Chapter 7

Summary and Discussion

The aim of this dissertation was to further our understanding of risk factors associated with childhood aggression and the assessment of childhood aggression. To this end, Chapter 2 comprised an overview of meta-analyses and systematic reviews on treatment effectiveness and its moderators for childhood aggression. In addition, Chapter 3 to 5 examined macro-level and micro-level predictors of childhood and adolescent aggression and moderation on the contribution of genetic and environmental factors to individual differences in childhood aggression. Finally, Chapter 6 tested the agreement between different instruments commonly used to assess aggressive behavior. Table 1 briefly describes the aims and highlights of each chapter. The next paragraphs provide a more elaborate summary of each chapter.

The goal of Chapter 2 was to enhance our understanding of treatment effectiveness for childhood aggression. Therefore, Chapter 2 presented a literature synthesis of 72 meta-analyses and systematic reviews that examined effectiveness of treatments for childhood aggression. The study reviewed the characteristics of the meta-analyses and systematic reviews, effect sizes across types of treatments, and effects of various moderators (i.e., participant variables, treatment variables, and methodological variables). Treatments included psychosocial (non-pharmacological) universal prevention, selective prevention, indicated prevention, and intervention. The conclusion was that for universal and selective prevention, effects were mostly absent or small; for indicated prevention and intervention, effects were mostly small to medium. Furthermore, most moderators of treatment effectiveness had no effect in the majority of studies (i.e., child age, child gender, implementation to individuals or groups, person implementing the treatment, different treatment programs, and session related factors or treatment intensity) or mixed effects (i.e., socioeconomic status, type of treatment, informant, research quality). The only two significant moderators comprised of pre-treatment levels of aggression and parental involvement. Treatment effectiveness was higher for children with higher levels of aggression before treatment and when parents were involved in the treatment.

The discussion elaborated on two patterns that emerged within the results and on the implications of those patterns for research and clinical practice. First, the results identified similarities between universal and selective prevention compared to indicated prevention and intervention, respectively. Second, results revealed that based on existing research it is not yet possible to distinguish subgroups of children that would benefit more from treatment for aggression than others. The positive moderating effect of parental involvement on treatment effectiveness for childhood aggression suggests that an opportunity for future research may be to focus more on parental influences as possible moderators of treatment effectiveness. In addition, more systematic research attention for the association between individual factors and treatment effectiveness for childhood aggression would be promising.

Table 1. Research aim and highlights of each chapter.

Chapter	Research aim	Highlights
2	Create an overview of overall treatment effectiveness and its moderators for childhood aggression.	Effect sizes for treatments for childhood aggression were mostly small. Promising distinction between treating aggression vs. treating associated factors. Treatment might benefit from a stronger emphasis on individual differences.
3	Examine the association between national-level policies for child and adolescent mental health (CAMH) and adolescent mental health.	The association between policies for CAMH and adolescent aggressive behaviors was negative; aggressive behaviors were higher in countries with less policies. This association held when controlling for other national-level variables. There was no association between policies for CAMH and adolescent life satisfaction or psychosomatic symptoms.
4	Predict childhood aggression based on a large sample with a broad set of predictor variables.	Regression coefficients were in line with previous research, yet weaker, probably due to simultaneous inclusion. Most important predictors were externalizing, non-aggressive behaviors such as arguing, being easily distracted, and hyperactivity. These behaviors may function as salient targets for early detection and prevention of childhood aggression.
5	Investigate the moderating effect of socioeconomic status (SES) on the genetic architecture of childhood aggressive behavior.	SES moderated the contribution of genetic and environmental factors to childhood aggressive behavior. Heritability was higher, the contribution of the shared environment was lower, and the contribution of the nonshared environment was higher for children from high SES families compared to children from low or medium SES families. This pattern was similar in the Netherlands and the United Kingdom.
6	Assess the agreement between different measures of childhood aggressive behavior.	Convergence in item content was low. Concordance between diagnoses was low. Correlations between measures were moderate to high. Genetic overlap was moderate to high. The extent to which different measures of childhood aggressive behavior converge depends on the type (i.e., item content, clinical concordance, correlation, genetic overlap) of agreement considered

To examine the extent to which national-level variables explain variance in aggression, Chapter 3 assessed the association between national-level policies for child and adolescent mental health (CAMH) and individual-level adolescent mental health. Data were from 172,829 adolescents aged eleven to fifteen years, from 30 European countries in the 2013/14 Health Behaviour in School-aged Children (HBSC) study. Adolescent mental health indicators comprised aggressive behavior, life satisfaction, and psychosomatic symptoms. Information on national-level policies for CAMH was gathered from renowned statistical institutes and included availability of epidemiological data, the number of CAMH facilities, investment in family benefits, and investment in education. In addition, to ascertain that the association between

CAMH policies and adolescent mental health was not overestimated, analyses controlled for national-level adult violence, adult well-being, and income inequality. Multi-level analyses revealed that adolescent aggressive behavior was lower in countries with more CAMH policies, even when taking other national-level variables into account. There was no association between CAMH policies and adolescent life satisfaction and psychosomatic symptoms, respectively. More research is needed to understand how and why policies for child and adolescent mental health associate with adolescent mental health and might be deployed for better adolescent mental health.

Chapter 4 focused on identifying more proximal predictors for childhood aggression. In this chapter, data were analyzed from the Child and Adolescent Twins Study in Sweden (CATSS) and the Netherlands Twin Register (NTR; combined sample size was 62,227 children) to find a model to predict childhood overt/physical aggression with a large set of predictor variables using a novel methodological approach. Overt/physical aggression, as assessed around age 9, was psychometrically harmonized across multiple European cohorts including CATSS and NTR. The large set of predictor variables encompassed demographics, prenatal characteristics, physical development, parental education level, life events, and mother-reported behavioral symptoms. To avoid capitalization of chance, data were partitioned in four parts for the different analysis steps. These included 1) exploratory data analysis and tuning meta-parameters for the data mining, 2) fitting increasingly complex data mining models to assess which predictors had which types of effects (i.e., linear, nonlinear, interaction), 3) assessment of model performance and importance of the predictor variables, and 4) fitting a confirmatory prediction model of aggression that integrated the results of the data mining analyses. The resulting multi-group model accounted for interactions with sex and cohort and confirmed linear main effects of variables measuring behavioral symptoms (e.g., related to non-physical aggression, attention-deficit/hyperactivity disorder, and conduct disorder), maternal smoking during pregnancy, parenting, and proportion of life events. The most important predictors comprised behavioral symptoms such as arguing, being easily distracted, and hyperactivity. Findings were in line with previous research (e.g., Burke, Pardini, & Loeber, 2008; Malanchini et al., 2018; Mcknight, Huebner, & Suldo, 2002; Piotrowska, Stride, Croft, & Rowe, 2015; Racz & McMahon, 2011), yet weaker, likely due to the simultaneous analyses of many predictors. These easily observable predictive behaviors may act as targets for early detection and prevention of childhood aggression.

Chapter 5 aimed to examine whether the contribution of genetic and environmental factors to individual differences in childhood aggression varied in different environmental circumstances. To this end, Chapter 5 tested the moderating effect of socioeconomic status (SES) on the genetic architecture of childhood aggressive behavior in 7-year-old children. Data were from the Netherlands Twin Register (N = 24,112) and from the Twins Early Development Study (N = 19,644) from the United Kingdom. Results revealed that SES moderated the contribution of genetic and environmental factors. For the standardized variance components, the contribution of genetic factors was higher, the contribution of the shared environment was lower, and the contribution of the nonshared environment was higher for children from a high SES background compared to children from a low or medium SES background. The unstandardized variance components revealed that the contribution of genetic factors was similar across SES strata, the contribution of shared environmental factors was lower, and the contribution of nonshared environmental factors was higher for children from a high SES background compared to children from a low or medium SES background. This pattern was similar for children from the Netherlands and the United Kingdom. The total variance was higher for low and medium SES, compared to high SES, indicating that children from low and medium SES were more heterogeneous in their levels of childhood aggressive behavior. Further work is required to examine whether these findings replicate in other countries, because the moderating effect of SES on the contribution of genetic and environmental factors to childhood aggression may vary as a result of differences in income inequality or a countries' investment in children and families. Moreover, aggressive behavior was assessed differently in the samples. It is an important issue for future research and collaboration projects to examine the extent to which the use of different measures has implications for outcomes.

Therefore, the purpose of Chapter 6 was to assess the extent to which heterogeneity in measures of aggressive behavior has implications for studies that combine data from research groups. To this end, Chapter 6 examined the level of agreement of different measures childhood aggressive behavior on item content, clinical concordance, correlation, and the degree to which they measure a common genetic construct. The sample consisted of 1,254 twin pairs aged 8 to 10 years from the Netherlands Twin Register. Mothers and fathers filled in multiple aggressive behavior measures for these children. These measures included the Autism - tics, attention-deficit hyperactivity disorder, and other comorbidities (A-TAC; Hansson et al., 2005), the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001), and the Strengths and Difficulties Questionnaire (SDQ; Goodman, 2001). Overall, the findings revealed that agreement between different measures of childhood aggressive behaviors depended on the metric of agreement under consideration (i.e., item content, clinical concordance, correlation, underlying genetics). For instance, the overlap between the item content of the aggressive behavior measures was absent to moderate. Concordance on who received a score above the clinical cut-off was very weak to weak. Associations between the different measures of aggressive behavior based on continuous scores, while correcting for skewness,

yielded higher agreement (i.e., moderate to strong) than clinical cut-off scores. Genetic correlations ranged from weak to very strong, which generally indicated high overlap in underlying genetics between the different measures of aggressive behavior. Unlike observed correlations, such as the analyses of clinical concordance and correlation in the present study, genetic correlations were not influenced by measurement error. Therefore, the high genetic correlations may suggest that if we were to account for measurement error, the constructs that underlie the different measures of aggressive behavior in the present study were highly consistent.

Implications for Treatment, Prediction, and Assessment

This section discusses implications with regards to improvement of development and implementation of treatment and prevention programs for childhood aggression. In addition, this section will translate the outcomes of this dissertation into implications with regards to the assessment and prediction of childhood aggression.

Chapter 2 concluded that general treatment effects on childhood aggression were weak. Nevertheless, the treatments may have positively affected children or their families on other aspects than aggressive symptoms. Many of the treatments, especially the prevention programs, focused on skills and risk factors associated with childhood aggression such as social and emotional learning, academic performance, or classroom management for teachers (Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011; Oliver, Wehby, & Reschly, 2011; Park-Higgerson, Perumean-Chaney, Bartolucci, Grimley, & Singh, 2008). In addition, found treatment effects were larger for social and emotional learning and academic performance than for childhood aggression (e.g., Durlak et al., 2011). Because Chapter 2 did not consider such outcomes of treatment effectiveness for childhood aggression, the effectiveness of treatments for childhood aggression might be more promising than our findings suggest. Childhood aggression is associated with many adversities and other psychosocial problems (Bartels et al., 2018), burden for parents, and high financial costs for society (Meltzer, Ford, Goodman, & Vostanis, 2011; Rivenbark et al., 2018; Roberts, McCrory, Joffe, de Lima, & Viding, 2017). Although treatments may not have been effective in reducing aggression, they may have been effective for comorbid problems, indirectly preventing the aggravation of childhood aggression. Future studies examining the direct and indirect effects of treatments for childhood aggression would be promising.

In addition, Chapter 2 revealed that a significant moderator of treatment effectiveness for childhood aggression was parental involvement. Parents are important because they shape the environment in which their children grow up. If parents suffer from emotional or behavioral problems, this may disrupt their parenting behaviors (Belsky, Hsieh, & Crnic, 1998; Berg-Nielsen, Vikan, & Dahl, 2002). Prior research suggests that treatments that solely focus on the parents' emotional and behavioral health, in which children are not involved, positively affect their children (Hudziak & Ivanova, 2016; Ivanova, Dewey, Swift, Weinberger, & Hudziak, 2019). Parental psychopathology is associated with higher child psychopathology (Wesseldijk, Dieleman, van Steensel, Bleijenberg, et al., 2018). Moreover, children with behavioral problems and parents with a psychiatric disorder have worse longitudinal outcomes than children with behavioral problems with parents that do not have a psychiatric disorder (Roetman et al., 2019). Conversely, parents of children with behavior problems are at higher risk for a psychiatric disorder (Wesseldijk, Dieleman, van Steensel, Bartels, et al., 2018). Additionally, because of the strong contribution of genetic factors to individual differences in aggression (Burt, 2009; Tuvblad & Baker, 2011; Waltes, Chiocchetti, & Freitag, 2016), it is not unlikely that parents of children with (symptoms of) aggression show aggression-related symptoms themselves (Frick et al., 1992). Altogether, these findings support the importance of parental involvement in treatment for childhood aggression. This suggests that it would be beneficial to screen for parental psychiatric disorders for the treatment of childhood behavior problems (Roetman et al., 2019; Wesseldijk, Dieleman, van Steensel, Bleijenberg, et al., 2018)**.** A better understanding of direct and indirect treatment effects and the contribution of parental influences to treatment effectiveness for childhood aggression would be promising and could be informative for policy making.

Chapter 3 revealed an association between national-level policies for child and adolescent mental and adolescent mental health. For further advancement of our understanding of this association, two approaches might be beneficial.

First, longitudinal research which monitors the implementation of policies in countries and levels of adolescent mental health before and after the implementation of a specific CAMH policy may potentially reveal information about the direction of effect (e.g., better adolescent mental health as a result of more policies for child and adolescent mental health or vice versa). Longitudinal research also allows assessment of changes over time in the association between policies for child and adolescent mental health and adolescent mental health (e.g., some policies might become increasingly effective over time, or policies may lose their impact over time). To illustrate, it may take time before an increase in child and adolescent mental health services affects child and adolescent mental health, because it may take time for services to accommodate to the needs of children and adolescents and overcome barriers related to availability, accessibility, acceptability, and equity (Tylee, Haller, Graham, Churchill, & Sanci, 2007).

Second, research on more intermediate geographical levels, such as provinces or smaller regions, in addition to our country level analyses, might reveal a stronger association between policies for child and adolescent mental health and adolescent mental health. Indeed, the implementation of policies for child and mental health

may vary across regions (Braddick, Carral, Jenkins, & Jané-Llopis, 2009; Signorini et al., 2017). For example, in Slovenia the number of facilities for child and adolescent mental health increased in the past years, but there are still regions without child and adolescent mental health services (Kumperscak, 2019). This implies that information at the national-level is not fully representative. Moreover, only 3.1% of variance in adolescent aggressive behavior was explained by country differences, which indicates more heterogeneity in adolescent aggressive behaviors within countries than between countries. Therefore, a more fine-grained examination of the association between policies for child and adolescent mental health and adolescent mental is needed to better understand this association.

The importance of behavioral symptoms for the prediction of childhood aggression reported in Chapter 4 confirms the high co-occurrence of childhood aggression with other behavioral and emotional problems reported in existing research (Bartels et al., 2018; Harvey, Breaux, & Lugo-Candelas, 2016; Marshall, Arnold, Rolon-Arroyo, & Griffith, 2015). These findings need to be interpreted taking two issues into account. First, many behavioral symptoms are found to genetically overlap with childhood aggression (Dick, Viken, Kaprio, Pulkkinen, & Rose, 2005; Latvala, Kuja-Halkola, Almqvist, Larsson, & Lichtenstein, 2015). It is likely that due to genetic overlap, associations between childhood aggression and predictor variables in Chapter 4 were overestimated and that controlling for this overlap would yield weaker associations. Second, the literature reveals important associations between childhood aggression and family factors that were not available for analysis for Chapter 4. For instance, growing up with parental harsh control, psychological control, or neglectful parenting is consistently related with childhood aggression (Larsson, Viding, Rijsdijk, & Plomin, 2008; Oliver, 2015; Pinquart, 2017). Exposure to interparental violence also contributes to childhood aggression (Buehler et al., 1997; Ehrensaft & Cohen, 2012), as does exposure to parental psychopathology (Goodman et al., 2011). Factors outside the family also associate with aggression, such as neighborhood disadvantage (Burt, Klump, Gorman-Smith, & Neiderhiser, 2016; Leventhal & Brooks-Gunn, 2000), and national-level policies for child and adolescent mental, as demonstrated in Chapter 3. To paint a more complete picture of childhood aggression, future research requires to pay more attention to risk factors at different levels of context.

The results from Chapter 5 indicated that the shared environment contributes more strongly to individual differences in childhood aggression in children from low and medium SES backgrounds compared to children from high SES backgrounds. This finding suggests that children from low or medium SES backgrounds would benefit more from treatment to improve shared environmental factors. Examples of such shared environmental factors are healthy family functioning, less parental stress, housing quality, or positive school attachment (Brumley & Jaffee, 2016; Burt, Klahr, Neale, & Klump, 2013; Hudziak & Ivanova, 2016; Klahr & Burt, 2014). To some extent, policies for child and adolescent mental health such as investment in family benefits and investment in education as examined in Chapter 3 attempt to already do so through alleviation of factors associated with low SES (Piotrowska et al., 2015; Reiss, 2013). The results from Chapter 5 suggest that such early prevention measures on the shared environment indeed may benefit children at risk for heightened levels of aggression. Furthermore, due to the large genetic component in childhood aggression, there might be intergenerational transmission of aggression from parents to children, both through genetic factors and environmental factors (D'Onofrio et al., 2007) such as heightened levels of interparental violence (Ehrensaft & Cohen, 2012). The findings of Chapter 5 underline the importance of parental involvement in treatments for childhood aggression as found in Chapter 2, and suggest that this would be most beneficial for children from low and medium SES backgrounds.

Chapter 6 revealed that the level of agreement between measures of aggressive behavior depends on the type of agreement under scrutiny (i.e., item content, clinical concordance, correlation, and genetic overlap). Genetic correlations between the measures of aggressive behavior were strong to very strong. This suggests that the same genetic factors influence the different measures, despite the differences in the purpose, construct of interest, and item content. Therefore, the findings indicate that different measures of aggressive behavior can readily be combined in future collaboration studies on the genetics of childhood aggressive behavior.

In addition, Chapter 6 revealed that agreement between measures of childhood aggressive behaviors was stronger for continuous scores than for agreement on clinical levels. What this implies for future collaboration research is that the different measures of aggression cannot be used interchangeably when making decisions based on a clinical cut-off score, rather, decision-making based on continuous scores may improve reliability. Continuous scores may be more robust across measures, and perhaps also across development. It is not uncommon that children differ in their expression of childhood aggression with age (i.e., heterotypic continuity; Bolhuis et al., 2017; Lubke, Mcartor, Boomsma, & Bartels, 2017), which implies that children's aggression scores may fluctuate above and below the clinical threshold in assessment. As demonstrated in Chapter 4, children with heightened, yet not necessarily clinical, levels of aggression likely display other behavioral symptoms of disorders strongly associated with childhood aggression. Prevention or intervention would possibly diminish the likelihood that children with subclinical levels of aggression would develop clinical aggression or a disorder strongly associated with aggression and, consequently, mitigate the adverse outcomes associated with later detection (Campbell, Lundstrom, Larsson, Lichtenstein, & Lubke, 2018). In addition, Chapter 2 showed that children with subthreshold levels of aggression are as likely

to benefit from treatment as children with above-threshold levels of aggression. Altogether, these findings suggest that a dimensional approach to the assessment of childhood aggression would be promising, especially when combining data that use different measures.

The research in this dissertation, especially in Chapters 3, 4, 5, and 6, focused on the more overt and physical types of aggression. Nonetheless, childhood aggression may take other forms, such as indirect or relational aggression. These types of aggression do not occur in direct confrontation, as is the case for fighting or bullying, but comprise behaviors such as manipulation or social exclusion (Björkqvist, Lagerspetz, & Kaukiainen, 1992; Vaillancourt, Brendgen, Boivin, & Tremblay, 2003). Overt/physical aggression may differ in etiology from indirect or relational aggression, as suggested by the partial genetic correlations (i.e., .54 for boys and .43 for boys; Ligthart, Bartels, Hoekstra, Hudziak, & Boomsma, 2005). This suggests that it is uncertain whether the results from this dissertation would apply to other types of aggression. Future research that, for example, examines whether the predictors for childhood aggression found in Chapter 4, such as arguing, being easily distracted, and hyperactivity, also predict indirect or relational aggression would reveal whether or not the same targets may be useful for early detection and prevention for different types of aggression.

The results from Chapter 3 to Chapter 6 need to be interpreted as cross-sectional. The conclusions are not causal, however, future longitudinal research may reveal the direction of effect, such as whether the predictors in Chapter 3 and Chapter 4 are a cause or an effect of higher levels of aggression. In addition, the chapters did not allow for an examination of developmental trajectories (e.g., which risk factors best predict the onset and development of childhood aggression at which age). Longitudinal research is needed to uncover whether predictors such as parental education level, maternal smoking during pregnancy, or hyperactivity as found in Chapter 4 are equally predictive across development. A reason to suspect differential predictor effects across age is that child development is marked by different developmental stages with their accompanying landmarks for development, such as the formation of attachment around the 6- to 12-month period or development of the ability to inhibit aggressive outbursts, which develops in children aged 4 to 7 years old (Bakermans-kranenburg, Ijzendoorn, & Juffer, 2003; Wachs, Georgieff, Cusick, & Mcewen, 2014). These different stages suggest that children vary in sensitivity for risk factors across development. To illustrate, a meta-analysis revealed that the concurrent association between parental emotion socialization behaviors and childhood aggression decreases with age (Johnson, Hawes, Eisenberg, Kohlhoff, & Dudeney, 2017). In addition, prior work revealed that the contribution of genetic and environmental factors to childhood aggression varies across age; the shared environment explains around 44% of individual differences in childhood, but this influence disappears in adolescence (Porsch et al., 2016; Wesseldijk et al., 2017). It would be useful to examine at what age childhood aggression can be best predicted by which risk factors to optimally detect children most likely to become aggressive early enough to prevent worse outcomes from later diagnosis and treatment (e.g., Campbell, Lundstrom, Larsson, Lichtenstein, & Lubke, 2018).

GENERAL CONCLUSION

Within ACTION, the goal was to inform the development of prevention and treatment strategies. The wealth of available data and expertise within ACTION permitted examination of new research questions. The studies in this dissertation highlighted the complexities in the etiology of childhood aggression. Childhood aggression is found to be associated with a broad range of factors, from country-level policies to more proximal factors as the family environment, and individual level factors such as behavior and genetics, which may also interact. Assessing whether children score above or below a clinical cut-off for inclusion for treatment may lead to children to be excluded from treatment from which they would benefit as much as children who score above a clinical cut-off. Moreover, measures of aggressive behavior agree only to a small extent on which children display clinical levels of aggression, which may cause children to miss out on treatment not because of their level of aggression, but because of the measure selected to assess their aggression.

Although the influence of the broad range of factors discussed in this dissertation on childhood aggression adds complexity to the etiology of childhood aggression, it also provides opportunities to improve prevention and intervention strategies for childhood aggression. For example, inclusion of parental characteristics (i.e., a family based approach) in diagnosis and treatment might improve treatment effectiveness for childhood aggression. Additionally, more policies for child and adolescent mental health were associated with lower levels of aggressive behaviors, which suggests merit in employment of policies as early prevention efforts. Moreover, differences in etiology of aggression as a result of socioeconomic background highlight that it is promising to distinguish subgroups of children more likely to develop childhood aggression and children more likely to benefit from treatment. The research in this dissertation contributes to previous work to advance our understanding of treatment, prediction, and assessment of childhood aggression and provided directions for future research working towards a more personalized approach to childhood aggression.