Understanding Adjustment of Adolescents Conceived Using Medically Assisted Reproduction within Family Contexts

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Muzi Chen

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Dedication

For my dearest parents and husband.

Abstract

Adolescents conceived using medically assisted reproduction (MAR), as a continually growing population in the U.S., may be at risk for adjustment problems due to three challenging parenting tasks faced by their families. These challenges include a high likelihood of parental pregnancy loss, raising twins, and whether and when parents should tell children about being conceived using MAR. This dissertation investigated psychosocial adjustment of MAR-conceived adolescents in relation to these parenting challenges within family contexts in two studies. **Study 1** tested a moderated mediation model that proposes a possible family process through which a pile-up stressors of pregnancy loss and twin status indirectly influence adolescent psychosocial adjustment in a sample of 278 adolescents from 193 families. Results suggest pregnancy loss has long-lasting, differential effects on parental emotions at middle childhood when parenting twins versus singletons, which relates to subsequent adolescent adjustment. **Study 2** examined adolescent psychosocial adjustment following the MAR information sharing within family communication environments using multiple group analysis in a sample of 163 adolescents from 115 families. Results indicate a complex picture that family communication environments interplay with the timing of MAR information sharing to influence adolescent psychosocial adjustment. These studies suggest a critical role of family contextual factors in shaping MAR-conceived adolescents' psychosocial adjustment.

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Infertility, defined as the inability to successfully conceive after one year or more of unprotected sex, affects one in six couples worldwide (Centers for Disease Control and Prevention [CDC], 2018; European Society of Human Reproduction and Embryology [ESHRE], 2014). Medically assisted reproduction (MAR), which refers to various infertility treatments such as intrauterine insemination and assisted reproductive technology (ART; Zegers-Hochschild et al., 2009), has been widely used over the past four decades and resulted in at least five million children worldwide to date (ESHRE, 2014). The use of MAR has also notably increased over time. For example, the number of ART cycles conducted in the U.S. had grown by 39% from 2007 to 2016 (CDC, 2018). Thus, there is a considerable and continually growing population of MAR-conceived children in the U.S. and a substantial number of them have entered into adolescence.

Families created using MAR (termed as MAR families) are undoubtedly resilient given the lengthy, painful infertility and treatments they have undergone. Yet, adolescents in MAR families may be at risk for adjustment problems due to three stressful parenting tasks. These challenges involve a high likelihood of parental pregnancy loss (Farr, Schieve, & Jamieson, 2008), raising twins (American Society for Reproductive Medicine [ASRM], 2011), and whether and when parents should tell children about their MAR conception (termed as MAR information sharing; Ethics Committee of the ASRM, 2013).

Addressing the above concern, the two studies presented in this dissertation investigated the psychosocial adjustment of MAR-conceived adolescents in relation to

specific family contexts. **Study 1** examined the combined effects of pregnancy loss and parenting twins on adolescent adjustment within the context of parental emotional well-being. **Study 2** focused on MAR information sharing and considered family communication environment as a family contextual factor.

Study 1

Longitudinal Effects of Parental Pregnancy Loss on Adjustment of Adolescents Conceived using Medically Assisted Reproduction: Differential Role of Twins versus Singletons

MAR families are likely to experience stressors of pregnancy loss and parenting twins, which may pose long-term risks to parents and children (ASRM, 2011; Cheung, Chan, & Ng, 2013; Farr, et al., 2008). Despite the common coexistence of these stressors in MAR families (Ellison & Hall, 2003), previous research has examined their impacts independently from one another. Informed by the Double ABCX model (McCubbin & Patterson, 1983a) and the role of parental emotional well-being (Goodman et al., 2011), this study evaluated a possible process through which a pile-up of stressors influenced adolescent adjustment.

Pregnancy Loss as a Stressor: Implications for MAR Families

Pregnancy loss, distinct from infertility, refers to the loss of pregnancy by miscarriage, stillbirth, or termination (Robinson, 2014; Practice Committee of ASRM, 2013a). Pregnancy loss rate has remained high in MAR families (Farr et al., 2008; CDC, 2018). For example, in 2016, 17 – 58% of U.S. pregnancies conceived through ART using fresh embryos from fresh intended mothers' own eggs ended in miscarriage (CDC, 2018). Further, although distressing for almost all parents (Klier, Geller, & Ritsher, 2002), pregnancy loss may be especially devastating for formerly infertile parents due to their enormous emotional and financial investments in achieving a pregnancy (Harris & Daniluk, 2010; Jaffe & Diamond, 2011; Nachtigall, MacDougall, Davis, & Beyene,

2012). Given these considerations and the increasing use of MAR, pregnancy loss in MAR families deserves close scholarly attention.

Extant MAR research demonstrates the tremendous psychological toll pregnancy loss has on parents. Emotional responses can include depression, anxiety, a profound sense of grief, despair, powerlessness, fear, and psychological trauma (Cheung et al., 2013; Ellison & Hall, 2003; Harris & Daniluk, 2010; Patel et al., 2018). Although in line with the large body of general population literature (see reviews by Diamond & Diamond, 2016; Due, Chiarolli, & Riggs, 2017), parents of MAR families may be at exceptionally high risk for emotional distress following pregnancy loss. Cheung et al. (2013) showed that women who experienced a first-trimester miscarriage after ART had greater stress, depression, and traumatic responses than those who miscarried after natural conception.

Moreover, the detrimental effects of pregnancy loss on MAR parents may extend for years beyond the birth of a child. The few available MAR studies point to a lingering sense of sadness and loss among some mothers during early parenthood (Ellison et al., 2003; Harris & Daniluk, 2010). General population studies also lend support to this potentially enduring effect of pregnancy loss (Broen, Moum, Bødtker, & Ekeberg, 2005; Christiansen, Elklit, & Olff, 2013; Price, 2008; Schwerdtfeger et al., 2009). For example, Schwerdtfeger et al (2009) found that 9 years following their loss, mothers who experienced pregnancy loss had greater depression than mothers without fertility issues or childless women.

Parental pregnancy loss may also directly or indirectly influence adolescents in MAR families. Although MAR research is unavailable, general population studies

suggest a potential direct, negative effect of pregnancy loss on children (Badenhorst & Hughes, 2007; O'Leary & Gaziano, 2011; Wilson, 2001). Also, given the established link between parental emotional issues and child problems (Goodman et al., 2011; Nelson, Hammen, Brennan, & Ullman, 2003), pregnancy loss may compromise MAR-conceived adolescents' adjustment through its potential long-lasting impacts on parents.

Twins as a Stressor: Implications for MAR families

MAR treatments often involve multiple embryo transfer in order to achieve conception of at least one child, resulting in a notable rate of twin births (ASRM, 2012). The 19 – 29% twin birth rate following MAR over the past decade has remained high relative to the 3.4% U.S. twin birth rate (CDC, 2018; Hamilton et al., 2015). Twins may present a stressor in MAR families for several reasons. Having a single infant enter a family can be challenging for almost all parents due to the associated physical, emotional, and relational changes to the family system (Belsky, 1986). Parenting demands can rise exponentially when raising twins who enter the family simultaneously (ASRM, 2011; CDC, 2018). Moreover, twins are more prone to prematurity or low birth weight compared to singletons (ASRM, 2012). Neonatal health risks can make twins vulnerable to less optimal physical, cognitive, and psychosocial adjustment throughout life (CDC, 2018; Nosarti, Murray, & Hack, 2010). This compounded parenting demands likely place parents at an elevated risk for emotional difficulties, especially during the early years (ASRM, 2011). Indeed, mothers of MAR-conceived twins tend to have greater depression during infancy (e.g., Sheard et al., 2007; Vilska et al., 2009) and preschool stage relative to those of MAR-conceived singletons (Olivennes et al., 2005).

General population research indicates that parental emotional distress can pose risks to longitudinal child psychosocial adjustment (Goodman et al., 2011; Leve, Kim, & Pears, 2005). This evidence and twins' neonatal adversities raise concerns about MAR-conceived twins' long-term well-being. The only available study on MAR-conceived twins in adolescence shows that adolescent twins function well and have comparable psychosocial adjustment with adolescent singletons (Anderson et al., 2016). However, it should be noted that this finding is based on research examining the main effect of twin status without considering other potential stressors that may co-exist in MAR families.

A Pile-up Stressors of Pregnancy Loss and Parenting Twins

The Double ABCX model is useful for conceptualizing a combination of stressors (McCubbin & Patterson, 1983a). This model proposes that families can experience additional stressors following the initial major stressor, contributing to a pile-up of demands. The more severe pile-up of demands can potentially place families at a lower level of adaptation in the future if the demands are inadequately or ineffectively managed (Lavee, McCubbin, Patterson, 1985; McCubbin & Patterson, 1983a). This less optimal adaptation may be characterized by deterioration in various aspects, with one being the compromised well-being of individual family members (Lavee, et al., 1985). From this perspective, pregnancy loss is seen as a major stressor and parenting twins (or singletons) as an additional stressor. When these stressors pile up in a MAR family, parents and their child(ren) can be negatively affected. Indeed, anecdotal evidence suggests a potential long-term vulnerability of MAR families who have a pregnancy loss history and are raising multiples (Ellison & Hall, 2003).

The Present Study

The present study tested a moderated mediation model derived from the aforementioned empirical evidence and theoretical lens to potentially explain the psychosocial adjustment of MAR-conceived adolescents (see Figure 1.1). The pile-up of stressors was operationalized as an interaction between pregnancy loss and twin status. Of primary interest, this model proposed that pregnancy loss and twin status would interact to influence parental emotional well-being, which would relate to adolescent psychosocial adjustment. It was expected that the effects of pregnancy loss on parental emotions might differ across parents of twins versus singletons, which would indirectly account for adolescent adjustment.

Method

Participants

Participants in the present study completed two waves of a longitudinal survey study investigating outcomes of MAR-conceived children. At Wave 1, families with at least one parent and at least one MAR-conceived child born between 1998 and 2004 (aged 6 – 12 years) were recruited through a university reproductive medicine clinic. Of these eligible families, 86% were located and 82% of the located families participated in the survey study, resulting in a full Wave 1 sample of 209 families with 307 MAR-conceived children. Five years later at Wave 2 (children aged 11 – 17 years), 60% of Wave 1 families continued their participation.

The present study included 278 MAR-conceived adolescents from 193 families (54.3% female; adolescent's age: $M = 13.36$, $SD = 1.37$). Participants did not include MAR families with same-sex couples (n = 7) or single mother by choice (n = 1) because

their use of MAR was typically due to the absence of a male partner instead of infertility. Families with MAR-conceived triplets were also excluded. There were 156 singletons and 122 twins in this study. In line with national statistic (CDC, 2018), 28.1% of pregnancies following MAR produced live twin births. Consistent with U.S. MAR user demographics (Nachtigall et al., 2012), participating families were primarily headed by White (mothers: 96.9%; fathers: 94.4%), two married parents (93.3%), who had above-average education (74.1% of mothers and 64.6% of fathers with at least a bachelor's degree) and family incomes (median: $100,000– $149,000).

Procedure

Following university IRB-approved procedures, eligible families were identified via patient records at a university reproductive medicine clinic before Wave 1. Patients were sent letters from the clinic introducing the study and inviting one parent to complete an online survey. Because all patients at reproductive medicine clinics are female even when male infertility represents the treatment issue, participates at Wave 1 were predominantly mothers (99%). Parents provided data about demographics, pregnancy loss, twin status, and their emotional adjustment. Wave 1 families who indicated an interest in future research were contacted again at adolescence (Wave 2) to complete an online survey. Parents (99% mothers) provided adolescent psychosocial adjustment data. Families received a $25 gift card at each time for participation.

Measures

Pregnancy loss. Pregnancy loss was determined by parents' responses to two questions at Wave 1:(a) "How many times have you or your partner been pregnant?" and (b) "How many of these pregnancies resulted in live births?". Differences between the

responses were used to categorize pregnancy loss into three groups (0 = *no loss*, 1 = *one loss*, 2 = *recurrent loss*). Two or more pregnancy loss was considered as recurrent (Practice Committee of ASRM, 2013a).

Twin status. Parents reported the twin status at Wave 1 (0 = *singleton*, 1= *twins*).

Parental emotional problems. Parental emotional problems were assessed at Wave 1 (middle childhood) using the anxious/depressed subscale of the Adult Self-Report (ASR; Achenbach & Rescorla, 2003). The ASR has strong test– retest reliability (r = .88) and validity (Achenbach & Rescorla, 2003). Eighteen items measured on a 3-point scale (0 = *not true* to 2 = *very true or often true*) were summed (α = .82), with higher scores indicating greater emotional problems.

Adolescent psychosocial adjustment. Adolescent psychosocial adjustment in the form of emotional and behavioral adjustment was measured at Wave 2 (adolescence) using the internalizing and externalizing problems subscales of the Child Behavior Checklist subscales (CBCL; Achenbach & Rescorla, 2001). The CBCL has strong content, criterion, and construct validity and high test-retest reliability (*r* = .91 - .95; Achenbach & Rescorla, 2001). All items use a 3-point scale (0 = *not true* to 2 = *very true or often true*). Items of the internalizing problems subscale (32 items; α = .82) and externalizing problems subscale (35 items; α = .86) were summed. Higher scores indicate greater adjustment problems.

Covariates. Parent and adolescent characteristics with potential implications for outcome variables were controlled (Anderson et al., 2014; Bongers, Koot, van der Ende, & Verhulst, 2003; Hahn, 2001; Nosarti, Murray, Hack, 2010). These covariates included parental education (1 = *did not complete high school* to 7 = *doctoral degree*), parental

age, adolescent's age, sex (1 = *female*, 2 = *male*), and premature birth status (0 = *full term*, 1 = *premature*). Adolescents born with less than 37 weeks of pregnancy were regarded as premature (ASRM, 2012).

Missing Data

Study variables had 0 to 51% missing data, with demographic variables missing less than 5%. The over 20% of missing (46 – 51%) on study variables was because of the attrition between Wave 1 and Wave 2. Adolescents and their families with and without missing data were compared on demographic and study variables using *t* tests and chi-squared tests. A few differences emerged. Adolescents with complete data were less likely to be premature than those without ($\chi^2 = 4.32$, $p = .038$; no missing: 28%; missing: 72%). Families with complete data had fewer children ($t = –3.44$, $p = .001$; no missing: $M = 2.00$, $SE = .01$; missing: $M = 2.41$, $SE = .06$) and mothers with higher education ($t = 3.43$, $p = .001$; no missing: $M = 5.25$ [Bachelor's degree], $SE = .12$; missing: $M = 4.78$ [between Associate's and Bachelor's degree], $SE = .07$). Missing data were handled by full-information maximum-likelihood (FIML) in Mplus 8 (Muthén & Muthén, 1998-2017), which produces less biased results than traditional methods (Acock, 2005).

Data Analysis Plan

The proposed direct, interaction, and indirect effects were examined using two moderated mediation path models (Figure 1.1). Model one specified adolescent emotional problems as the dependent variable, and model two specified adolescent behavioral problems as the dependent variable. For each model, the mediator – parental emotional problems – was regressed on pregnancy loss, twin status, the interaction between pregnancy loss and twin status, and four covariates (i.e., adolescent's sex and

prematurity, parental education and age). The interaction term was created by first subtracting each variable from its own mean and then multiplying the two variables. In each model, the dependent variable was regressed on parental emotional problems, pregnancy loss, twin status, and three covariates (i.e., adolescent's age, sex, and prematurity). Indirect effects from pregnancy loss to adolescent adjustment, twin status to adolescent adjustment, and the interaction term to adolescent adjustment were estimated using parental emotional problems as the mediator.

Analyses were conducted on a child-level dataset with multiple children from the same family in some cases (278 adolescents from 193 families), indicating a potential for shared variance (Cook, 2012). To adjust the negatively biased standard errors produced by the shared variance, the COMPLEX specification in Mplus 8 was used (Muthén & Muthén, 1998-2017). A good fitting model has several requirements: a statistically nonsignificant χ^2(Bollen, 1989), a comparative fit index (CFI) and Tucker-Lewis index (TLI) above .90, a standardized root-mean-square residual (RMSEA) less than .08, and root mean square error (SRMR) of approximation less than .06 (Hu & Bentler, 1999).

Results

Model Testing: Adolescent Emotional Problems

Table 1.1 displays descriptive statistics for study variables. Table 1.2 shows parameter estimates for the adolescent emotional problems model. Parental emotional problems at middle childhood was positively associated with adolescent emotional problems ($\beta = .46$, $p < .001$). Thus, parents who were more emotionally distressed in middle childhood tended to report greater child emotional problems in adolescence. Of particular importance, there was a significant positive interaction effect between

pregnancy loss and twin status on parental emotional problems at middle childhood (β = .19, p = .025), after covariate adjustment. Further, the interaction term (pregnancy loss by twin status) had a significant indirect effect on adolescent emotional problems through parental emotional difficulties (β = .09, p = .047). This indirect effect and its associated interaction effect are described later.

Among the remaining paths, only the direct path from pregnancy loss to adolescent emotional problems was significant (β = .19, p = .023). This suggested parents who reported higher levels of pregnancy loss reported more emotional difficulties for their adolescents. Other direct or indirect paths in the model were not significant.

Model Testing: Adolescent Behavioral Problems

The adolescent behavioral problems model produced similar results as the emotional problems model (see Table 1.3). There was again a significant interaction effect on parental emotional problems (β = .18, p = .029), which was positively related to adolescent behavioral problems (β = .40, p < .001), after controlling for covariates. The indirect effect from the interaction term to adolescent behavioral problems via parental emotional problems was not significant (β = .07, p = .060).

Among the remaining paths, the paths from adolescent's age (β = .17, p = .039) and sex (β = .25, p < .001) to adolescent behavioral problems were significant. These results indicated that older adolescents and male adolescents tended to be reported more behavioral problems. Other direct or indirect paths in the model were not significant.

Describing the Interaction Effect and Indirect Effect

Figure 1.2 illustrates the interaction effect (pregnancy loss by twin status) on parental emotional problems, which was similar across adolescent emotional and

behavioral problems models. The association between pregnancy loss and parental emotional problems, after accounting for covariates, was separately examined for twins and singletons using multiple regression in Mplus 8. Results showed that, in the singletons group, pregnancy loss was not significantly related to parental emotional problems ($\beta = -.12$, $p = .169$; $M = 3.85$, $SD = 3.77$). However, in the twins group, pregnancy loss was significantly positively related to parental emotional problems ($\beta = .27$, $p = .040$; $M = 3.98$, $SD = 3.74$). This suggested that parents who experienced higher levels of pregnancy loss, when coupled with parenting twins, tended to show more emotional issues. Means and standard deviations of parental emotional problems by pregnancy loss groups and twin status are displayed in Table 1.4.

As stated earlier, there was also a positive indirect effect of the interaction term on adolescent emotional problems through parental emotional problems. This finding suggested that among twins, adolescents of parents who experienced higher levels of pregnancy loss tended to be reported more emotional problems through the positive relationship between pregnancy loss and parental emotional difficulties.

Discussion

MAR-conceived adolescents are at potential risk due to the stressors of parental pregnancy loss and raising twins as well as their negative effects (ASRM, 2011; Cheung et al., 2013; Farr, et al., 2008). Although these stressors often co-exist in MAR families (Ellison & Hall, 2003), few studies have examined their joint effects. This prospective longitudinal study suggests pregnancy loss, when combined with parenting twins, has long-lasting adverse effects on parents and subsequent adolescent psychosocial adjustment. Study findings provide insights into family context nuances, enhance

understandings of long-term parental and adolescent functioning in MAR families, and inform future intervention development.

Differential Role of Parenting Twins versus Singletons

Results showed that pregnancy loss interacted with parenting twins (or singletons) to influence parental emotional problems and subsequent adolescent adjustment. In families with twins, pregnancy loss was associated with more parental emotional issues, which related to adolescent adjustment difficulties. This finding suggests parenting twins tends to intensify the negative impacts of pregnancy loss for parents and their adolescents. Interpreting this result through the lens of Double ABCX model (McCubbin & Patterson, 1983a), it is possible that the accumulated demands resulting from pregnancy loss and the more challenging task of parenting twins may have exceeded the family's capacities to meet the demands. This capacity-demand imbalance can compromise family adaption (McCubbin & Patterson, 1983a) as indicated by the negative effects of pregnancy loss coupled with raising twins on parent and adolescent well-being. This theoretical account needs to be tested in future research. Although further studies are necessary to replicate and expand this study's findings, it appears that MAR families with a pregnancy loss history and twins might be a subgroup vulnerable for elevated risks.

In families raising singletons, pregnancy loss was not significantly related to parental emotional problems. Singleton parents with a pregnancy loss history, especially those who experienced recurrent pregnancy loss, showed similar levels of emotional problems to those who never lost a pregnancy. This result suggests parents of singletons tend to be adaptive to the stressful pregnancy loss situation, which indicates resilience. Through the lens of the Double ABCX model (McCubbin & Patterson, 1983a), singleton

parents may experience less severe demands relative to twin parents. These demands may have been effectively buffered by their resources, adaptive coping mechanisms, and positive perceptions, contributing to more optimal outcomes. Future research emphasizing resilience and evaluating the intervening effects of these factors is needed to better understand MAR families with a pregnancy loss history and singletons.

Enduring Impacts of the Pile-up of Stressors

Results indicate the compounding effects of the two stressors on parents are long-lasting, persisting into middle childhood. The Double ABCX model suggests that families often carry unresolved difficulties from earlier stressors into later stages (McCubbin & Patterson, 1983a). Taking this perspective, one possible salient contributor to the unresolved difficulties can be the prolonged grief following pregnancy loss. Parents commonly do not see pregnancy loss as a loss of pregnancy but rather a loss of a baby and many parents grieve years after the loss (Brier, 2008; Kersting & Wagner, 2012). Parents with an infertility history are likely to experience this persistent grief because of their intense desire and substantial investment in parenthood (Harris & Daniluk, 2010). Unresolved grief can pose long-term psychological risks to parents (Kersting & Wagner, 2012). It is worth noting that parental emotional problems in this study were predominantly reported by mothers. Pregnancy loss can profoundly influence men (Due et al., 2017). Men grieve as well, and they express grief differently from women (McCreight, 2004; Harris & Daniluk, 2010). Future research is needed to assess the impacts of pregnancy loss and its associated difficulties (e.g., grief) on fathers in the long run.

Practical Implications

The emotional needs of patients who experienced pregnancy loss are often overlooked by medical professionals (Ellison & Hall, 2003), and patients often deal with the loss silently and in isolation (Harris & Daniluk, 2010). Study findings suggest the need to recognize the long-lasting adverse impacts of pregnancy loss on MAR families and intervene timely to prevent the transmission of risks into later stages. Results also identify a potential subgroup of MAR families – those who experienced pregnancy loss and parent twins – as a fruitful target for continued psychological support over time. Further, results suggest future evidence-based interventions for MAR families may identify pregnancy loss and raising twins as potential risk factors and intervene at parental emotional difficulties to promote adolescent adjustment.

Study Strengths and Limitations

Several strengths increase confidence in the study findings. Study representativeness was improved by using a large sample of MAR families (193 families with 278 adolescents) with a high recruitment rate (82%). Also, potential results bias due to parental reports of the most difficult child (Glazebrook et al., 2004) was mitigated by including both MAR-conceived twins from the same family. Shared variance resulted from this practice was addressed using an appropriate statistical approach (Cook, 2012). Moreover, the use of a prospective longitudinal design allowed the establishment of long-term consequences of combined stressors and the causal effect of parental emotional problems on adolescent adjustment.

Study limitations warrant attention despite the strengths. First, study findings were based on a sample of MAR families headed by heterosexual parents who

experienced infertility. Both infertility and its MAR treatments can be lengthy and painful with a series of detriments on families (Ulrich & Weatherall, 2000; Urman, Yakin, & Balaban, 2005), making generalizability outside this context limited. Although families were drawn from only one U.S. university reproductive clinic, their demographics were comparable with those of U.S. MAR families (Nachtigall et al., 2012). Second, one parent reported all study variables, potentially generating a social desirability bias in data (Colpin & Soenen, 2002). Future research would benefit from a multi-informant, multimethod approach. Lastly, details about pregnancy loss with possible implications for study outcomes were unavailable in the current study due to data constraints. This may include types of loss (e.g., miscarriage, stillbirth) and proximity between last loss and the subsequent pregnancy with live birth (Broen, et al., 2005; Jaffe & Diamond, 2011). Future research on MAR families should consider the effects of these factors.

Conclusions

MAR-conceived adolescents may be at risk given the psychosocial difficulties associated with parental pregnancy loss and raising twins. This prospective longitudinal study evaluated a possible family process through which combined stressors of pregnancy loss and parenting twins (or singletons) influence adolescent psychosocial adjustment. Results suggest that pregnancy loss, when coupled with parenting twins, has long-lasting adverse effects on parents and subsequent adolescent psychosocial adjustment. MAR families who experienced pregnancy loss and raise twins might be especially vulnerable to less optimal parent and adolescent outcomes, representing a potential target for future evidence-based interventions.

Study 2

Adolescent Adjustment Following Information Sharing of Medically Assisted Reproduction: The Role of Family Communication Environments

Parents in MAR families face the unique task of whether and when they will tell children about the assisted conception. Previous research focusing on *adolescence* suggests MAR information sharing is at least not harmful for adolescents, if not beneficial for them when performed early (Ilioi, Blake, Jadva, Roman, & Golombok, 2017; Jadva et al., 2009). However, past research has largely overlooked the overall family communication environments within which MAR information sharing operates (Ilioi & Golombok, 2015; Scheib, Riordan, & Rubin, 2005). Based on theoretical and empirical evidence that communication contexts vary across families and can have differential impacts on children (Koerner & Schrodt, 2014), the present study examined the role of family communication environments in child adjustment at adolescence in relation to MAR information sharing.

MAR Information Sharing Effects on Adolescents

Regardless of whether parents conceive using donor gametes (sperm or egg; the child lacks a genetic link to the intended father or mother) or their own gametes (child is genetically related to both intended parents), the MAR field generally recommends that parents share the assisted conception information with their children early (Ethics Committee of the ASRM, 2013; Mendell & Gordon, 2010). However, most parents do not do so with their young children (Casey, Jadva, Blake, & Golombok, 2013; Rosholm, Lund, Molbo, & Schmidt, 2010). Many parents intend to share later (Peters, Kantaris, Barnes, & Sutcliffe, 2005; Rosholm et al., 2010), with higher information sharing rates

reported in adolescence (Colpin & Bossaert, 2008; Ilioi et al., 2017). Still, others have decided against telling children about their MAR conception (Ludwig et al., 2008; Soderstrom-Anttila, Salevaara, & Suikkari, 2010). The discrepancy between professional and parental attitudes has raised scholarly concerns about child outcomes, especially in adolescence. This is largely because development in adolescence involves the pursuit of autonomy and independence (Blos, 1967), improved understanding of biological inheritance (Williams & Smith, 2010), and identity formation (Beyers & Cok, 2008).

Two lines of research have examined the effects of MAR information sharing on *adolescents,* although the emphasis is on those who were conceived using donor gametes. One line of research has evaluated the effects of sharing versus not sharing on *adolescent adjustment.* Regardless of whether adolescents were conceived using gametes from the intended parents or a donor, those who have known about their MAR conception and those who have not known tend to show similar adjustment (Colpin & Bossaert, 2008, Freeman & Golombok, 2012; Ilioi et al., 2017).

The other line of research focuses on adolescents who have learned about their MAR conception and examines the impacts of early- versus late-sharing. Collectively, this research appears to suggest sharing MAR conception information early benefits adolescents (Ilioi & Golombok, 2015; Ilioi et al., 2017; Jadva et al., 2009; Scheib et al., 2005; Turner & Coyle, 2000). For example, Scheib et al. (2005) found that most participating adolescents conceived using donor sperm had always known about the donor conception and felt somewhat to very comfortable with it. Additionally, Ilioi et al. (2017) showed that adolescents disclosed of the reproductive donation before age 7 had more optimal psychological wellbeing relative to those disclosed at or beyond age 7

based on their self-reports. Taken together, these lines of research suggest MAR information sharing is at least not harmful for adolescents, if not beneficial for them when performed early.

Family Communication Environments

However, past research has primarily overlooked the overall family communication environments within which MAR information sharing operates. The very limited research supports an important role of family communication contexts in the outcomes of MAR information sharing (Chen, Rueter, Anderson, & Connor, 2018; Rueter et al., 2016). For instance, Chen et al (2018) found a moderating effect of family communication context on the relationship between MAR information sharing (or not) and child psychosocial adjustment in middle childhood. Yet, little is known about the role of family communication environments in *adolescence*.

Family communication environments can be conceptualized using the Family Communication Patterns Theory (FCPT, Koerner & Fitzpatrick, 2002b, 2004; Koerner & Schrodt, 2014). According to the FCPT, families may prefer a conversation orientation or a conformity orientation or use both orientations in their interactions. This preference can create differential communication contexts that guide parent-child discussions on a variety of topics (Koerner & Fitzpatrick, 2002b, 2004), including MAR conception.

Conversation orientation refers to the extent to which families develop a climate that supports unrestricted interactions regarding various topics among family members. Family members in a conversation-oriented communication context engage in open, frequent, and spontaneous discussions about concepts with each other regardless of time and topics. Family interactions are warm and supportive and guided by a parental belief

that open and frequent communication is crucial for educating and socializing children (Koerner & Fitzpatrick, 2002b, 2004). Children explore and assign meanings to a concept by communicating them with parents (Koerner & Schrodt, 2014).

Conformity orientation refers to the extent to which families establish an environment that reinforces uniform attitudes and beliefs. Family interactions in a conformity-oriented communication context emphasize parental authority, child compliance with parental control, the interdependence of family members, and conflict avoidance. These features reflect the parental belief of a cohesive hierarchical family structure (Koerner & Fitzpatrick, 2002b; 2004). Parents discourage divergent views and expect children to conform to their perceptions of concepts (Koerner & Schrodt, 2014).

Conversation and conformity orientations are not mutually exclusive but often interact with one another (Koerner & Fitzpatrick, 2002b, 2004). Thus, the effects of conversation orientation are moderated by the degree of conformity orientation (Koerner & Fitzpatrick, 2004; Koerner & Schrodt, 2014). Conversation orientation coupled with a high conformity orientation in the form of parental control allows children to explore new concepts while also sharing a homogenous attitude with parents (Koerner & Fitzpatrick, 2004). Conversation orientation combined with a low conformity orientation that favors individuality enables free exchanges of ideas at a potential expense of divergent perceptions, conflicts, and a weakened family structure (Koerner & Fitzpatrick, 2004).

Differential Family Communication Environments of MAR Information Sharing

The three aforementioned family communication environments appear to echo characteristics of early, late, or not sharing MAR conception information with children. Through the lens of FCTP (Koerner & Fitzpatrick, 2002b, 2004), families who have

shared early appear to relate to a conversation-orientated communication environment featured by open, frequent, and spontaneous interactions between family members. Evidence suggests early-sharing parents endorse openness, honesty, and the child's right to know about their MAR conception (Nekkebroeck, Bonduelle, & Ponjaert-Kristoffersen, 2008; Rumball & Adair, 1999). These parents view MAR information sharing as a continuous interactive process and approach it in a taboo-free, casual, and recurring manner contextualized within their family life (Mac Dougall et al., 2007; Rumball & Adair, 1999; Siegel, Dittrich, & Vollmann, 2008).

Late-sharing families, from the perspective of FCPT (Koerner & Fitzpatrick, 2002b, 2004), may be characterized as having a communication environment in which conversation and conformity orientations interact. It appears that late-sharing families coincide with those who employ a "right-time strategy" for MAR information sharing (Mac Dougall et al., 2007). Parents who use this strategy believe there is an optimal time in children's development to know about their MAR conception. Parents generally anticipate the right time to start when children can cognitively understand the technical and biological aspects of assisted reproduction but end before adolescence (Mac Dougall et al., 2007). On one hand, parents using the "right-time strategy" want to tell children and acknowledge the need to revisit the topic after the initial information sharing (Mac Dougall et al., 2007). This reflects some degree of conversation orientation. On the other hand, they determine the optimal time for children to know about the information and emphasize establishing and maintaining strong family routines, relationships, and cohesion (Mac Dougall et al., 2007). These characteristics reflect a high conformity orientation featured by a cohesive hierarchical family structure (Koerner & Fitzpatrick,

2004). Because children learn about the assisted conception at a later age when they can construct their own understandings, parents may need to exercise firm control such that they perceive the MAR conception in the same way.

Through the lens of FCPT (Koerner & Fitzpatrick, 2002b, 2004), non-sharing families may be characterized as using a conformity-orientated communication environment featured by parental control and family cohesion. Evidence suggests non-sharing parents view MAR conception information as unnecessary, irrelevant, or unimportant for their children (Ludwig et al., 2008; Nekkebroeck et al., 2008; Rumball & Adair,1999; Soderstrom-Anttila et al., 2010). These parents also wish to protect children, themselves, and family relationships from perceived harms of information sharing, painful infertility, and social stigma by not sharing the information (Indekeu et al., 2013; Jadva et al., 2009; Ludwig et al., 2008; Nekkebroeck et al., 2008).

Varied Effects of Family Communication Environments on Adolescent Adjustment

Ample empirical evidence based on the FCPT has demonstrated the implications of the three aforementioned family communication environments for a wide range of child-related outcomes (see reviews by Koerner & Fitzpatrick, 2002b; Schrodt, Witt, & Messersmith, 2008; Koerner & Schrodt, 2014). Overall, communication research on the general population has documented a positive effect of conversation orientation on various indicators of child adjustment (Koerner & Fitzpatrick, 2002b; Schrodt et al., 2008). Conformity orientation generally has a negative effect on dimensions of child functioning (Koerner & Fitzpatrick, 2002b; Schrodt et al., 2008), although it may benefit children under certain circumstances (Anderson, Rueter, Connor, & Koerner, 2018; Schrodt, et al., 2009). Conversation and conformity orientations also interact to relate to

child outcomes (Bakir, Rose & Shoham, 2006; Bristol & Mangleburg, 2005; Koerner & Fitzpatrick, 2002b; Rueter & Koerner, 2008). Thus, it is possible that family communication environments are associated with adjustment of MAR-conceived adolescents. Given that early-sharing, late-sharing, and non-sharing families may be characterized by differential family communication environments, it is likely that associations between family communication environments and MAR-conceived adolescents' adjustment may vary across information sharing status.

The Present Study

Derived from the extant evidence and the Family Communication Patterns Theory (Ilioi et al., 2017; Koerner & Fitzpatrick, 2002; Mac Dougall et al., 2007), the present study investigated if the relationships between family communication environments (i.e., conversation orientation, conformity orientation, their interaction) and adolescent psychosocial adjustment would differ across early-sharing, late-sharing, and non-sharing families (Figure 2.1). Hypotheses were as follows: (1) in early-sharing families, conversation orientation would significantly negatively relate to adolescent psychosocial adjustment problems, (2) in late-sharing families, conversation and conformity orientations would interact to relate to adolescent psychosocial adjustment problems, and (3) in non-sharing families, conformity orientation would significantly positively relate to adolescent psychosocial adjustment problems.

Methods

Participants

Participants in the present study completed two waves of a longitudinal survey study investigating outcomes of MAR-conceived children. At Wave 1, families with at least one parent and at least one MAR-conceived child born between 1998 and 2004

(aged 6 – 12 years) were recruited through a university reproductive medicine clinic. Of these eligible families, 86% were located and 82% of the located families participated in the survey study, resulting in a full Wave 1 sample of 209 families with 307 MAR-conceived children. Five years later at Wave 2 (children aged 11 – 17 years), 60% of Wave 1 families continued their participation.

The present study included 163 adolescents from 115 families (55.2% female; adolescent's age: $M = 13.25$, $SD = 1.23$). This study did not contain same-sex female-couple families (n = 7) and single-mother-by-choice family (n = 1) to avoid the confound of family types because they were more likely to tell children about their MAR conception early (Jadva et al., 2009; Scheib et al., 2005). Adolescents without available MAR information sharing information were also excluded. Adolescents and their families who participated in the present study were compared with those who did not on demographic variables using *t* tests and chi-squared tests. A few differences emerged. Adolescents who participated had mothers with higher educational level than those who did not ($t = 2.38$, $p = .018$; participated: $M = 5.07$, $SE = .09$ [Bachelor's degree]; not participated: $M = 4.72$, $SE = .12$ [between Associate's and Bachelor's degree]). A lower proportion of the participating adolescents were conceived using donor gametes than that of the non-participating adolescents ($\chi^2 = 11.96$, $p = .003$; participated: 7.4%; not participated: 20.1%).

Consistent with previously reported MAR information sharing rates by adolescence (Colpin & Bossaert, 2008; Ilioi et al., 2017), 51% of adolescents had known about their MAR conception. Of the 163 adolescents, 12 (7.4%) were conceived using donor gametes (donor sperm: n = 5; donor egg: n = 7) in combination with MAR

procedures. Four of the donor-conceived adolescents had known about the assisted conception. In line with U.S. MAR user demographics (Nachtigall et al., 2012), adolescents came from families where most parents were White (mothers: 97.4%; fathers: 95.4%) and had above-average education (79.1% of mothers and 64.0% of fathers with at least a bachelor's degree) and family incomes (median: $100,000 – 149,999; range: $20,000 – 29,999 to $200,000 or more). A vast majority of parents (94.8%) remained married at Wave 2.

Procedures

Following university IRB-approved procedures, eligible families were identified via patient records at a university reproductive medicine clinic before Wave 1. Patients were sent letters from the clinic introducing the study and inviting one parent to complete an online survey. Because all patients at reproductive medicine clinics are female even when male infertility represents the treatment issue, participates at Wave 1 were predominantly mothers (99%). Parents provided demographics and MAR information sharing data at Wave 1. Wave 1 families who indicated an interest in future research were contacted again at adolescence (Wave 2) to complete an online survey. Parents provided data on MAR information sharing, family communication environments, their emotional state, and adolescent psychosocial adjustment at Wave 2. Families received a $25 gift card at each time for their participation.

Measures

MAR information sharing status. Three MAR information sharing groups (1 = *early-sharing*, 2= *late-sharing*, 3 = *non-sharing*) were determined based on parent-reported MAR information sharing data at both waves. At Wave 1, parents answered the

question “Does your child know that s/he was conceived by assisted reproductive technologies (ART)?” (0 = *no,* 1 = *yes*). At Wave 2, parents answered the question “Does your child know you used help from a doctor or medical professional to conceive him or her?” (0 = *no,* 1 = *yes*). The non-sharing group status (n = 80, 49.1%) was determined by negative answers to both questions.

At Wave 2, parents who provided an affirmative answer also gave the age at which their adolescents knew of the assisted conception. Age 7 was used as a criterion to determine early- or late-sharing status. This criterion was informed by previous MAR research (Ilioi et al., 2017) and child development evidence. For example, Piaget’s (1955) stages of cognitive development propose that it is not until the concrete operational stage (7 – 12 years) that children begin to think logically. Relatedly, Bernstein (1994) demonstrated that 7- to 12-year-olds can "give primarily physiological explanations of reproduction" (p.113). As such, adolescents who knew of their MAR conception before age 7 constituted the early-sharing group (n = 36, 22.1%). Those who knew at or beyond age 7 (n = 47, 28.8%) represented the late-sharing group, with the maximum age of knowing being age 13.

Conversation orientation. At Wave 2, parents reported their family’s conversation orientation using the Conversation Orientation subscale of the Revised Family Communication Patterns Questionnaire (RFCP, Ritchie & Fitzpatrick, 1990), which has good reliability and validity (Schrodt et al., 2008). This subscale included 15 items measured on a 7-point scale (1 = *disagree completely* to 7 = *agree completely*). Example items include: “I often ask my child's opinion when the family is talking about

something" and "My child can tell me almost anything". Items were summed and averaged (α = .88), with greater scores indicating higher conversation orientation.

Conformity orientation. At Wave 2, parents reported on the conformity orientation subscale of the Revised Family Communication Patterns Questionnaire (RFCP, Ritchie & Fitzpatrick, 1990), which has good reliability and validity (Schrodt et al., 2008). This subscale contained 11 items assessed with a 7-point scale (1 = *disagree completely* to 7 = *agree completely*). Example items include: "When anything really important is involved, I expect my child to obey me without question" and "I often say things like you'll know better when you grow up." Items were summed and averaged (α = .74), with greater scores suggesting higher conformity orientation.

Adolescent psychosocial adjustment. At Wave 2, parents reported adolescent's emotional and behavioral adjustment respectively using the internalizing and externalizing problems subscales of the Child Behavior Checklist subscales (CBCL; Achenbach & Rescorla, 2001). The CBCL has strong content, criterion, and construct validity and high test-retest reliability (Achenbach & Rescorla, 2001). All items use a 3-point scale (0 = *not true* to 2 = *very true or often true*). Items of the internalizing problems subscale (32 items; α = .82) and externalizing problems subscale (35 items; α = .86) were summed. Higher scores indicated greater adjustment problems.

Covariates. Covariates with demonstrated relations with outcome variables were controlled (Bongers et al., 2003; Goodman et al., 2011). Covariates involved adolescent's sex, adolescent's age, and parental emotional state. Parental emotional state was measured by the Centers for Epidemiologic Studies Depression Scale-Short Form (CESD-10) at Wave 2, which has acceptable reliability and validity (Radloff, 1977). The

CESD-10 includes 10 items measured on a 4-point scale (0 = *rarely or none of the time* to 3 = *all of the time*). Items were reverse coded when necessary and then summed (α = .70). Higher scores suggested more depressive symptoms, with a score of 10 or more indicating a clinical depression.

Missing Data

Study variables had less than 10% missing data. Adolescents with and without missing values were compared on demographic and study variables using *t* tests and chi-squared tests. No differences were found. Missing data were handled by full-information maximum-likelihood (FIML) in Mplus 8 (Muthén & Muthén, 1998-2017) as this approach produces less biased estimates than traditional methods (Acock, 2005).

Data Analysis Plan

Hypotheses about information sharing group differences in the associations between family communication environments and adolescent psychosocial adjustment were tested using multiple group analysis in Mplus 8. There were two sets of model testing. The first set identified adolescent emotional problems as the dependent variable, and the second set identified adolescent behavioral problems as the dependent variable.

For each set of model testing, three steps were performed. In the first step, a multiple group model that allowed regression coefficients to vary across the three groups was fitted (i.e., variant model). In this model, the dependent variable was regressed on conversation orientation, conformity orientation, the interaction of conversation and conformity orientations, and three covariates. The interaction term was created by first subtracting each variable from its own mean and then multiplying the two variables.

In the second step, the significantly different regression coefficients that emerged from the variant model were constrained to be equal across the three groups one at a time (i.e., invariant model). Chi-square statistics of model fit generated by the variant and invariant models were compared. If the chi-square difference was greater than the critical value for a certain degree of freedom of change, the constrained regression coefficient was considered as significantly different across the three groups.

When such a difference emerged, a series of between-group comparisons were conducted in the third step to determine which pair of groups differed on the constrained regression coefficient. This was achieved by following the same procedures described in the first and second steps, producing a variant and an invariant model based on two groups. Again, a chi-square difference from the two models was compared against the critical value to determine if the constrained coefficient differed between groups.

All analyses were performed using child-level data with multiple adolescents from the same family in some cases (163 adolescents from 115 families), suggesting a potential shared variance (Cook, 2012). To adjust the negatively biased standard errors and therefore the inflated *t*-values produced by the shared variance, the COMPLEX specification was used (Muthén & Muthén, 1998-2017). A good fitting model has several requirements, including a statistically nonsignificant χ^2(Bollen, 1989), a comparative fit index (CFI) and Tucker-Lewis index (TLI) above .90, a standardized root-mean-square residual (RMSEA) less than .08, and root mean square error (SRMR) of approximation less than .06 (Hu & Bentler, 1999).

Results

Preliminary Analyses

Descriptive statistics (see Table 2.1) and mean differences in study variables across MAR information sharing groups were evaluated before model testing. Consistent with the FCPT prediction (Koerner & Fitzpatrick, 2004), conversation orientation was inversely related to conformity orientation ($t = –3.14$, $p = .002$). Mean difference results showed that early-sharing group had higher conversation orientation score ($M = 6.02$, $SD = .53$) relative to late-sharing ($M = 5.62$, $SD = .58$) and non-sharing groups ($M = 5.67$, $SD = .72$; $\beta = –.20$, $p = .029$). Yet, no significant differences in conformity orientation, adolescent emotional problems, or adolescent behavioral problems were found across groups. Mean adolescent emotional and behavioral problems scores fell within normal CBCL ranges (Achenbach & Rescorla, 2001).

Model Testing: Adolescent Emotional Problems

As shown in Table 2.2, each information sharing group produced one unique statistically significant association between communication environments and adolescent emotional adjustment, supporting the hypotheses. After accounting for covariates, conversation orientation was associated with adolescent emotional problems in the early-sharing group ($\beta = –.48$, $p = .039$), whereas this association was not significant in the late-sharing or non-sharing group. In the early-sharing group only, higher conversation orientation scores were related to fewer adolescent emotional problems.

In the late-sharing group, conversation and conformity orientations interacted to relate to adolescent emotional problems ($\beta = –.29$, $p = .005$). This association was insignificant in the early-sharing or non-sharing group. The interaction effect is interpreted later.

Finally, conformity orientation was associated with adolescent emotional problems only in the non-sharing group ($\beta = .35$, $p = .034$). Among adolescents who did not know of their MAR conception, higher conformity orientation was related to greater adolescent emotional problems.

These unique communication environments group effects were tested one by one to determine the presence of statistically significant differences in associations across groups. For conversation orientation, results indicated that the effect of conversation orientation on adolescent emotional problems significantly differed across the three groups ($\Delta\chi^2(2) = 12.27$, $p < .01$). Subsequent between-group comparisons suggested the effect of conversation orientation found in the early-sharing group significantly differed from that in the non-sharing group ($\Delta\chi^2(1) = 17.75$, $p < .001$) but not the late-sharing group ($\Delta\chi^2(1) = .80$, $p > .05$).

For conversation by conformity interaction, results showed that the interaction effect on adolescent emotional problems was significantly different across the three groups ($\Delta\chi^2(2) = 9.39$, $p < .01$). Subsequent between-group comparisons suggested the interaction effect found in the late-sharing group differed from that in the early-sharing group ($\Delta\chi^2(1) = 25.17$, $p < .001$) but not the non-sharing group ($\Delta\chi^2(1) = 1.93$, $p > .05$).

For conformity orientation, a marginally significant group difference was found ($\Delta\chi^2(2) = 5.95$, $p = .051$). This suggested potential variance between certain pairs of groups, thus comparisons were continued. Results suggested the effect of conformity orientation found in the non-sharing group differed from that in the early-sharing group ($\Delta\chi^2(1) = 22.85$, $p < .001$) but not the late-sharing group ($\Delta\chi^2(1) = .01$, $p > .05$).

Model Testing: Adolescent Behavioral Problems

Unlike the adolescent emotional problems model, hypotheses were partially confirmed by the adolescent behavioral problems model. Conversation orientation and the interaction term did not produce significant associations with adolescent behavioral problems in any information sharing group after covariate adjustment (see Table 2.3). Conformity orientation was related to adolescent behavioral problems in late-sharing (β = .32, p = .039) and non-sharing groups (β = .33, p = .017) but not early-sharing group.

The significant regression coefficient for conformity orientation was constrained to be equal across the three groups. A significant group difference was found ($\Delta\chi^2(2) = 14.33$, $p < .001$). Subsequent between-group comparisons indicated that the effect of conformity orientation was significant between early-sharing and late-sharing groups ($\Delta\chi^2(1) = 4.31$, $p < .05$) and between early-sharing and non-sharing groups ($\Delta\chi^2(1) = 5.60$, $p < .05$). The late-sharing and non-sharing groups were similar in the effect of conformity orientation ($\Delta\chi^2(1) = .02$, $p > .05$).

Describing the Interaction Effect

Figure 2.2 illustrates the interaction effect between conversation orientation and conformity orientation on adolescent emotional problems in the late-sharing group. "Low" and "high" conformity orientation and conversation orientation groups were created based on the median score. The "low" conformity orientation group included adolescents who scored below or equal to the median (n = 23, 49%); the "high" conformity orientation group contained adolescents who scored above the median (n = 24; 51%). Multiple regression with covariates (i.e., adolescent's sex, age, parental

emotional state) was used to determine the relationship between conversation orientation and adolescent emotional problems for each conformity orientation group using Mplus 8.

When conformity orientation was low, conversation orientation did not significantly relate to adolescent emotional problems after covariate adjustment (Figure 2.2: $\beta = -.15$, $p = .427$). However, when conformity orientation was high, conversation orientation significantly negatively related to adolescent emotional problems (Figure 2.2; $\beta = -.52$, $p = .029$). Thus, in families with a high conformity orientation, increased levels of conversation orientation were associated with decreased emotional difficulties of adolescents who knew the assisted conception later in life. Adolescent emotional problems in the low conformity orientation group ($M = 2.00$, $SD = 2.77$) and high conformity orientation group ($M = 5.88$, $SD = 6.18$), on average, were within or close to CBCL normal ranges (Achenbach & Rescorla, 2001; boys norm: $M = 5.10$, $SD = 4.80$; girls norm: $M = 6.00$, $SD = 5.00$).

Discussion

Whether and when parents should share MAR conception information with their children has remained an issue. Although MAR information sharing operates within the overall family communication environments (Ilioi & Golombok, 2015), few studies have considered them jointly. The present study suggests a complex view in which, although adolescents on average are well-adjusted, family communication environments interplay with the timing of MAR information sharing to relate to adolescent psychosocial adjustment. Families who have shared early, late, or have not shared appears to show varied patterns of associations between communication environments and adolescent adjustment. In terms of these associations, early-sharing families tend to be more

different from late- and non-sharing families, whereas late- and non-sharing families appear to be more similar than different. These findings support the critical role of family contexts and enhance understandings of adolescent adjustment following the MAR information sharing.

Early-sharing Families

Preliminary analysis results suggest early-sharing families tend to have a more conversation-oriented communication environment relative to late-sharing and non-sharing families. This finding supports the previously suggested link between early-sharing and open family communication context (Ilioi & Golombok, 2015; Scheib et al., 2005). Further, model testing results indicate that early-sharing families with a more open communication context tend to raise adolescents with fewer emotional difficulties.

Through the lens of FCPT (Koerner & Fitzpatrick, 2002b, 2004), it is possible that this communication environment encourages parents who have shared early to engage children in open, ongoing, and interactive family dialogues about their MAR conception. These conversations may help to satisfy children's increasing developmental need and cognitive sophistication for more details about their conception method as they grow (Mendell & Gordon, 2010), thus promoting their adjustment. This speculation requires future testing as the current study did not directly assess how early-sharing families approach MAR information sharing.

Late-sharing Families

However, conversation-orientated communication context does not universally facilitate adolescent psychosocial adjustment. Model testing results showed that it was in the late-sharing families with strong conformity orientation that higher conversation

orientation was related to fewer adolescent emotional problems. This suggests, among late-sharing families, a communication context within which openness is coupled with parental control tends to support adolescent well-being.

From the perspective of FCPT, the above finding might be due to that such communication context allows parents and their adolescents to share a social reality (Koerner & Fitzpatrick, 2002b, 2004). Adolescents of late-sharing families in this study knew about their MAR conception in middle childhood or early adolescence. These stages are characterized by considerable child social-cognitive developments, such as logical-thinking and understanding of abstract concepts (Brodzinsky, 2011; Piaget, 1955). As such, children could independently conceptualize concepts like being conceived using MAR and potentially diverge from their parents' views. Yet, a communication environment in which parents value child perspectives but also exercise firm parental guidance will likely enable the child to adopt parents' views on the MAR conception, thus creating a shared social reality in the family. Sharing a social reality produces fewer misunderstandings and conflicts, promoting adolescent adjustment (Koerner & Fitzpatrick, 2004). Future research is needed to test this theoretical account as this study did not explicitly examine the shared social reality.

Non-sharing Families

It is worth noting that conformity orientation on average does not differ across the three types of families based on preliminary analysis results. However, in non-sharing families with a high conformity orientation, this orientation was associated with less optimal adolescent psychosocial adjustment. Possible explanations of this finding lie in the two factors of conformity orientation. The structural traditionalism factor emphasizes

conforming to a family's authority figure (Baxter, Bylund, Imes, & Scheive, 2005; Fitzpatrick & Ritchie, 1994), like child obedience to parents in a MAR family. This conformity may contradict adolescents' pursuit of independence and autonomy, thus amplifying their adjustment problems (Baumrind, 2005; Barber & Harmon, 2002; Koerner & Fitzpatrick, 2004).

The other factor, avoidance, emphasizes suppressing unpleasant topics (Baxter et al., 2005; Fitzpatrick & Ritchie, 1994). As such, parents in non-sharing families with a high conformity orientation may have purposefully avoided the MAR conception topic in their family interactions. This potential parental topic avoidance may compromise adolescent adjustment as research showed that MAR-conceived young adults who perceived their parents as avoiding conception-related topics reported less optimal family functioning (Paul & Berger, 2007). Future research is needed to examine the separate effects of these conformity orientation factors on MAR-conceived adolescents.

Half of the adolescents in this study did not know about their conception method. Whether some of them will know this information later and how they will function in relation to their communication environment remain to be determined. It has been speculated that parents who have not shared the information with their adolescents may eventually not share at all (Mac Dougall et al., 2007). However, most parents have told others (Peters et al., 2005; Rosholm et al., 2010), resulting in an elevated risk of accidental discovery by children and a perceived parental deception (Jadva et al., 2009). Although the vast majority of adolescents in this study are fully genetically related to their parents, family secret literature suggests perceived parental deception, more than the

content of the secret, could be detrimental for children (Imber-Black, 1998; Nekkebroeck et al., 2008). Future longitudinal studies are needed to examine the above speculations.

Differences and Similarities across Families

Overall, it appears that early-sharing families are more different from late-sharing or non-sharing families regarding the effects of varied communication environments on adolescent adjustment. This might relate to the differential parental beliefs about communication across families as the FCPT proposes that beliefs and communication orientations are interconnected (Koerner & Fitzpatrick, 2002b). This theoretical speculation and other possibilities need to be evaluated in future research.

However, late-sharing and non-sharing families tend to be more similar than different regarding the effects of conformity orientation on adolescent adjustment. This finding echoes previous conjecture that late-sharing families might represent those who have shifted from the attitude of non-sharing into sharing due to the recent social context that favors parental openness (Mac Dougall et al., 2007).

Practical Implications

Parents who have conceived using MAR often express concerns and uncertainties about how to approach the MAR information sharing and desire for professional guidance (Indekeu et al., 2013; Peters et al., 2005; Gross et al., 2004). Study results suggest families who plan to or have shared early would likely benefit from professional support in creating and maintaining a communication context featured by open and warm parent-child interactions. For families who plan to or have shared late, continued support in strengthening a communication climate that emphasizes both open communication and firm parental guidance would likely be beneficial. Lastly, families who have not shared

with their adolescents and have a communication context characterized by strong parental control may potentially need the most professional assistance.

Study Strengths and Limitations

Study strengths of acceptable response rates at both waves of data collection and appropriately addressing the shared variance resulting from having multiple adolescents from the same family increase confidence in the findings. Despite the strengths, several limitations warrant attention. First, study results may have limited generalizability to families of adolescents conceived using donor gametes and families of MAR-conceived children in late adolescence or beyond. Also, one parent reported all study variables, generating a potential method bias (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Although parental emotional state at the time of data collection was statistically accounted for, future research would benefit from a multi-informant, multimethod approach. Lastly, although previous research suggests a differential role of conformity orientation in shaping adjustment of MAR-conceived twins relative to singletons (Anderson et al., 2018), this study was unable to factor in the twin status due to small group sizes. Nonetheless, the chi-square test indicated no difference in the distribution of twins and singletons across information sharing groups. Future research with larger samples needs to consider the interaction between twin status and conformity orientation.

Conclusions

Considering the important role of family contexts, this study examined adolescent psychosocial adjustment following the MAR information sharing within the greater family communication environments. Findings indicate a more complex picture that family communication contexts and the timing of MAR information sharing work

together to influence adolescent adjustment. Study results enhance understandings of the psychosocial consequences of MAR information sharing for adolescents in relation to family communication contexts. A potentially fruitful focus for future prevention may be the family communication contexts within which MAR information sharing operates.

General Conclusions

Study 1 and **Study 2** together provide a more complex view of psychosocial adjustment of MAR-conceived adolescents in relation to three significant parenting challenges by highlighting the critical role of family contexts. **Study 1** results suggest pregnancy loss, when combined with parenting twins, has long-lasting adverse effects on parental emotions, which in turn relates to adolescent psychosocial adjustment. Future research is needed to assess family capacities, resilience, and fathers. **Study 2** results indicate that family communication environments interplay with the timing of MAR information sharing to influence adolescent psychosocial adjustment. Future research needs to consider adolescent outcomes of MAR information sharing in light of the varied family communication environments. Overall, the two studies lay the foundation for future work to examine and understand MAR-conceived adolescents within their specific family contexts.

Table 1.1

Bivariate Correlations, Means, and Standard Deviations about Study Variables

Variable	1	2	3	4	5	6	7	8	9	10	*M*	*SD*
1. Pregnancy loss	—										.68	.76
2. Twin status	–.09	—									.44	.50
3. Parental emotional problems	.03	.04	—								3.84	3.75
4. Adolescent emotional problems	.20*	.08	.46***	—							3.45	4.04
5. Adolescent behavioral problems	.09	.02	.40***	.42***	—						2.75	3.68
6. Adolescent's age	.04	.03	–.09	.02	.14	—					13.34	1.37
7. Adolescent's sex	.14*	–.03	–.01	.03	.26***	.09	—				1.46	.50
8. Adolescent's prematurity	–.03	.40***	.05	.00	–.01	.09	.01	—			.33	.47
9. Parental education	–.07	–.18*	.03	.12	–.01	–.05	.02	–.13	—		4.85	1.06
10. Parental age	.14	–.06	–.13	–.08	.06	.38***	.04	.10	–.03	—	42.85	4.04

Note. Pregnancy loss: no loss = 0, one loss = 1, recurrent loss = 2; Twin status: 0 = singleton, 1= twins; Adolescent's sex: 1 = female, 2 = male; Adolescent's prematurity: 0 = full term, 1 = premature; Parental education: 1 = did not complete high school to 7 = doctoral degree.

*p <.05. ***p <.001.

Table 1.2

Parameter Estimates and Fit Indices for Adolescent Emotional Problems Model

	Parental emotional problems					Adolescent emotional problems				
Variables	*B*	95% CI	ß	*t*	*p*	*B*	95% CI	ß	*t*	*p*
Pregnancy loss	.27	[–.56, 1.09]	.05	.64	.524	1.03	[.11, 1.96]	.19	2.28	.023*
Twin status	.10	[–1.28, 1.47]	.01	.14	.889	.92	[–.52, 2.36]	.11	1.26	.208
Loss x twin	1.89	[.12, 3.65]	.19	2.25	.025*	—	—	—	—	—
Parental emotional problems	—	—	—	—	—	.50	[.34, .66]	.46	6.58	<.001***
Adolescent's age	—	—	—	—	—	.06	[–.46, .58]	.02	.22	.825
Adolescent's sex	.09	[–.91, 1.09]	.01	.18	.859	.12	[–1.00, 1.23]	.02	.21	.837
Adolescent's prematurity	.56	[–.85, 1.97]	.07	.81	.421	–.75	[–2.30, .79]	–.09	–.97	.334
Parental education	.16	[–.37, .69]	.05	.61	.544	—	—	—	—	—
Parental age	–.13	[–.27, .01]	– .14	–1.79	.073	—	—	—	—	—

	CFL	TLI	RMSEA	SRMR	χ^2	*df*	*p*
Model fit	*1.00*	*1.20*	*0.00*	*0.02*	*2.67*	4	.615

Note. CI = confidence interval; CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root-mean-square error of approximation; SRMR = standardized root-mean-square residual; parental emotional problems: $R^2 = .06$, $t = 1.53$, $p = .127$; adolescent emotional problems: $R^2 = .26$, $t = 3.93$, $p < .001$.

*$p < .05$. ***$p < .001$.

Table 1.3

Parameter Estimates and Fit Indices for Adolescent Behavioral Problems Model

	Parental emotional problems					Adolescent behavioral problems				
Variables	*B*	95% CI	ß	*t*	*p*	*B*	95% CI	ß	*t*	*p*
Pregnancy loss	.27	[–.56, 1.09]	.05	.64	.524	.27	[–.45, .98]	.06	.75	.452
Twin status	.09	[–1.27, 1.46]	.01	.13	.895	.36	[–.79, 1.51]	.05	.62	.532
Loss x twin	1.85	[.08, 3.62]	.18	2.18	.029*	—	—	—	—	—
Parental emotional problems	—	—	—	—	—	.39	[.25, .53]	.40	5.61	<.001***
Adolescent's age	—	—	—	—	—	.47	[.01, .93]	.17	2.08	.038*
Adolescent's sex	.04	[–.98, 1.05]	.01	.07	.944	1.83	[.70, 2.97]	.25	3.78	<.001***
Adolescent's prematurity	.50	[–.91, 1.91]	.06	.71	.475	–.48	[–1.79, .82]	–.06	–.73	.466
Parental education	.16	[–.38, .69]	.04	.57	.567	—	—	—	—	—
Parental age	–.13	[–.27, .02]	–.14	–1.75	.081	—	—	—	—	—
	CFL	TLI		RMSEA	SRMR		χ^2	*df*		*p*
Model fit	.98	.92		.02	.02		4.65	4		.325

Note. CI = confidence interval; CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root-mean-square error of approximation; SRMR = standardized root-mean-square residual; parental emotional problems: $R^2 = .06$, $t = 1.49$, $p = .137$; adolescent emotional problems: $R^2 = .26$, $t = 4.45$, $p < .001$.

*$p < .05$. ***$p < .001$.

Table 1.4

Means and Standard Deviations of Parental Emotional Problems by Pregnancy Loss and Twin Status

	Twins			Singletons	
Pregnancy loss	*M*	*SD*	Pregnancy loss	*M*	*SD*
No loss (n = 66)	3.37	2.73	No loss (n = 68)	3.91	3.99
One loss (n = 38)	4.15	4.06	One loss (n = 52)	3.35	3.21
Recurrent loss (n = 18)	5.80	5.17	Recurrent loss (n = 31)	3.05	3.00

**Note*. All descriptive statistics reflect marginal estimates after accounting for covariates and shared family variance. Singleton group had 5 missing cases.

Table 2.1

Bivariate Correlations, Means, and Standard Deviations about Study Variables

Variable	1	2	3	4	5	6	7	8	*M*	*SD*
1. Information sharing status	—								2.27	.80
2. Conversation	–.19*	—							5.74	.67
3. Conformity	.07	–.27**	—						3.44	.69
4. Adolescent emotional problems	–.04	–.15	.28*	—					3.79	4.26
5. Adolescent behavioral problems	.09	–.17	.31	.55***	—				2.93	4.31
6. Adolescent's sex	–.13	–.17*	.06	.04	.23***	—			1.45	.50
7. Adolescent's age	–.05	–.06	.06	.14	.26**	.03	—		13.25	1.23
8. Parental emotional state	.01	–.24**	.08	.28**	.23*	.15	–.01	—	3.83	3.01

Note. Information sharing status: 1 = early-sharing, 2 = late-sharing, 3 = non-sharing. Adolescent's sex: 1 = female, 2 = male.
*$p < .05$, **$p <$. 01, ***$p < .001$.

Table 2.2

Parameter Estimates and Fit Indices for Adolescent Emotional Problems Model by MAR Information Sharing Groups

	Adolescent emotional problems			
	B	95% CI	ß	*t*	*p*
Early-sharing					
Conversation	– 3.99	[–8.30, –.32]	–.48	–2.06	.039*
Conformity	–1.86	[–5.67, 1.95]	–.29	–.96	.337
Conversation X Conformity	3.82	[–1.65, 9.28]	.39	1.311	.190
Adolescent's sex	–3.11	[–6.67, .45]	–.36	–1.89	.059
Adolescent's age	.44	[–.62, 1.50]	.13	.87	.386
Parental emotional state	.35	[–.24, .94]	.23	1.16	.248
Late-sharing					
Conversation	–2.14	[–4.45, .16]	–.24	–1.94	.053
Conformity	1.81	[–.66, 4.28]	.20	1.42	.155
Conversation X Conformity	–4.23	[–7.36, –1.10]	–.29	–2.83	.005**
Adolescent's sex	1.12	[–1.19, 3.43]	.11	.92	.359
Adolescent's age	–.59	[–1.70, .53]	–.13	–1.06	.288
Parental emotional state	.35	[–.20, .90]	.24	1.91	.234
Non-sharing					
Conversation	.71	[–.55, 1.98]	.14	1.11	.269
Conformity	1.72	[.17, 3.62]	.35	2.12	.034*
Conversation X Conformity	–.86	[–3.86, 2.14]	–.10	–.60	.546
Adolescent's sex	.61	[–.84, 2.05]	.08	.85	.396
Adolescent's age	.83	[.16, 1.50]	.27	2.70	.007**
Parental emotional state	.32	[.05, .58]	.23	2.12	.034*

	CFI	TLI	RMSEA	SRMR	χ^2	*df*	*p*
Model fit indices	1.00	1.00	.00	.00	.00	0	.000

Note. CI = confidence interval; CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root-mean-square error of approximation; SRMR = standardized root-mean-square residual; early-sharing: $R^2 = .29$. $t = 2.17$, $p = .03$*; late-sharing: $R^2 = .37$. $t = 2.88$, $p = .004$**; non-sharing: $R^2 = .27$. $t = 1.44$, $p = .151$. *$p < .05$, **$p <. 01$.

Table 2.3

Parameter Estimates and Fit Indices for Adolescent Behavioral Problems Model by MAR Information Sharing Status

	Adolescent behavioral problems				
	B	95% CI	ß	*t*	*p*
Early-sharing					
Conversation	–1.10	[–3.54, 1.34]	–.18	–.95	.344
Conformity	–1.15	[–2.91, .61]	–.25	–1.21	.227
Conversation X Conformity	2.27	[–.26, 4.81]	.32	1.49	.135
Adolescent's sex	–.43	[–2.45, 1.59]	–.07	–.41	.680
Adolescent's age	.51	[–.63, 1.65]	.21	1.05	.294
Parental emotional state	.27	[–.26, .79]	.24	1.16	.246
Late-sharing					
Conversation	–.29	[–2.35, 1.77]	–.04	–.27	.785
Conformity	2.29	[.15, 4.42]	.32	2.06	.039*
Conversation X Conformity	–1.28	[–3.21, .66]	–.11	–1.39	.164
Adolescent's sex	2.86	[.71, 5.00]	.35	2.90	.004**
Adolescent's age	–.01	[–1.07, 1.05]	–.01	–.02	.987
Parental emotional state	.02	[–.22, .27]	.02	.18	.857
Non-sharing					
Conversation	.36	[–.91, 1.63]	.06	.55	.584
Conformity	2.06	[.06, 4.17]	.33	2.38	.017*
Conversation X Conformity	–1.84	[–5.29, 1.60]	–.17	–1.24	.217
Adolescent's sex	2.59	[.58, 4.61]	.27	3.09	.002**
Adolescent's age	1.28	[.48, 2.08]	.33	3.57	<.001***
Parental emotional state	.45	[.12, .77]	.26	2.78	.006**

	CFI	TLI	RMSEA	SRMR	χ^2	*df*	*p*
Model fit indices	1.00	1.00	.00	.00	.00	0	.000

Note. CI = confidence interval; CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root-mean-square error of approximation; SRMR = standardized root-mean-square residual; early-sharing: $R^2 = .17$, $t = 1.23$, $p = .219$; late-sharing: $R^2 = .27$, $t = 2.49$, $p = .013$*; non-sharing: $R^2 = .38$, $t = 2.03$, $p = .043$*; *$p < .05$, **$p <. 01$, ***$p < .001$.

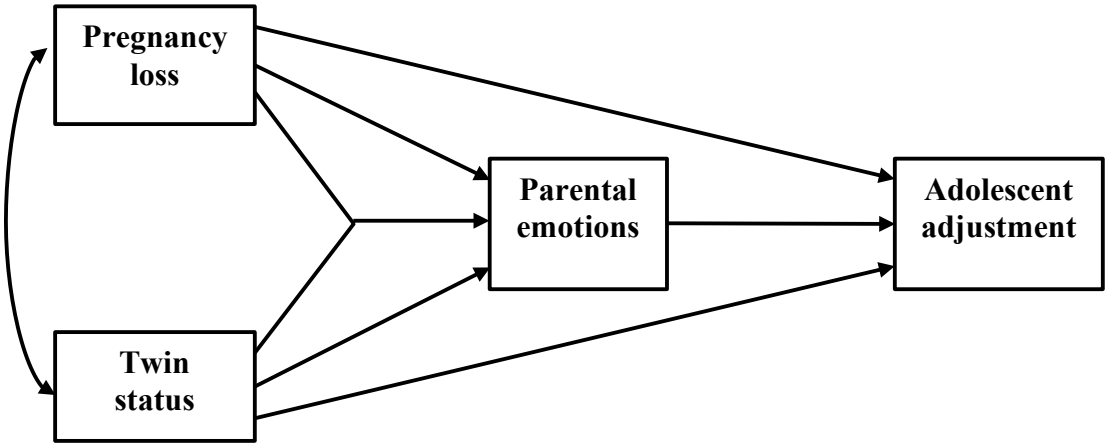

Figure 1.1. Conceptual model illustrating hypothesized associations between study variables.

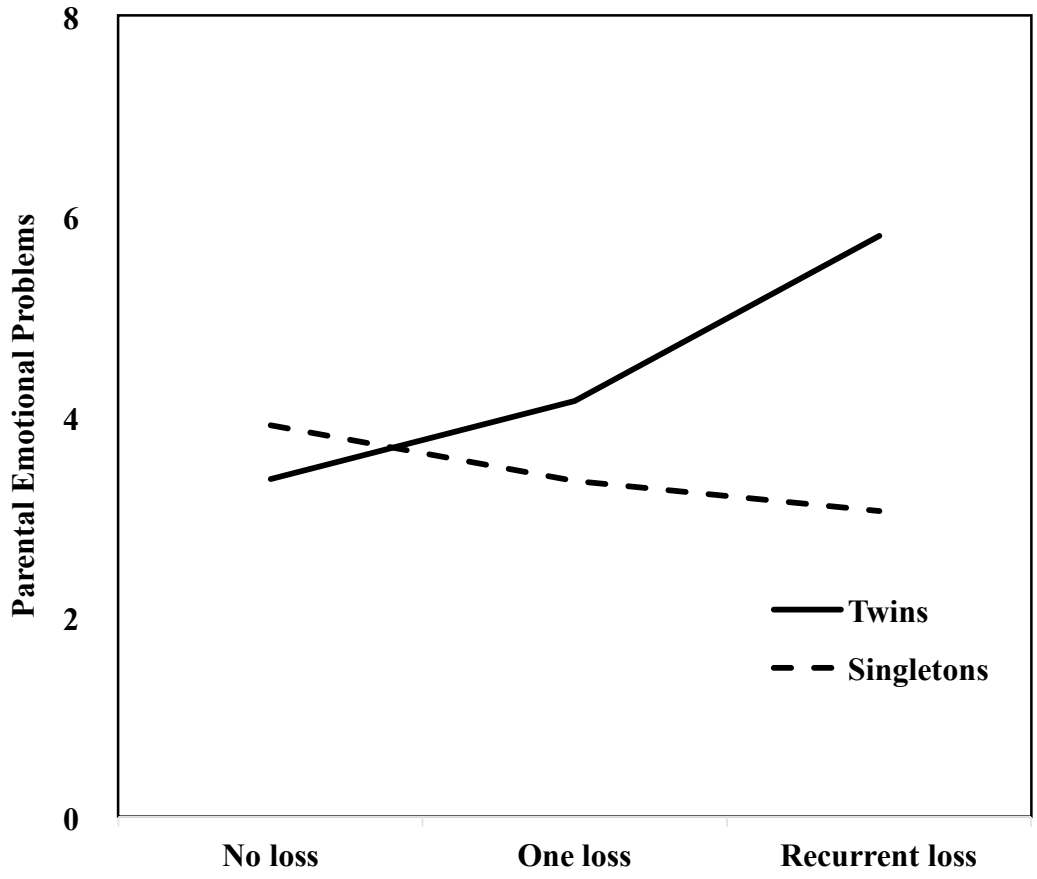

Figure 1.2. Plotting of the interaction effect between pregnancy loss and twin status on parental emotional problems at middle childhood.

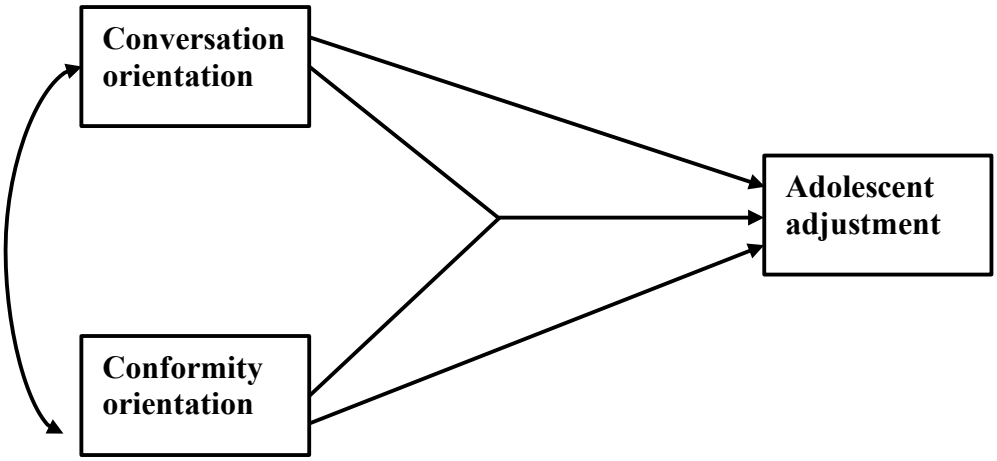

Figure 2.1. Conceptual model illustrating hypothesized associations between study variables

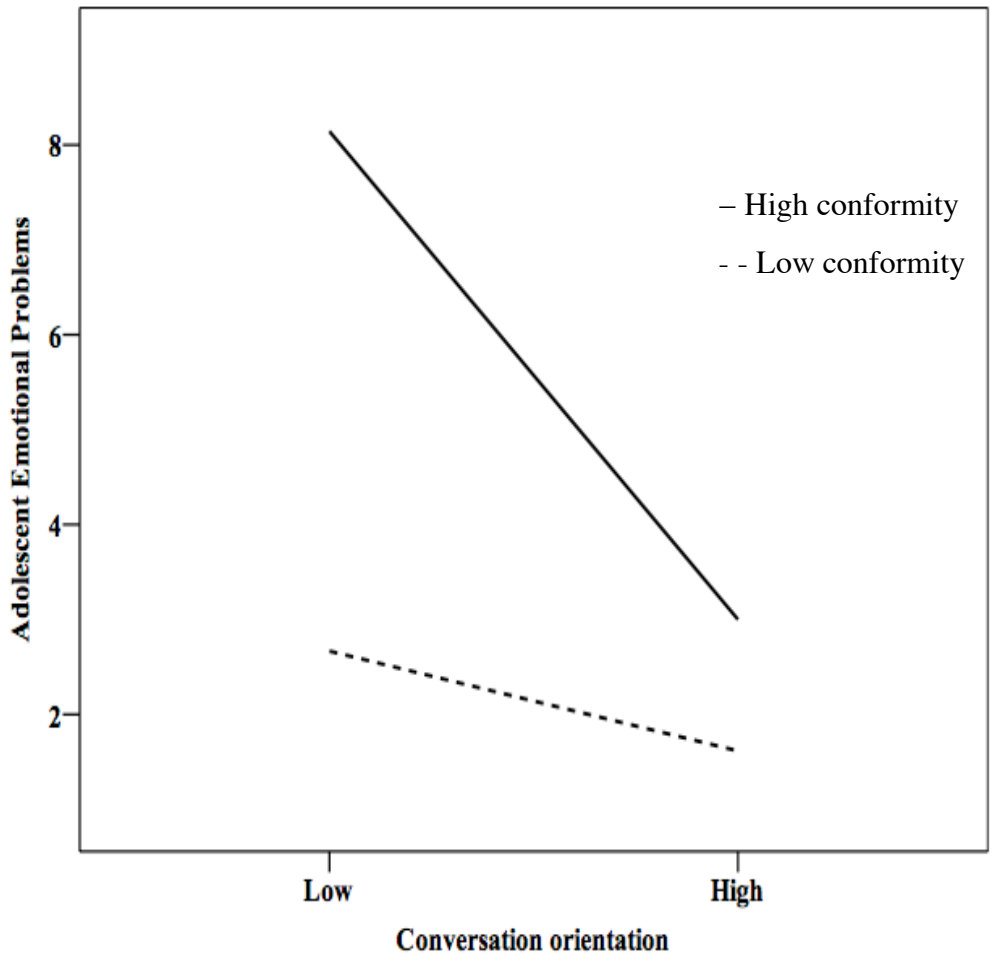

Figure 2.2. Plotting of the interaction effect between conversation orientation and conformity orientation on adolescent emotional problems for late-sharing group.

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