wave 2 but significantly predictive in Wave 3.

As would be expected, previous incarceration yielded the strongest associations within each model. The magnitudes were large. In the Wave 2 analysis, incarceration before age 17 was associated with an increase in odds of over 300%. In the Wave 3 analysis, incarceration between 17-19 increased the odds by over 650%. However, in the Wave 3 model, incarceration before 17 had similar magnitudes as several of the CWS history indicators. That more recent incarceration is more predictive than past incarceration is not surprising.

Receipt of ILS services had mixed levels of association. In the Wave 2 model, receipt of 1-6 wellness services before age 17 was not significant, but receipt of 7 or more was significant. Receipt of 1-6 services was in the direction of 7 or more, however. The OR was fairly large in effect size, with those receiving 7 or more having half the odds of incarceration between 17-19 compared to those with 0 ILS services. The posterior predictive distribution are plotted in Figure 1 for the three ILS categories. These findings give evidence that there is a dose-response

relationship with wellness services. Reductions in risk of incarceration come about only when a sufficient number of wellness services have been received.

In Wave 3, the main effects for wellness services before turning 17 were not significant. However, they are very similar in magnitudes to the same coefficients in the Wave 2 analysis. The wider credible intervals however increased uncertainty of the association between ILS before 17 and incarceration between 19-21. The two main effects measuring ILS between 17-19, financial services receipt and 7+ wellbeing services without financial services were not significant. Interestingly, they were similar in terms of distribution, both in the direction associated with decreased risk of incarceration. Their posterior distributions are plotted in Figures 4-5. Approximately 93% of each distribution is below 1. The interaction terms were not significant.

Interaction terms between ILS and prior incarceration were not significant in either the Wave 2 or 3 models. This analysis does not provide direct evidence that ILS services are equipped to be leveraged as an intervention for dual-system youth specifically at the national level.

The multi-level structure of the model warrants further interpretation. Model fit improved after adding random slopes on the main effects of ILS and the interaction terms. These results imply that, while the main effects of ILS were not significant, their association with ILS varied, and that some states they were associated with decreased incarceration rates. Additionally, the random slopes on the interaction terms give evidence that the association between ILS and incarceration varies from state to state. Some states might implement services in such a way that they serve the unique needs of dual-system youth particularly well.

Discussion

This section discusses the relevance, interpretations, and limitations of Aim 1 and Aim 2 separately. Following this, I discuss implications for practice, policy, and future research.

Aim 1

In order for ILS to meet the needs of youth aging out of care, we need to differentiate conditions that predict successful vs unsuccessful service delivery. Because youth approaching emancipation are at increased risk of juvenile justice, it can be very important to also understand how ILS services are delivered, jointly with delinquency onset. This study expands on prior literature by following youth over time such that conditions of start and end of delivery can be observed jointly with delinquency onset.

Both the descriptive and modeling analysis add important perspectives to the literature. Table 2 provides an idea of how often youth transition on and off ILS. The top two rows identify the most traversed pairs of states. The main diagonal cells are by far the largest frequencies, implying that youth tend to transition less than they stay in the same state. Once youth began receiving ILS, they tended to continue receiving ILS. Similarly, if they were not, they tended to continue to not receive. This might imply that a primary barrier to delivering ILS is not necessarily keeping youth involved in curriculum, but getting youth to start to be involved in the first place. This information can inform the interpretation of Figure 2. From approximate ages of 16.5-17.5, the proportion receiving ILS remains unchanged, at about 50%. From Figure 2 alone, it is unclear if the proportion remains unchanged because the same youth occupy the state, or youth are transitioning in and out at about equal rates. However, Table 2 provides some information that it tends to be the same youth occupying each category across bars.

The hazard ratios (Tables 3-5) give information on how the probabilities of state transitions vary across youth's placements and demographics. They can be interpreted as informing the two main issues regarding barriers to service delivery: kids not starting or kids stopping. Representing the most traversed paths, the hazard ratios in Table 3 reflect the experience of the majority of youth. Group home/institutions have a 20% lower hazard of beginning to receive ILS, compared to non-relative FC. This is particularly problematic given the population. Group home/institutions are common placement types for these youth. Over 50% of the sample experienced at least one of these placements (Table 1). Given that a barrier to ILS receipt is kids not starting ILS at all, these kids in group home/institutions could account for a large number of youth not receiving ILS. Although less in numbers, runaway and trial home visits could also account for a large number given the magnitudes of the HRs. For both, the risk of starting is below 50% of non-relative foster homes. Interestingly, being in a supervised independent living situation did not predict a different probability of state transition among non-delinquent youth, as compared to non-relative foster care. This could be because youth who are in a supervised independent living placement generally came from non-relative foster home placements, and their ILS status did not change during or after that placement change.

Although group home/institutions and trial home visits are associated with kids not starting, they do not appear to be associated with kids stopping, at least compared to non-relative foster care. If youth changes to these placement types directly from non-relative foster care, there could be a similar dynamic as highlighted directly above regarding supervised independent living, i.e., their ILS status remains constant. Notably, relative foster homes have increased risk of stopping. Their hazard is 30% higher than non-relative foster homes. These placements tend to

be more stable than non-relative foster home stays. If case planners assume that the youth are getting their needs met, they may cease prioritizing outreach efforts for ILS to these youth.

Two control variables both predict not starting and losing ILS: identifying as Hispanic and children that entered for behavior problems or relinquishment (Non-CAN Entry). Youth who identify as Hispanic were more likely to begin receiving and more likely to stop receiving. These findings imply that Hispanic youth tended to experience instability in the receipt of ILS. One potential reason is that they tend to live in states or counties with less consistent ILS programming. The opposite is true for kids who entered for behavior problems or relinquishment. They are less likely to begin to receive, but once they do, they are less likely to stop receiving. This finding could be an indication of unobserved heterogeneity in this group, with some youth more likely to engage in services than CAN entries and others less likely. However, Research has shown that these children have unique sets of needs and outcomes that differentiate them from CAN entries, including longer case duration and increased risk of delinquent activity (Orsi et al., 2017). More research is needed to confidently interpret these findings.

The first two rows of Table 4 identify the transitions leading to delinquency. Cutuli et al. 2016 provides a similar sample (youth first placed age 9 and above), outcome (JJS petition), and analysis (estimated HRs) that can be used as a basis of comparison for select measures. The HR's for group home/institutions are similar to those found in Cutuli et al. 2016. They are smaller in magnitude. One reason is that in this analysis, delinquency onset is broken two paths, so "combining" each path would give a single, higher HR, comparatively. As shown in Table 4, runaway and trial home visit stand out as having large magnitudes, particularly for youth already receiving ILS. Prior literature has found that runaway status can be a predictor of delinquent behavior (Sarri et al. 2016, Kim et al. 2009).

The relation to trial home visit is somewhat surprising. However, Cutuli et al. 2016 does find a similar finding regarding the placement “Home/Out of Care.” The magnitude of the HR in this analysis is larger, however. One possibility is that because this sample is conditioned on youth who age out, these trial home visits could select for “unsuccessful” reunifications, where youth were sent home with the goal to reunify, but later re-entered a foster home due to neglectful conditions and inadequate supervision. States can vary greatly in reporting standards for national CWS administrative data, and it was thought that maybe the connection has to do with aberrational data isolated to a select number of states. A descriptive sensitivity analysis was conducted to examine the distribution of trial home visits and delinquencies by state. Table 6 presents the results. The number of kids with at least one trial home visit for each state is identified in column 2. Four states do not report any trial home visits. The fifth column provides the percent of children with a trial home visit that have a delinquency at time of trial home visit. If the connection between trial home visits and delinquency in the multistate model was inflated due to a small number of states, it is expected that the percents in column 5 would also be inflated. The percents range from 0% to 25.4. The rate of delinquency for the full sample is 14%. It is possible that CA is driving the association. However, the variation is fairly spread out over the states. There is no clear evidence that the connection is due to highly state dependent or otherwise aberrational data.

A couple of interpretations also exist that do not have to do with state variation. One could be that youth might be under less supervision when put on trial home visit, in relation to foster care. Previous research has linked parental supervision to delinquency (Hoeve et al 2009). Another explanation is that youth might be returning to neighborhoods or friend groups that make delinquency more likely. For example, given the association with maltreatment and

poverty, the households of birthparents might be more likely to be in areas with high poverty, which is also linked with delinquency.

The hazard ratio's for the control variables yielded results that generally aligned with previous literature. Males were 50% more likely to transition into a state involving delinquency than females. These are similar to those found by Cutili et al. (2016) in Cuyahoga and NYC. Hispanic youth showed particular variability in delinquency transitions. They were more likely if they were not receiving services, and less likely if they were receiving services. These results warrant further investigation. It is possible if these HR's could be related to the instability of service receipt inferred from Table 3. One possibility is that the ILS services received for Hispanics decrease the risk of delinquency, or there is a self-selection of Hispanic youth who are less likely to become delinquent who begin to participate in ILS services. That such a self-selection would occur for Hispanic youth, and not White or Black youth, is unclear, however.

Both youth who entered for reasons unrelated to CAN and youth in rural settings were consistently at an increased risk of transitioning to delinquency. Both of these groups of youth are systematically understudied, and these results further provides evidence of the urgency to pay them more attention. If services for these youth need to be tailored, then research must be guided by an understanding of unique risk factors, especially for delinquency.

The transition HR's for placements leading to emancipation generally agree with what one would expect. Supervised independent living placements are associated with decreased risk of emancipation. These placements are generally associated with extended foster care stays (GAO, 2019), which would make them less likely to exit by the study's end. On the other hand, trail home visit are associated with increased risk, which is expected as they are frequently used as an interim placement before discharge. However, that runaway is always more likely is

potentially problematic. Runaway status often represent youth with heightened needs and is likely associated with less safe living conditions (Lin, 2012; Crosland & Dunlap, 2015). Staying in foster care, particularly past age 18, has been shown to be protective on a number of outcomes (Rosenberg & Abbot, 2019). This HR could represent a potentially vicious cycle, where existing troubles of youth are exacerbated by not receiving continued supports from foster care.

Similarly, group homes/Institutions are associated with a heightened risk of emancipation.

However, this could be that as youth age, the probability of transferring to a group home/institution increases, and so it could just be a natural result of youth just being older.

Hispanic youth were consistently less likely to emancipate, which is expected given the descriptive results from Table 1. Extended foster care has been shown to be protective, so one might interpret this positively. One explanation is that Hispanic youth tended to live in states or counties with robust services around extended care. Unfortunately, the literature around when and where extended care is utilized remains sparse, so further examining this dynamic is difficult. Rural youth tended to emancipate more often than non-rural youth. Referencing Table 1, they had among the highest rates of emancipation during the study period. One interpretation is that the policies and programing around extending foster care may not be equally distributed between rural and non-rural areas. These areas may not be provided funding to provided extended care at equal rates as non-rural communities.

There are at least two limitations of this analysis that should be considered when interpreted findings. First, state variation is not considered, which could result in standard errors that are downwardly biased. Unfortunately, random effects models are currently not implemented in *msm*, the R package used to fit the model. Second, transition probabilities assume the Markov property. The probability of transitioning from the current state to the next is

only conditional on the current state. In the case of ILS receipt, it is entirely probable that this property does not hold. For example, one might assume that a youth not receiving services who has never received services might have a different probability of receiving services in the near future than a youth not receiving services but has in the past.

A third potential limitation is the data itself. While the national data provide unequalled coverage of the populations we are looking at, there are limitations inherent in these data, as in any administrative data set, as previously discussed. Using comparisons to CalYOUTH data, prior literature has noted that NYTD services data have yielded undercounts of ILS service provision (Okpych, 2015) and that the outcomes data have yielded undercounts of educational achievement measures (Okpych, 2024). The delinquency measure in the services file has rarely, if ever, been used in the literature, potentially because the degree to which it accurately reflects delinquency is uncertain. It has yet to be determined to be an accurate estimate of delinquency. Administratively, the delinquency measure is housed in the NYTD services data, which potentially could inflate its association with receiving ILS services. Case planners could be less likely to input delinquency onset for youth who have not or are not receiving ILS. Potential evidence could be interpreted from Figure 3. Youth rarely transition to delinquency without either starting, or having started, receiving ILS. However, ILS receipt is common in the data, with over 80% receiving at least one ILS during the study period. So if this bias exists, it might be minimized. It is also possible that case planners provide ILS more frequently to delinquent youth to address higher needs.

However, a strength of this analysis is that the findings regarding delinquency onset largely converge with prior literature, particularly with the “9 and older” subsample in Cutili et al. (2016), both regarding the univariate findings (rate of delinquency) and multivariate findings

(HRs). The rate of delinquency observed in Cutili et al. (2016) was 16.7%, while in this study was 14.0%. The HR's of similar variables for the "9 and older" subsample are generally convergent. For example, males have about a 50% higher hazard of delinquency than females, (Cuyahoga and NYC) similar to those found here.

Aim 2

Despite the prevalence of studies examining the impact of ILS services on outcomes, few have examined how they are associated with future criminal justice system involvement of dual-system youth. This analysis provides some evidence that ILS is associated with decreased risk of incarceration in young adulthood for youth regardless dual-system status, and the degree to which dual-system youth are differentially impacted by them varies by state.

The Wave 2 analysis provides evidence of a non-linear dose-response effect between ILS and incarceration. Only the coefficient for seven or more wellness services is significant. It appears that the association between ILS receipt and incarceration only becomes meaningful after a youth has received many services. However, it is worth noting that the coefficient for 1-6 services is in the same direction, with a 95% credible interval that slightly overlaps with 1. It could be that a linear relationship of ILS could be masked by sampling variation or inadequate power. It also remains unclear if the receipt of these services depends on how they are distributed over time. For example, a youth could receive many in a one 6-month FY period, or a few over several periods. It could also be that those with seven or more tended to start receiving ILS earlier than those without, and it is the earliness in age of receipt that differentiates incarceration risk, not simply quantity.

Although the <17 wellness services are not significant in the Wave 3 analysis, there are a couple of things to note. The effect sizes (distribution means) in the Wave 3 analysis for ILS

received before 17 are very similar to those of the Wave 2, but with larger posterior variances, suggesting that receiving ILS before 17 might continue to have protective effects after age 19, but that the study has too little data to confidently observe such an effect. Also, one could posit an indirect relationship. If these variables were associated with incarceration after 19, it is possible that the relationship could be mediated by their association with incarceration from 17-19.

The two measures of ILS receipt between ages 17-19 are very similar. They are both in the expected direction, and although 95% credible intervals contain 1, they do so only slightly. For financial services, 97% of the posterior distribution is below 1. For perspective, a one-tailed t-test testing if the parameter were less than zero would be statistically significant. For the 7+ Wellness coefficient, just over 94% of the distribution is below 1. It should be noted that the magnitudes of each are non-trivial as well. They expected 38 and 34% reduction in risk of incarceration, as compared to youth without financial services and below 7 wellness services.

These findings give some evidence of an association, but more research is needed. Also, despite their lack of significance, that the posterior distributions of both the financial services and 7+ wellness coefficients are so similar warrants further investigation. Because those with financial services can have any range of wellness services, the only necessary difference between these sets of youth is either receiving or not receiving financial services. One potential conclusion is that the financial services have no impact, and it is just that those with financial services have the same high rates of wellness as those without financial services but with 7+ wellness services. Another important consideration for the Wave 3 analysis is that the model itself was not ideally calibrated, particularly in relation to Wave 2. It is possible that the addition of more salient variables might alter the distributions of the ILS predictors, giving more evidence

of an association. It should also be considered that incarceration at age 17-19 is closer temporally to many of the CWS history experiences used in the models than incarceration in 19-21. It is reasonable to think that they become less predictive of behavior as the youth experience more events or changes in life associated with future incarceration that are observed in our data.

Although these results present evidence of an association, the results are not causal, and it remains unclear exactly how this association might play out. For example, ILS are varied. They target needs that may or may not have anything to do with each other. It is possible only one or two services might prevent incarceration. Alternatively, it could be that each plays a small role, and the aggregate effect of the services is additive across each individual ones. Future studies could disaggregate service types to explore this possibility. However, one of the reasons the current study did not, is the often inconsistent distributions of each, particularly across states. It is also possible that a selection bias of sorts played out, with youth less likely to become delinquent due to endogenous factors more likely to receive ILS. However, because the study was able to control for prior incarceration, this does not seem particularly likely.

The complexity of the relationship between ILS and incarceration is highlighted with the significance of the random slopes on the main effect and interaction terms. In some respects, these model fits highlight the limited potential in understanding the role of ILS and dual-system pathways at the national level. Not only does the relationship between ILS and later incarceration vary by state, but also the relationship between the interaction of ILS and prior incarceration vary by state. Putting random slopes on interaction terms generally runs a particular risk of overfitting. The $elpd_{waic}$ estimates, however, provide evidence against overfitting. For both analyses, the additions of interaction terms alone decrease model fit performance, implying that interactions without random slopes lead to overfit. The addition of random slopes on the

interaction terms increase the $elpd_{waic}$ for both analyses, but the increase for the Wave 3 analysis is fairly dramatic. It is actually the largest increase (+127) of all model additions, even between the baseline and random intercepts.

However, this complexity is not necessarily surprising once the distribution of ILS types are disaggregated and looked at by state. These distributions of service types differ dramatically. It could be that certain states provide more of a given service that has a particularly salient role in deterring future incarceration. Another consideration is that states may vary in their eligibility criteria for ILS receipt. For example, past juvenile justice or criminal justice involvement may be ineligible for financial supports provided by ILS. Other states might differentially target ILS service delivery to youth based on past history or certain behavioral health dimensions that may be highly associated with past incarceration.

A recent GAO report (GAO, 2019) provides some insight. The report surveyed 26 states that had approval to receive federal funding to support their extended foster care programs. Most states that were surveyed reported considering youths' readiness, such as life skills, education, and employment status. However, five states reported other indicators of readiness. These states noted finding housing options could be difficult for youth with juvenile justice involvement, as private agencies did not allow residents with such a history. Similarly, they reported that District of Columbia reported requiring that youth have no pending or unresolved criminal proceedings at the time they apply for supervised independent living. It could be that such restrictions might be relatively common across other states, which could explain the model complexity.

The findings also provide policy implications other than ILS. Prince et al. 2019 conducted a similar analysis using 2011 NYTD data to predict incarceration between the ages of 17-19 and also found that remaining in foster care after age 18 reduced risk of incarceration.

Extended foster care has consistently been found to benefit youth on a variety of domains, including education and employment (Courtney et al. 2021). Unfortunately, utilizing it was relatively rare in the sample. Only 25% of youth were in care at age 20. An unexpected departure in findings from Prince et al. 2019 is regarding placement instability. Prince et al. 2019 did not find it to be predictive. However, it had one of the highest effect sizes. While the literature specifically linking placement instability to incarceration in adulthood is limited, it has been shown to be associated with a wide array of poor outcomes (Konijn et al., 2019).

Two oddities in the results should also be noted. Having a runaway is highly predictive of incarceration between 17-19, but not for incarceration between 19-21. On the flip side, having two or more foster care placements is not predictive of incarceration between 17-19. One explanation is that these two are actually related. The Wave 3 analysis continues to calculate system experiences through age 17, while the Wave 2 only through age 16. These two coefficients could be reflecting the same set of youth. Youth with a runaway status could have been discharged and reentered in age 17. In the Wave 3 analysis, the variation potentially explained by runaway status could instead be explained by the multiple foster care spells status.

Prior literature has linked chronic maltreatment to adult incarceration (Font & Kennedy, 2022), so it is somewhat surprising that the CMR measure is not predictive. One explanation is that all of these youth tend to have high numbers of CMRs, indicating that the majority have experienced chronic maltreatment. Half of the youth have at least three CMRs. The relationship between maltreatment and crime is likely non-linear. As the number of maltreatment reports increases, the variation explained in incarceration risk decreases. If the majority of youth have a history of chronic maltreatment, then there is little variation left to parse out with respect to

predicting incarceration. The interaction between gender and race is noteworthy, particularly as similar findings have been found previously in the literature, see Johnnon-Reid & Barth, 2000.

The use of non-response weights calculated using data from RAPIDS is a novel approach. The factors that differentiated respondents from non-respondents were often risk factors for incarceration, such as group home/institution placement and having a first placement as a teenager (Ryan et al. 2010; Herz et al. 2019). Without the incorporation of them with NYTD data, these youth are systematically unrepresented in the findings. This is particularly problematic in the context of evidence-based services. If these youth are not represented in the research that informs the services that target their very needs, it will be increasingly challenging for policies to provide adequate support to them. We do note however that the use of non-response weights is not a substitute for adequate response rates.

Implications for Policy, Practice, and Future Research

Designing policies that provide support for dual-system youth is not straightforward. For one, dual-system youth have highly varied experiences through the child welfare and juvenile justice systems. As the prospective studies above illustrated, there are many paths that youth can take. By virtue of the “severity” of system depth in either system, each path potentially represents different risk factors and needs. With such heterogeneity of experiences, well defined policies are difficult to design, as they have to encapsulate a wide breadth of potential supports.

The specific goal of interventions can vary as well. The prospective studies outlined above condition the samples on child welfare system involvement, and follow them forward in time to measure variation in juvenile justice involvement. These studies offer information on interventions to prevent JJS involvement, i.e., from youth becoming dual-system youth. In conjunction with foster care case management efforts, policy makers can focus funding on select after school programs with empirical evidence of delinquency prevention (Taheri & Welsh, 2024).

Alternatively, interventions could target needs of youth after they have juvenile justice intervention, i.e., once they have become dual-system youth status. Retrospective studies, not detailed above, are informative for this approach. They condition on juvenile justice involvement, and measure variation in prior CWS involvement. Studies have routinely found that JJS youth with prior CWS involvement have more extensive involvement in the JJS than JJS youth without CWS experience. Similarly, research from Culhane et al. 2011 and CIDI, 2015 have provided strong evidence that dual-system youth have worse outcomes across a variety of measures in young adulthood, in comparison to both CWS only or JJS only youth. These

interventions might provide targeted support to JJS youth these using administrative data linkages to detect prior CWS contact.

This dissertation focuses on a subset of dual-system youth, those aging out of foster care. An important consideration to keep in mind is that findings regarding efficacy of interventions for these dual-system youth may or may not apply to all. The indicators of system involvement used represent fairly “extensive” involvement in each system: foster care, and in many cases long term foster care, on the CWS, and either being adjudicated delinquent (Aim 1) or incarcerated (Aim 2). In comparison to other dual-system youth, for example, who had one unsubstantiated child maltreatment report and later arrested but never detained or petitioned, these youth in in this dissertation could very well enter adulthood with heightened history of trauma. While research has emphasized the need for trauma-based services for dual-system involvement (Modrowski et al. 2022), it is still unclear how levels of trauma vary within this group of youth.

While both are prospective samples, Aims 1 and 2 may help us consider the need for different kinds of interventions. By highlighting the placement types and demographics that increase the risk of delinquency onset and ILS receipt, Aim 1 informs policies seeking to prevent youth from becoming dual-system status, while also planning around the allocation of ILS service provision. Aim 2 stands out from other prospective studies with respect to its scope. Most prospective studies only measure juvenile justice involvement, stopping there. Because it measures juvenile justice and later criminal justice involvement, its finding can inform policies seeking to deter criminal justice involvement, while jointly considering prior juvenile justice involvement.

Policy recommendations for Aim 1: foster care agencies should increase focus of ILS provision to youth in relative foster care placements, group home/institutions, and youth on trial home visit. Although youth on runaway status should also be considered, intervention efforts should be more immediately focused on the youth's health and safety. Agencies should also empirically evaluate differences in the enrollment consistency of Hispanic youth. Agencies also should increase support provided to decrease juvenile justice involvement in group home/institutions and trial home visits. Policies should seek to curb juvenile justice involvement in rural settings, as fundings indicate it is more common than non-rural ones.

Policy recommendations from Aim 2: expand ILS, particularly early on in a youth's foster care experience. The association between ILS and incarceration reductions was strongest for those who received a lot of ILS before turning 17. The provision of ILS, and expected association with incarceration, is highly state dependent, so federal initiatives should not expect a one size fits all approach across states.

Implications for practice are limited in this dissertation. Measurement of ILS was aggregated to such a degree that parsing out the quality of implementation and model fidelity is challenging. One of the reasons behind the state variation in association with ILS is that the quality of service provision could vary across states. For example, more or less funding might have gone into programming, hiring higher credentialed staff, or expanding the hours that the services are provided. It is also unclear to the degree that mental health services are provided under ILS. Future research should look to disaggregate by race/ethnicity. Findings from Aim 1 regarding Hispanics give evidence that the receipt of ILS varies by race/ethnicity, so it is possible that efficacy might as well. It also remains unclear how ILS provision varied by dual-system status. The significant random slopes on the interaction terms imply that the ways in

which ILS services are provided to dual-system youth might vary compared to CWS only youth. Future research should examine state specific eligibility requirements or implementation policies that might explain this variation, expanding on the findings from GAO, 2019.

Aim 1 Tables and Figures

Table 1.

Percent of youth *ever* experiencing each state, conditioned on *ever* experiencing a placement and control

	# Youth	States (<i>Ever Experienced</i>)				Emancipated ^a (%)
		No ILS/ No Del (%)	Yes ILS/ No Del (%)	Yes ILS/ Yes Del (%)	No ILS/ Yes Del (%)	
Full Sample	34040	89	69	12	6	83
<i>Placements (Time Varying – Ever Experienced)</i>						
Non-Relative FC	23286	89	74	11	5	82
Group Home/Institution	21641	88	65	16	8	88
Relative FC	6558	92	71	11	6	81
Runaway	7147	92	58	17	10	90
Supervised Independent Living	6434	93	77	13	7	58
Trial Home Visit	1577	89	53	18	9	92
<i>Controls (Time Fixed)</i>						
Male	17170	88	65	15	8	84
Female	16870	90	73	9	5	83
White	21342	90	68	13	6	86
Black	10521	86	68	12	6	85
Hispanic	8659	93	72	12	7	74
Rural	16318	85	70	14	7	88
> 6 CMRs	9563	90	70	12	7	82
Non-CAN Entry	9461	89	62	16	8	82

^a Emancipations counted during study period only

Table 2.

Consecutive state frequency table, rows indicating starting state, and columns ending state. Off diagonal entries (bold) identify transitions. Main diagonal entries identify no change between consecutive states.

		<i>Ending States</i>				
		No ILS - No Del	Yes ILS - No Del	Yes ILS - Yes Del	No ILS - Yes Del	Emancipated
<i>Starting States</i>	No ILS - No Del	74513	23531	2513	415	11576
	Yes ILS - No Del	11924	56483	810	0	13210
	Yes ILS - Yes Del	0	0	7175	2031	2557
	No ILS - Yes Del	0	0	1336	1869	1063
	Emancipated	0	0	0	0	0

Note: Each number denotes the # of consecutive 6-month FY periods with each combination of starting state and ending state.

Table 3.

Hazard ratio's for transitions not involving delinquency or emancipation.

Transitions	# Transitions	Relative FC ^a	Group Hm/Inst ^a	Runaway ^a	Sup. Ind. Living ^a	Trial Home Visit ^a
No ILS / No Del -> Yes ILS / No Del	21460	0.9*	0.79*	0.47*	0.99	0.45*
Yes ILS / No Del -> No ILS / No Del	10957	1.28*	1.01	2.07*	0.98	1.06

^aRef=Non-Relative FC

Table 3 cont'

Transitions	# Transitions	Male ^b	Black ^c	Hispanic ^c	Non-CAN Entry ^d	Rural ^e
No ILS / No Del -> Yes ILS / No Del	21460	0.85*	1	1.24*	0.79*	1.04*
Yes ILS / No Del -> No ILS / No Del	10957	1.04	0.97	1.28*	0.74*	0.86*

^bRef=Female, ^cRef=White, ^dRef=CAN Entry, ^eRef=Non-Rural

Table 4.

Hazard ratio's for transitions involving delinquency and not emancipation.

Transitions	# Transitions	Relative FC ^a	Group Hm/Inst ^a	Runaway ^a	Sup. Ind. Living ^a	Trial Home Visit ^a
No ILS / No Del -> Yes ILS / Yes Del	2364	0.92	2.14*	1.79*	1.1	1.78*
Yes ILS / No Del -> Yes ILS / Yes Del	722	1.28	1.56*	3.82*	0.98	4.05*
Yes ILS / Yes Del -> No ILS / Yes Del	1917	1.15	1.04	1.81*	0.98	1.09
No ILS / Yes Del -> Yes ILS / Yes Del	1257	0.86	0.82*	0.58*	1.13	0.62

^aRef=Non-Relative FC

→

Table 4 cont'

Transitions	# Transitions	Male ^b	Black ^c	Hispanic ^c	Non-CAN Entry ^d	Rural ^e
No ILS / No Del -> Yes ILS / Yes Del	2364	1.49*	1.2*	1.32*	1.25*	1.35*
Yes ILS / No Del -> Yes ILS / Yes Del	722	1.68*	1.02	0.59*	1.26*	1.72*
Yes ILS / Yes Del -> No ILS / Yes Del	1917	0.89*	1.06	1.14*	0.73*	0.88*
No ILS / Yes Del -> Yes ILS / Yes Del	1257	0.84*	0.99	0.92	0.85*	1.02

^bRef=Female, ^cRef=White, ^dRef=CAN Entry, ^eRef=Non-Rural

Table 5.

Hazard ratio's for transitions leading to emancipation.

Transitions	# Transitions	Relative FC ^a	Group Hm/Inst ^a	Runaway ^a	Sup. Ind. Living ^a	Trial Home Visit ^a
No ILS / No Del -> Emancipated	10556	1.04	1.39*	1.98*	0.63*	1.47*
Yes ILS / No Del -> Emancipated	11995	0.93	1.45*	1.99*	0.49*	4.21*
Yes ILS / Yes Del -> Emancipated	2380	1.56*	1.53*	2.69*	0.67*	3.28*
No ILS / Yes Del -> Emancipated	1001	1.3	1.22	1.88*	0.43*	1.05

^aRef=Non-Relative FC**Table 5 cont'**

Transitions	# Transitions	Male ^b	Black ^c	Hispanic ^c	Non-CAN Entry ^d	Rural ^e
No ILS / No Del -> Emancipated	10556	0.95	0.95	0.79*	0.84*	1.06*
Yes ILS / No Del -> Emancipated	11995	0.99	0.96	0.52*	1.02	1.58*
Yes ILS / Yes Del -> Emancipated	2380	0.85*	0.95	0.84*	0.81*	1.57*
No ILS / Yes Del -> Emancipated	1001	0.87	1.39*	1.01	0.4*	0.82*

^bRef=Female, ^cRef=White, ^dRef=CAN Entry, ^eRef=Non-Rural

Table 6.

Posthoc examination of THV's and delinquency, by state. The last column presents percent of kids with a THV that had a delinquency.

State	#	# THV ^a	# Delinq.	# THV & Delinq.	% Delinq. of Child. With THV ^b
AK	52	1	3	0	0
AR	562	16	10	0	0
AZ	1110	8	222	1	12.5
CA	7172	63	676	16	25.4
CO	391	7	46	0	0
DC	120	0	2	0	NA
DE	207	8	120	1	12.5
FL	1376	0	171	0	NA
GA	1692	19	39	1	5.3
HI	75	0	2	0	NA
IA	778	57	258	6	10.5
ID	125	1	50	0	0
IN	429	60	106	0	0
KY	1365	57	97	3	5.3
LA	519	27	169	1	3.7
MD	652	57	47	3	5.3
ME	154	15	22	3	20
MI	926	38	62	0	0
MN	848	13	140	3	23.1
ND	79	8	15	1	12.5
NE	197	21	66	4	19
NH	76	4	26	0	0
NM	288	10	22	0	0
NV	485	34	27	6	17.6
NY	1898	457	112	38	8.3
OH	2037	39	132	1	2.6
OK	546	14	93	1	7.1
OR	844	63	14	1	1.6
PA	1019	44	132	1	2.3
RI	290	9	10	0	0
SC	844	0	89	0	NA
SD	143	7	3	0	0
TN	572	77	3	0	0
TX	3523	189	776	29	15.3
UT	310	20	213	6	30
VA	712	35	10	0	0
VT	156	30	43	5	16.7
WA	540	55	110	5	9.1
WI	796	11	195	2	18.2
WV	107	2	2	0	0
WY	25	1	1	0	0

^a THV=trial home visit, ^b Calculated as (column 5 / column 3)*100

Figure 1.

Multistate Model for Aim 1

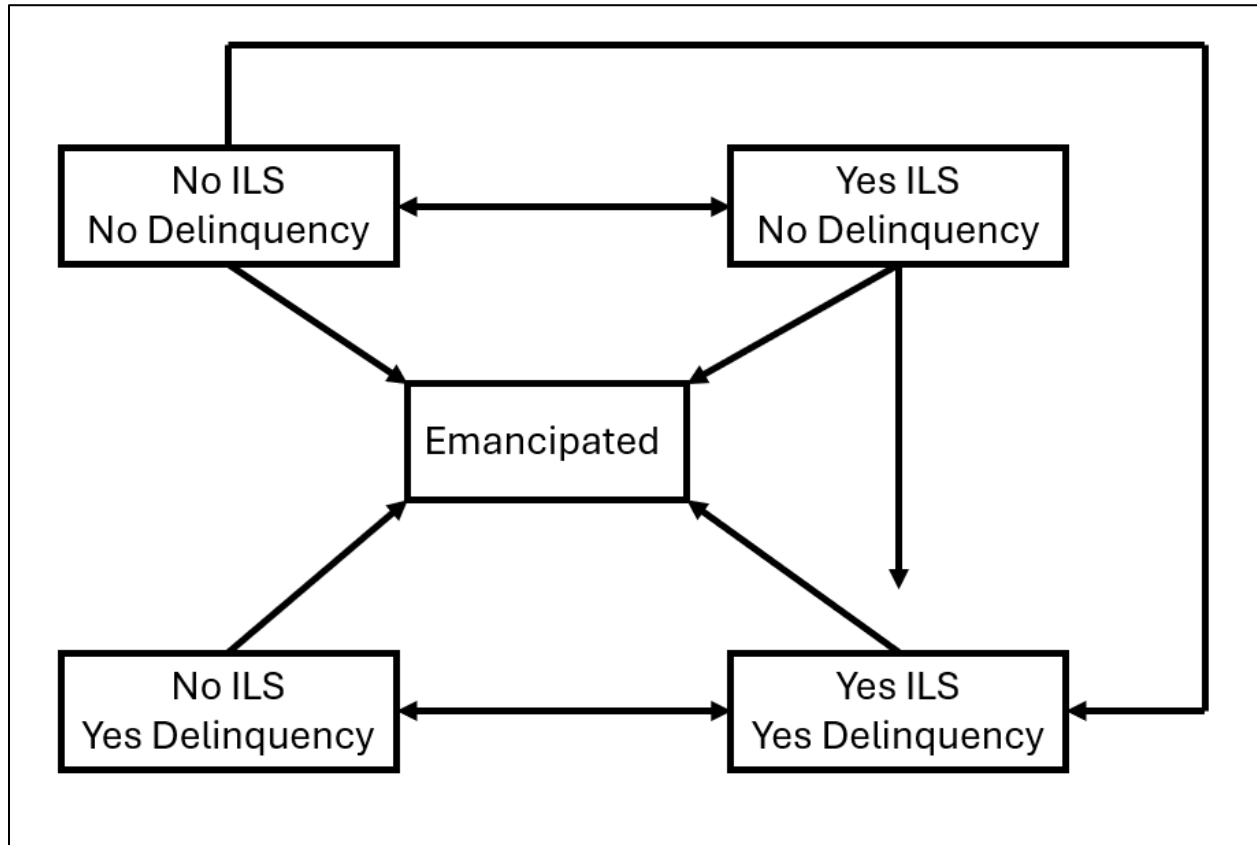


Figure 2.

Distribution of States by Approximate Age

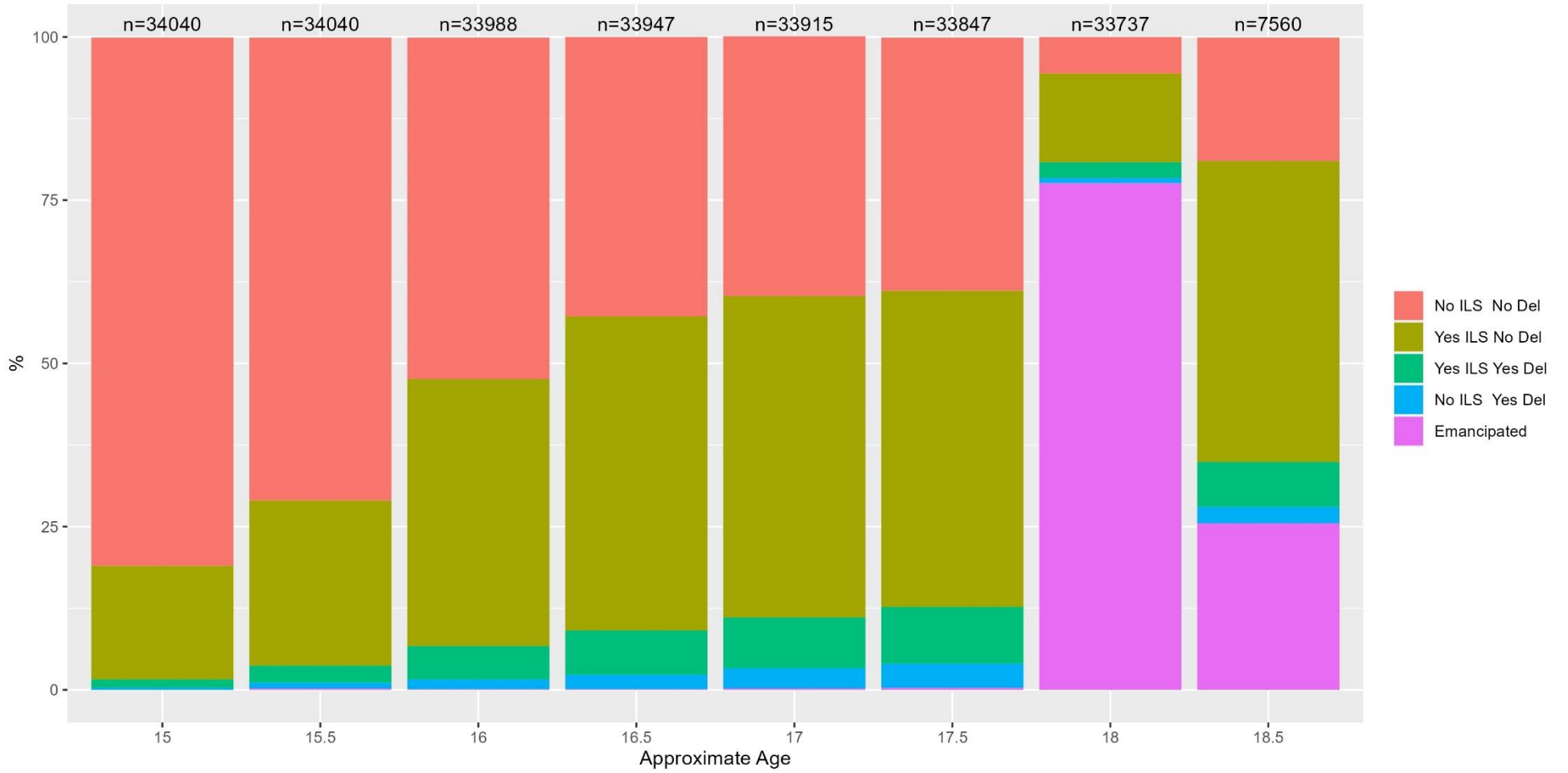


Figure 3.

Multistate Model with # of Transitions

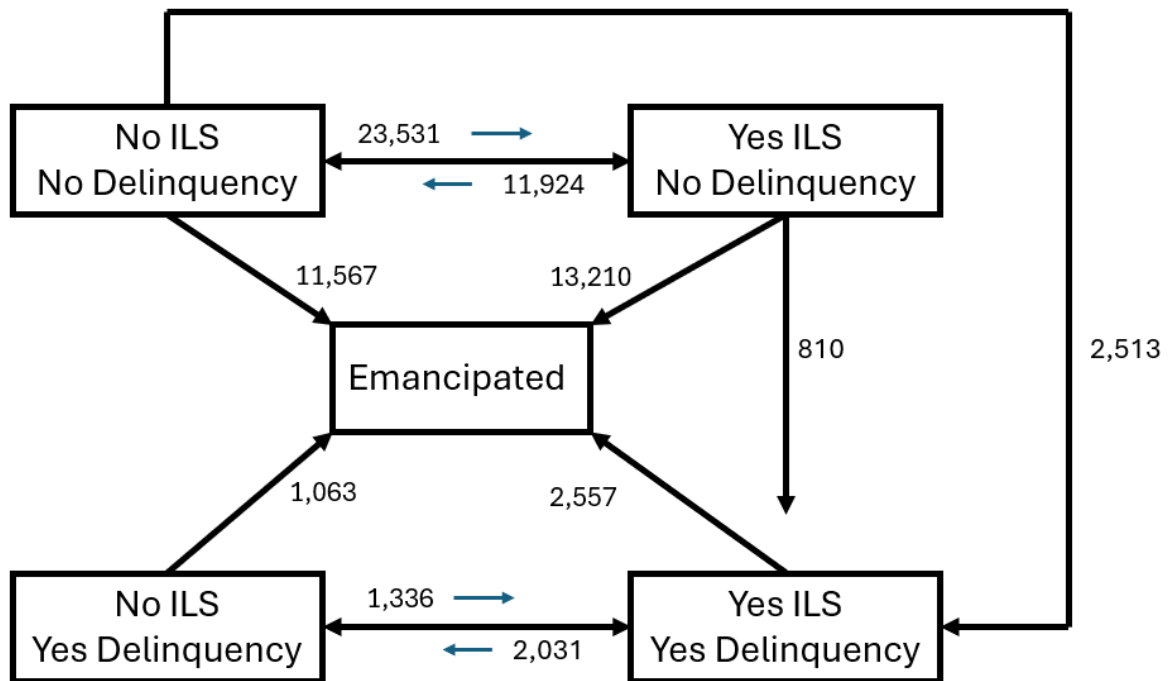
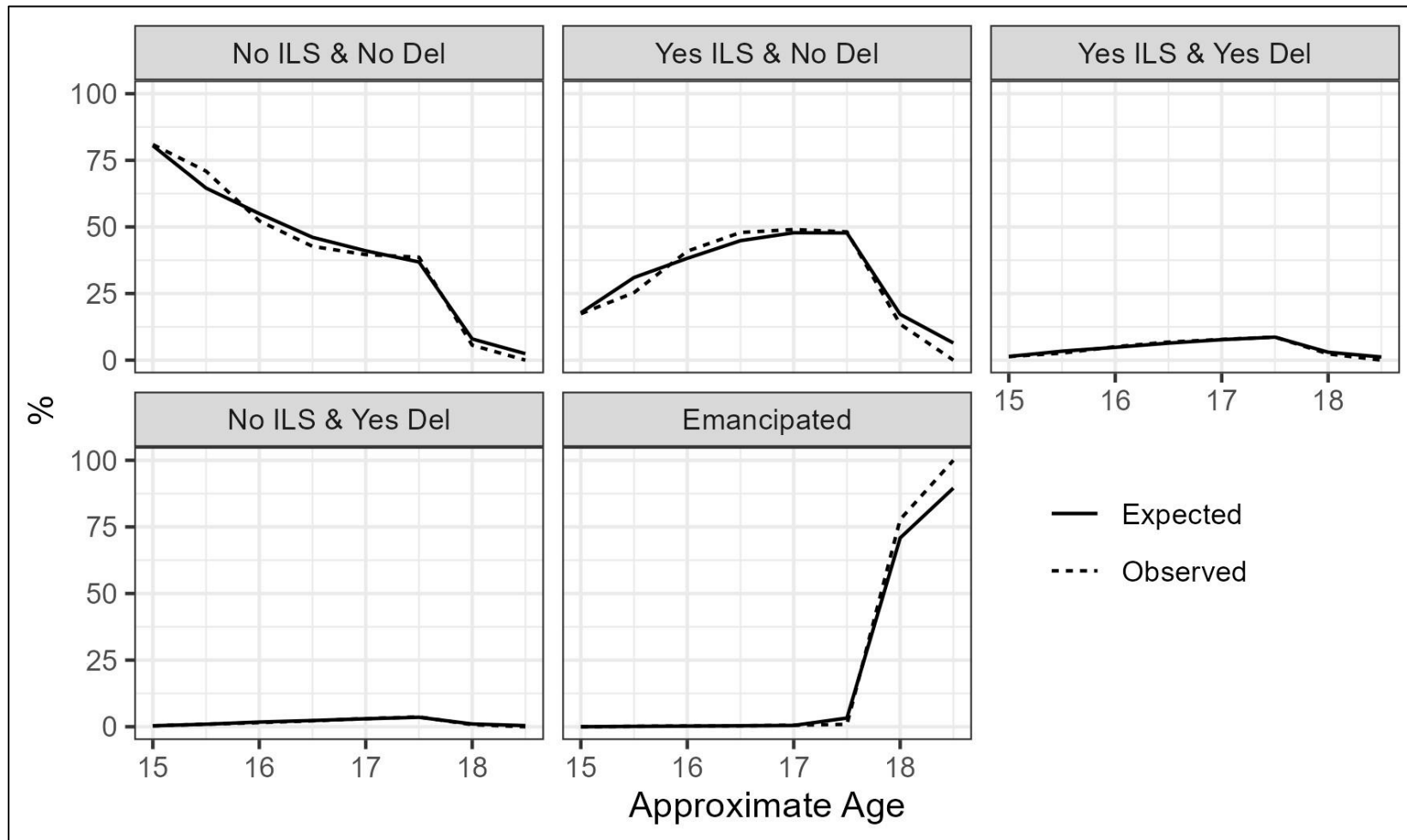


Figure 4.

Model validation measure: Prevalence plot of expected vs observed state distribution, by approximate age



Aim 2 Tables and Figures

Table 1.

Descriptives of Cohort 2017 NYTD population, Wave 2 analytic sample, and Wave 3 analytic sample.

	NYTD 2017 Cohort Population # (% of Population)	Wave 2 Analytic Sample # (% of W2 Sample)	Wave 3 Analytic Sample # (% of W3 Sample)
N	17876 (100)	6098 (100)	4482 (100)
Gender			
Female	9039 (51)	3391 (56)	2672 (60)
Male	8837 (49)	2707 (44)	1810 (40)
Race			
Black	5230 (29)	1644 (27)	1214 (27)
Hispanic	3976 (22)	1608 (26)	1233 (28)
White	8670 (49)	2846 (47)	2035 (45)
CWS History			
> 6 CMRs	3498 (20)	1154 (19)	885 (20)
> 1 FC Spells	4085 (23)	1380 (23)	1001 (22)
First Placement as Teen	9125 (51)	2886 (47)	2091 (47)
Group Home/Institution	8541 (48)	2757 (45)	1927 (43)
> 6 Placements	4204 (24)	1477 (24)	1091 (24)
No CAN at Entry	8616 (48)	2859 (47)	2039 (45)
Runaway	1601 (9)	318 (5)	201 (4)
Emotionally Disturbed	5396 (30)	2008 (33)	1417 (32)
In Care at Age 20	-	-	1104 (25)
Incarcerated			
<17 Years Old	-	1681 (28)	1151 (26)
17-19 Years Old	-	1090 (18)	714 (16)
19-21 Years Old	-	-	692 (15)
ILS < 17 Years Old	-	-	-
# Wellness = 0	-	2951 (48)	2071 (46)
# Wellness = 1-6	-	2488 (41)	1911 (43)
# Wellness > 6	-	659 (11)	500 (11)
ILS 17-19 Years Old			
# Financial > 0	-	-	2610 (58)
# Financial = 0 & # Wellness = 0-6	-	-	1368 (31)
# Financial = 0 & # Wellness > 7	-	-	504 (11)

Note: NYTD 2017 Cohort Population presented here includes only youth with a matched RAPIDS record and identify as Black, Hispanic, or White. All CWS History variables are measured up until Age 17

Table 2.

Sample descriptives before and after non-response weighting

		Wave 2 Analytic Sample (%)	Wave 3 Analytic Sample(%)
Before Weighting	Female	56*	60*
	Black	27*	27*
	First Placement as Teen	47*	47*
	Group Home/Institution	45*	43*
	No CAN at Entry	47*	45*
	Runaway	5*	4*
After Weighting	Female	51	51
	Black	29	29
	First Placement as Teen	51	51
	Group Home/Institution	48	48
	No CAN at Entry	48	48
	Runaway	9	9

* Indicates statistically significant difference from NYTD 2017 Cohort Population

Table 3.

GLMM coefficient posterior means and 95% credible intervals.

	Wave 2 Analysis: Incarceration 17-19 OR (95% CI)	Wave 3 Analysis: Incarceration 19-21 OR (95% CI)
Intercept	0.07 (0.05,0.09)*	0.05 (0.03,0.07)*
Gender (Ref=Male)		-
Female	0.54 (0.47,0.62)*	0.57 (0.49,0.66)*
Race/Ethnicity (Ref: White)		
Black	1.45 (1.27,1.65)*	1.29 (1.1,1.5)*
Hispanic	1.32 (1.14,1.54)*	0.68 (0.57,0.81)*
Black X Female	0.64 (0.52,0.78)*	0.56 (0.44,0.71)*
Hispanic X Female	0.57 (0.45,0.71)*	1.19 (0.92,1.56)
CWS History		-
> 6 CMRs	1.09 (0.97,1.23)	1.11 (0.97,1.27)
> 1 FC Spells	1.1 (0.97,1.23)	1.51 (1.32,1.72)*
First Placement as Teen	1.24 (1.11,1.39)*	1.52 (1.34,1.73)*
Group Home/Institution	1.79 (1.62,1.98)*	1.37 (1.22,1.54)*
> 6 Placements	1.74 (1.55,1.94)*	1.66 (1.47,1.88)*
No CAN at Entry	1.38 (1.25,1.52)*	1.12 (1.01,1.26)*
Runaway	2.57 (2.24,2.94)*	1.13 (0.96,1.34)
Emotionally Disturbed	1.06 (0.95,1.16)	1.19 (1.07,1.34)*
In Care at Age 20	-	0.68 (0.59,0.79)*
Incarcerated		-
<17 Years Old	4.43 (3.92,5.04)*	2.04 (1.75,2.37)*
17-19 Years Old	-	7.4 (6.2,8.84)*
ILS < 17 Years Old (Ref: # Wellness=0)		-
# Wellness = 1-6	0.75 (0.53,1.03)	0.84 (0.55,1.23)
# Wellness > 6	0.48 (0.22,0.89)*	0.46 (0.11,1.51)
# Wellness = 1-6 X		
Incarcerated	0.8 (0.54,1.21)	1.23 (0.61,2.43)
# Wellness > 6 X		
Incarcerated	0.5 (0.15,1.45)	1.48 (0.26,7.32)
ILS 17-19 Years Old (Ref: # Financial = 0 & # Wellness = 0-6)		
# Financial > 0	-	0.62 (0.37,1.01)
# Financial = 0 &		
# Wellness > 7	-	0.66 (0.36,1.09)
# Financial > 0 X		
Incarcerated	-	1.56 (0.74,3.53)
# Financial = 0 &		
# Wellness > 7 X		
Incarcerated	-	1.6 (0.26,10.08)

Note: * indicates 95% does not CI contains 1. Parameter estimates are exponentiated and interpreted as odds ratios

Table 4.

GLMM grouping parameter (random effects) posterior variance and 95% credible intervals. (Covariances not shown)

	Wave 2 Analysis: Incarceration 17-19	Wave 3 Analysis: Incarceration 19-21
Intercept	0.57 (0.33,0.97)	1.49 (0.84,2.63)
ILS < 17		
# Wellness = 1-6	0.75 (0.35,1.44)	0.95 (0.4,1.9)
# Wellness > 6	1.93 (0.61,4.98)	10.6 (4.77,22.95)
# Wellness = 1-6 X Incarcerated <17	0.98 (0.41,2.01)	3.29 (1.69,6.32)
# Wellness > 6 X Incarcerated <17	4.18 (1.17,11.92)	12.16 (4.57,30.59)
ILS 17-19		
# Financial > 0	-	1.93 (1.06,3.41)
# Financial = 0 & # Wellness > 7	-	1.12 (0.3,3.02)
# Financial > 0 X Incarcerated 17-19	-	5.12 (2.66,9.48)
# Financial = 0 & # Wellness > 7 X Incarcerated 17-19	-	15.09 (5.06,42.13)

Table 5.

GLMM selection: Expected log pointwise predictive density estimated with the widely applicable information criterion ($\text{elpd}_{\text{WAIC}}$) of increasingly complicated models. Interactions are with between ILS and Incarceration terms (see Results section).

	Wave 2 Analysis	Wave 3 Analysis
Baseline model	-7308.01	-6600.79
+ Random Intercepts	-7133.96	-6484.92
+ Random Intercepts + Random Slopes on ILS Terms	-7118.04	-6447.73
+ Random Intercepts + Random Slopes on ILS Terms + Interaction Terms	-7122.79	-6452.84
+ Random Intercepts * + Random Slopes on ILS Terms + Interaction Terms + Random Slopes on Interaction Terms	-7113.12	-6325.47

* Indicates final model

Figure 1a. Model validation measure: Calibration plot for Wave 2 Analysis Final GLMM

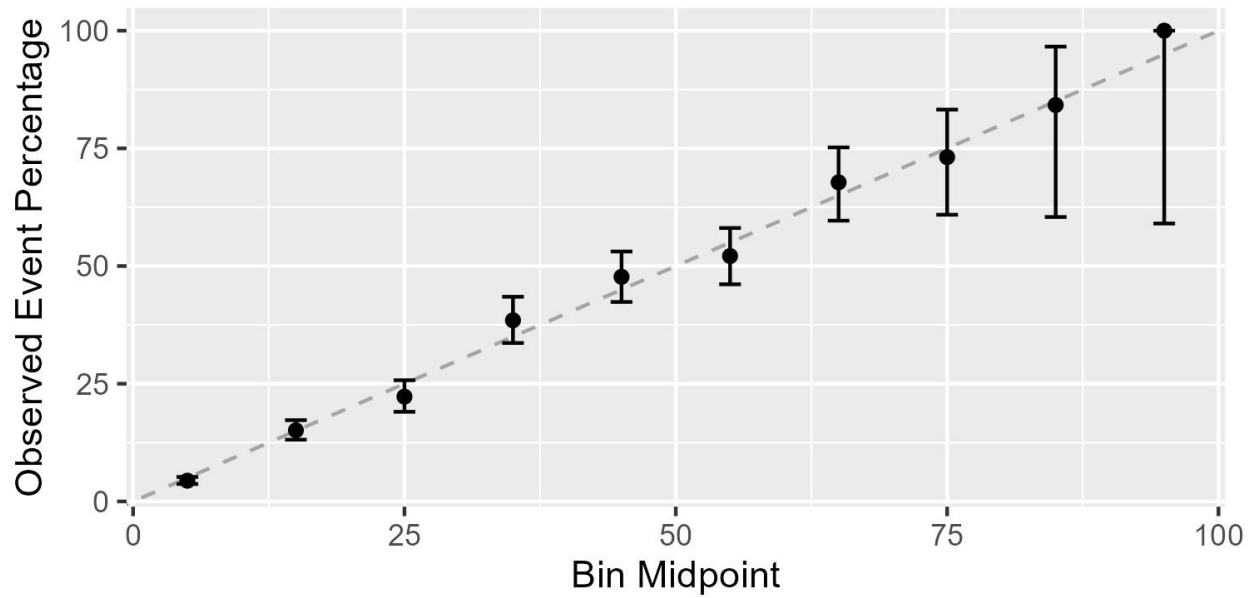


Figure 1b. Model validation measure: Calibration plot for Wave 3 Analysis GLMM

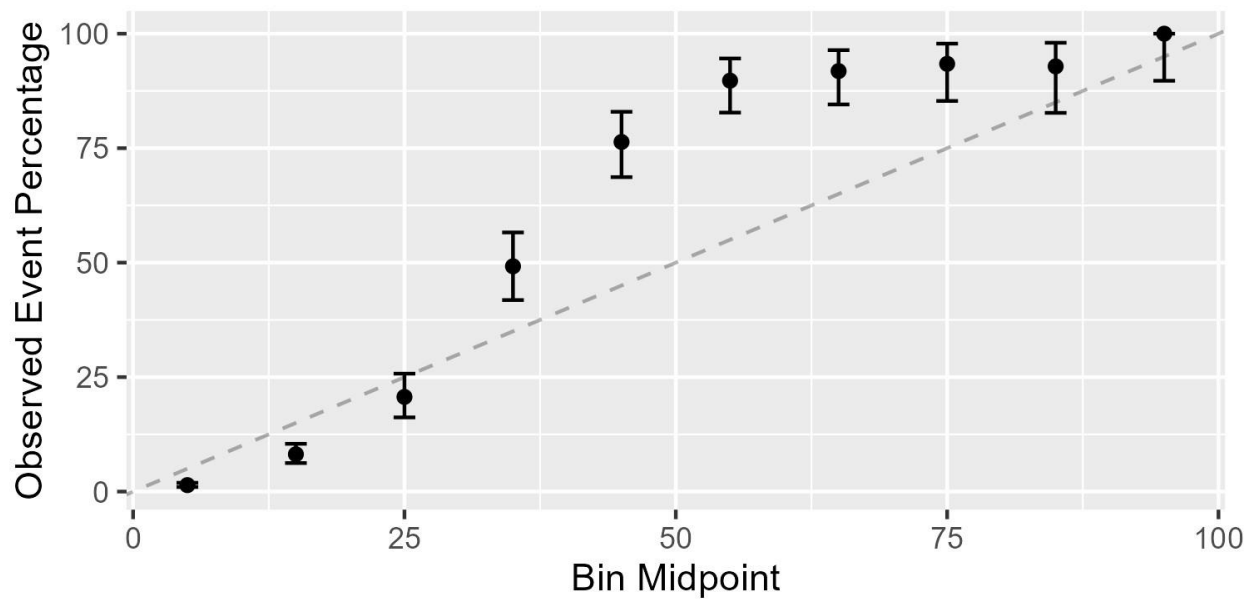
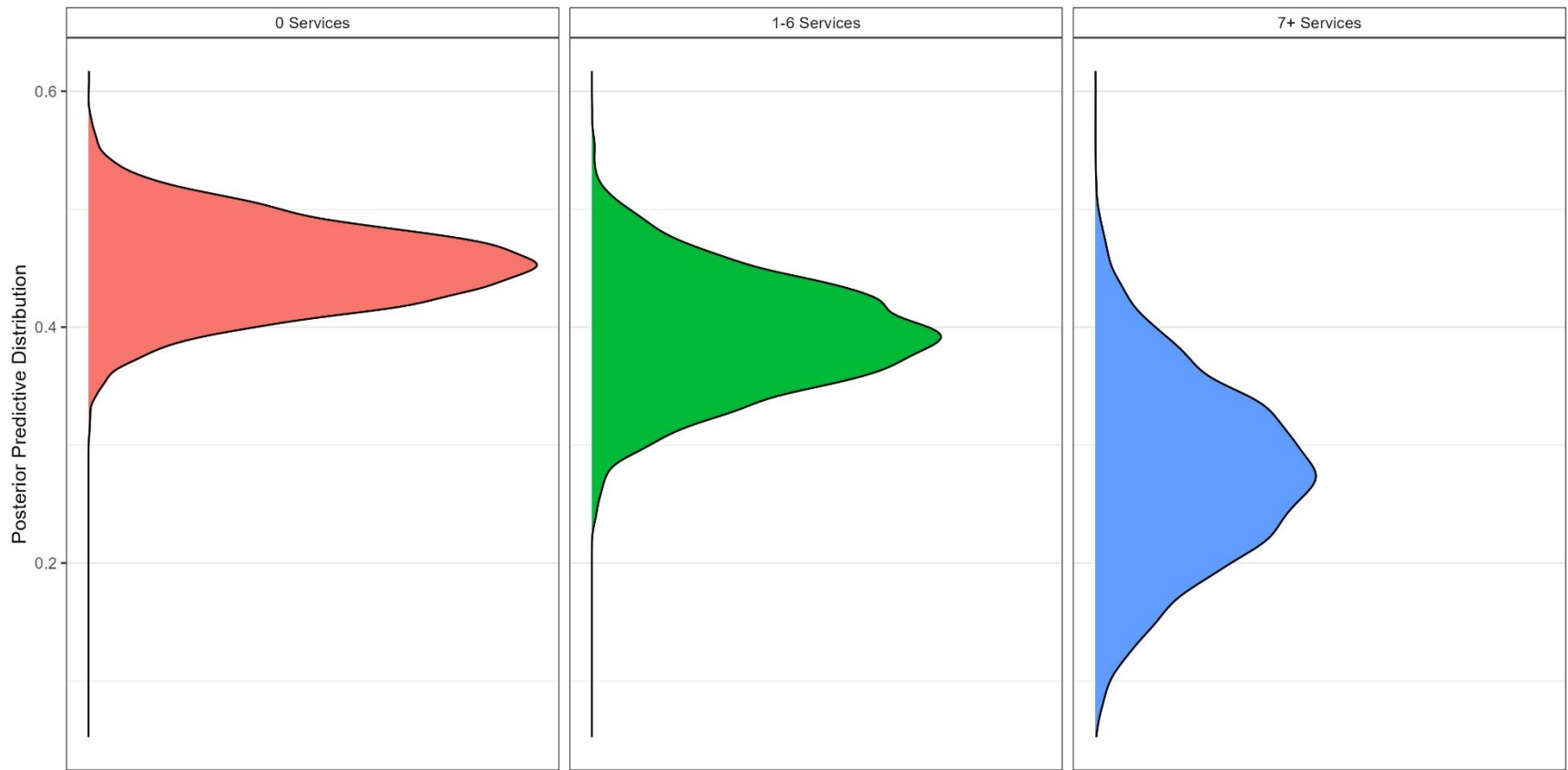


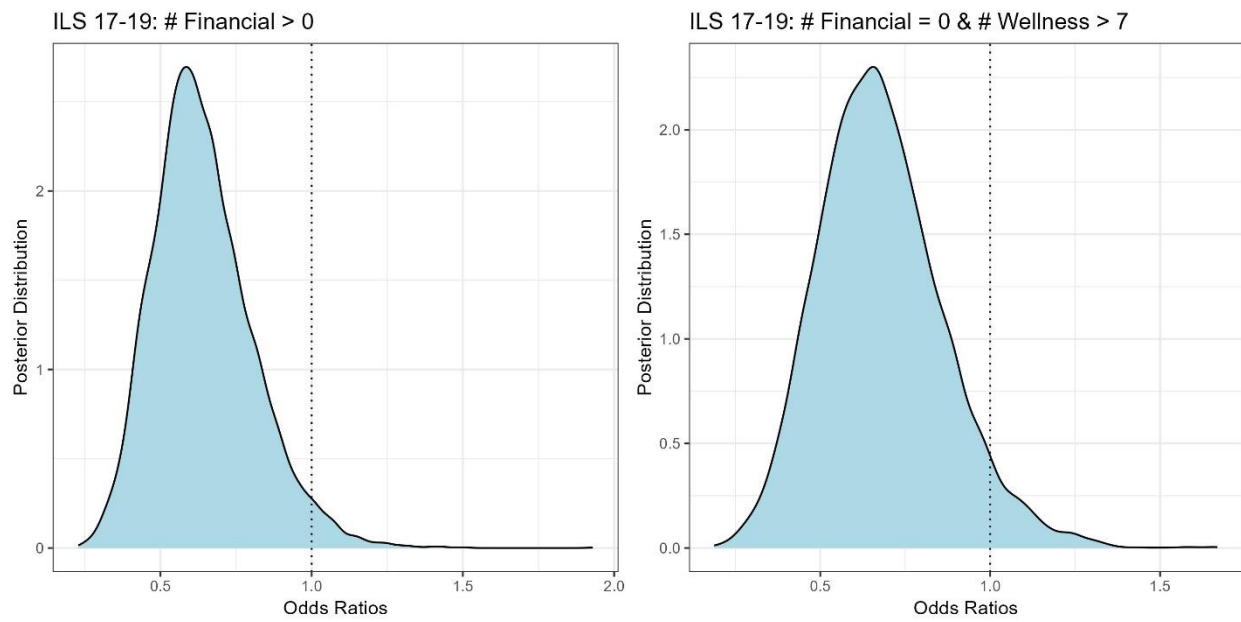
Figure 2.

Posterior predictive distribution with 5000 draws for Wave 2 final GLMM. ILS wellness terms vary across panels while all other variables are held constant at 0.



Figures 3.

Posterior distributions of ILS terms for Wave 3 final GLMM.



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