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A Longitudinal Study of Families Formed Through Third-Party Assisted Reproduction: Mother–Child Relationships and Child Adjustment From Infancy to Adulthood

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The seventh phase of this longitudinal study investigated whether children born through third-party assisted reproduction experienced psychological problems, or difficulties in their relationship with their mothers, in early adulthood. The impact of disclosure of their biological origins, and quality of mother–child relationships from age 3 onward, were also examined. Sixty-five assisted reproduction families, including 22 surrogacy families, 17 egg donation families, and 26 sperm donation families, were compared with 52 unassisted conception families when the children were aged 20. Less than half of the mothers had completed tertiary education and less than 5% were from ethnic minority backgrounds. Standardized interviews and questionnaires were administered to mothers and young adults. There were no differences between assisted reproduction and unassisted conception families in mothers' or young adults' psychological well-being, or the quality of family relationships. However, within the gamete donation families, egg donation mothers reported less positive family relationships than sperm donation mothers, and young adults conceived by sperm donation reported poorer family communication than those conceived by egg donation. Young adults who learned about their biological origins before age 7 had less negative relationships with their mothers, and their mothers showed lower levels of anxiety and depression. Associations between parenting and child adjustment did not differ between assisted and unassisted reproduction families from ages 3 to 20. The findings suggest that the absence of a biological connection between children and their parents in assisted reproduction families does not interfere with the development of positive mother–child relationships or psychological adjustment in adulthood.

Public Significance Statement

Contrary to the concerns that have been raised regarding the potentially negative consequences of third-party assisted reproduction for children's psychological well-being, the findings of this longitudinal study point to positive family relationships and child adjustment from childhood to adult life. The findings also suggest that families may benefit from parents of children born through third-party assisted reproduction beginning to speak to their children about the circumstances of their birth at an early age, in an age-appropriate way, ideally before they start school.

Keywords: assisted reproduction, surrogacy, egg donation, sperm donation, parent–child relationships

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Although surrogacy has been practiced since biblical times, and sperm donation was reported as early as 1884, it was not until after the introduction of IVF in 1978 that sperm donation became widely used as a treatment for male infertility, and that egg donation, embryo donation, and gestational surrogacy, whereby the intended mother's egg is used to create the pregnancy, became possible,

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thus enabling infertile women to have children. These procedures are referred to collectively as either third-party reproduction, or reproductive donation (Richards et al., 2012). Of the 107,066 IVF cycles conducted in the United States in 2018, around 5% involved donated eggs (Centers for Disease Control and Prevention, 2020), a similar proportion to the United Kingdom in 2019 (Human Fertilisation and Embryology Authority, 2021).

Absence of Biological Connections and Child Adjustment Problems

One assumption that has often been made in relation to egg and sperm (gamete) donation, is that the absence of a genetic connection to the mother or the father would interfere with the development of a positive relationship between the child and the nongenetic parent and result in raised levels of child adjustment problems (Baran & Pannor, 1993; Daniels & Taylor, 1993; Velleman, 2005). Theoretically, this assumption is grounded in evolutionary psychology, which views genetic relatedness, or its absence, between parents and children as a factor that, over generations, has influenced the amount of parental investment made in each child. That is, the extent to which parents invested in and cared for their children depended upon the likelihood of the children surviving and reproducing, and thus passing on their genes to the next generation. MacDougall-Shackleton (2011) distinguished between the passing of genes from one generation to the next, referred to as an ultimate level explanation, and proximate level influences on parental investment and care, such as crying and physical resemblance. According to evolutionary psychologists such as Trivers (1974) and Daly and Wilson (1989, 1996), the motivating factors for parental investment and care occur at the proximate level, such that parental behavior that favors genetically related children over unrelated children is more likely to be passed down to the next generation. From this perspective, difficulties may be expected for parent–child relationships and children's psychological well-being in families created by third-party assisted reproduction due to a lack of physical resemblance between the child and the nonbiological parent, the child behaving differently from the nonbiological parent, and parents not viewing the child as their own. The greater risk of distant or hostile relationships between stepparents and their stepchildren, and poorer child outcomes, than found among families in which parents and children share genetic links, are considered as an expression of these evolved parental decision-making strategies (Daly & Wilson, 1989, 1996; Trivers, 1974).

Empirical studies of stepfamilies have found stepfathers to be less warm and less involved in disciplining their children than fathers of genetically related children (Hetherington & Stanley-Hagan, 2002), and stepchildren to show raised levels of emotional and behavioral problems, especially those in stepmother families (Dunn et al., 1998, 2000; Hetherington & Stanley-Hagan, 2002; O'Connor et al., 2001), although it is uncertain to what extent stepparents are reacting to the negativity and resistance of the stepchildren toward them (Hetherington & Stanley-Hagan, 2002). Dunn and colleagues found that children's difficulties were related to factors associated with being in a stepfamily, such as mothers' depression, lack of social support, and financial problems. However, they also reported that stepparents did not view their stepchildren as their own children, and in families with both step and biological children, parents were found to be less affectionate toward, and supportive of, their step than their biological children (Dunn et al., 2000).

Research on adopted children, who lack a genetic link to both parents, has also given rise to the idea that the absence of genetic connections between parents and their children may be detrimental to children's adjustment. There is a large body of research showing that adopted children exhibit higher rates of psychological difficulties, especially behavioral problems, than nonadopted children (Palacios & Brodzinsky, 2010). This finding has been consistent in studies of children of different ages, and from different populations, ranging from children referred for psychiatric treatment to community samples. Nevertheless, meta-analyses have shown the differences in psychological problems between adopted and nonadopted children to have small effect sizes, with the higher overall levels of adjustment problems shown by adopted children reflecting severe difficulties in a small proportion of adopted children rather than greater difficulties in the majority (Juffer & van IJzendoorn, 2005, 2007).

Furthermore, the psychological problems shown by adopted children have been found to be largely related to factors associated with the adoption, such as prenatal exposure to drugs and alcohol, abusive and/or neglectful parenting, and multiple caretakers in the years before the adoption took place, rather than the absence of a biological link between children and their adoptive parents (Dozier et al., 2013; Dozier & Rutter, 2008; McCall, 2011; Palacios & Brodzinsky, 2010). The older children are when they are adopted, the more likely they are to have experienced prenatal risk factors, maltreatment, and multiple foster care placements, and the greater their risk of psychological problems.

A further predictor of adopted children's psychological adjustment is the extent to which parents communicate openly with their children about their origins. It is generally accepted that adopted children benefit from information about their birth family (Brodzinsky, 1987, 2006), and that adoptive parents should begin to talk to their children about their adoption from an early age and maintain open communication with them about their adoption (Brodzinsky, 2011; Brodzinsky & Pinderhughes, 2002). Poor communication about adoption has been associated with more negative relationships between adoptive parents and their children when the children reach adolescence (Brodzinsky & Pinderhughes, 2002; Passmore et al., 2007; Rueter & Koerner, 2008), and problems in adoptive identity development (Brodzinsky, 2011; Grotevant & Von Korff, 2011).

Children Born Through Reproductive Donation

Children conceived through gamete donation differ from step and adopted children in that they are born into the families in which they are raised, they are not relinquished by, or removed from, their biological parents, and their parents consider them to be their own children. These children also have a genetic and gestational connection to their mother, when conceived through sperm donation, and a genetic connection to their father, in the case of egg donation. Although children born through surrogacy lack a gestational connection to their mother, they do have a genetic link to their father, and also a genetic link to their mother when gestational surrogacy was used in their conception. Moreover, children born through reproductive donation are not generally exposed to the adverse experiences that are associated with the development of emotional and behavioral problems in step and adopted children.

Nevertheless, children born through gamete donation and surrogacy are similar to step and adopted children in the absence of lack of a genetic and/or gestational connection to a parent, and the presence of a biological connection to someone (a gamete donor and/or surrogate) outside their family, which may have implications for the quality of their relationships with their parents and psychological adjustment (Cahn, 2009). A recent study of families created using identifiable egg donors by the present research team, found that many mothers were concerned during pregnancy that they would not bond with their baby, and although most felt that the baby was their own by age 1, some still struggled with the idea that their child was not genetically related to them (Imrie et al., 2020). When followed up at age 5, some mothers reported feeling threatened by the prospect of their child discovering the identity of the egg donor, and possibly forming a relationship with her (Lysons et al., 2022). These reactions are perhaps unsurprising given the high level of social significance that is placed upon genetic connections (Freeman, 2014; Groll, 2021). The nature and extent of parents' disclosure to their children of their biological origins may also influence parent–child relationships and children's adjustment in families formed through third-party assisted reproduction (Crawshaw, 2002; Feast, 2003). Concerns about the potentially negative effects of secrecy, partly prompted by the negative experiences of some donor-conceived people who found out about their origins later in life (Turner & Coyle, 2000), led the Ethics Committee of the American Society for Reproductive Medicine (2018) to strongly encourage parents to be open with their children.

A small number of studies have examined the quality of parent–child relationships and the psychological well-being of children in heterosexual parent families created through reproductive donation. These include in-depth, longitudinal investigations of families formed by sperm donation (Golombok et al., 1995, 2002, 2009), egg donation (Golombok et al., 1999; Murray et al., 2006), and embryo donation (MacCallum et al., 2007; MacCallum & Keeley, 2008), and cross-sectional, questionnaire-based studies of families formed through sperm donation (Kovacs et al., 2013) and through egg, sperm and embryo donation, and surrogacy (Shelton et al., 2009). Although the families were found to be functioning well, the large majority of parents had not been open with their children about their biological origins.

The present longitudinal study of families formed through reproductive donation, which began at the millennium, has assessed the children six times from infancy to adolescence when they were 1, 2, 3, 7, 10, and 14 years old. The study has compared four groups of families: egg donation families, sperm donation families, surrogacy families, and a comparison group of families formed through unassisted conception, all of whom had two heterosexual parents at the start. It is the first study to examine the impact of disclosure of the children's biological origins on parenting and child development. The study is founded upon a relational developmental systems framework (Osher et al., 2020; Overton, 2015), whereby relationships, such as those between parents and children, and context, such as the disclosure or nondisclosure of children's biological origins, are considered to interact reciprocally with characteristics of the child to influence development.

In the preschool years, despite concerns to the contrary, the involvement of a gamete donor or surrogate did not adversely affect the relationship between parents and their children (Golombok et al., 2005; Golombok, Lycett, et al., 2004; Golombok, MacCallum, et al., 2006; Golombok, Murray, et al., 2004; Golombok, Murray, et al., 2006). Instead, where differences were identified between family types, these indicated more positive outcomes for the reproductive donation families than the unassisted conception families, which was attributed to the parents' pleasure in, and commitment to, their much-wanted children.

In middle childhood, the reproductive donation families continued to show a high quality of parenting. However, mother–child relationships in donor conception families where parents had not told their children about their genetic origins were less positive than in the disclosing families with respect to quality of interaction, and less positive than the unassisted conception families in terms of warmth, sensitivity, and quality of interaction (Golombok, Readings, Blake, Casey, Mellish, et al., 2011). Fathers of donor-conceived children did not differ from the fathers of children born through unassisted conception in terms of quality of parenting, although the children born through sperm donation showed greater negativity toward their fathers in an interaction task compared to children born through egg donation or unassisted conception (Casey et al., 2013). Almost all the surrogacy parents had been open with their children about the circumstances of their birth, and these families did not differ from the unassisted conception families with respect to the quality of mother–child relationships, apart from less positive mother–child interaction (Golombok, Readings, Blake, Casey, Marks, & Jadva, 2011). Regarding the children, those conceived by gamete donation showed high levels of adjustment (Golombok et al., 2013). The surrogacy children showed raised levels of psychological problems compared to the other groups of children at age 7, which was attributed to these children's need to confront identity issues at a younger age than other children, but this difference had disappeared by age 10 (Golombok et al., 2013).

Although adolescence, which is associated with identity formation and a desire for greater autonomy from parents (Smetana et al., 2006; Smetana & Rote, 2019), was expected to present specific challenges for families created by third-party assisted reproduction, no differences were found in the quality of mother–adolescent relationships between the reproductive donation and the unassisted conception families. However, mothers in surrogacy families showed greater acceptance of their 14-year olds, less negative parenting, and more positive family functioning than mothers of children born through donor conception (Golombok et al., 2017). Within the donor conception families, the egg donation families showed poorer outcomes than the sperm donation families in terms of family functioning and mothers' acceptance of their adolescent children, suggesting that the absence of a genetic connection between mothers and children posed a challenge to the mother–child relationship at adolescence. In all family types, the adolescents themselves exhibited high levels of adjustment, self-esteem, and psychological well-being (Golombok et al., 2017), with those who had been told about their origins in the preschool years showing more positive mother–child relationships and greater psychological well-being at age 14 (Ilioi et al., 2017).

The Present Study

The aim of the present phase of the study was to examine the quality of parent–child relationships and psychological adjustment of the children when they reached 20 years. Although the findings at age 14 showed the families formed by reproductive donation to be functioning well, it is not known whether this pattern continues into adulthood. By age 20, sometimes referred to as emerging adulthood

(Arnett, 2007), young adults have generally attained greater autonomy from their parents than during adolescence and they have greater freedom to explore their identity and question previously held attitudes and beliefs. Thus, young adults born through reproductive donation may show heightened interest in their biological origins which may have implications for their psychological well-being and relationships with their parents. Evidence for a desire for information about their biological origins in early adulthood comes from studies conducted in the United States, where donor-conceived young people have been found to search for their donors and donor siblings via the Internet (Canzi et al., 2019; Freeman et al., 2008), and through clinics that used donors who were willing for their identity to be released to their donor offspring when they reached adulthood (Scheib et al., 2017, 2020).

Thus, it was hypothesized that young adults born through reproductive donation would show higher levels of adjustment problems and difficulties in relationships with their mothers than those born by unassisted conception. Based on the findings at adolescence, it was also hypothesized that, within the reproductive donation families, the young adults from gamete donation families would show more negative outcomes than those from surrogacy families, the majority of whom had been born through gestational surrogacy and thus were genetically related to their mothers. A further hypothesis was that the egg donation families would show more negative outcomes than the sperm donation families since genetically unrelated mothers may find their adult children's desire for autonomy and interest in their origins more problematic than mothers who were genetically related to their children.

With respect to disclosure, based on the findings of the present study at age 14 (Ilioi et al., 2017), which showed more positive outcomes in assisted reproduction families where children had been told about their origins by age 7, it was hypothesized that young adults who had become aware of their biological origins before age 7 would show more positive relationships with their mothers, and higher levels of psychological adjustment, at age 20.

The present phase of the study provided the first opportunity to examine childhood predictors of the psychological well-being of young adults born through reproductive donation. To the extent that more supportive family environments in childhood and adolescence are associated with more positive parent–child relationships in early adulthood (Belsky et al., 2001), and moderate stability in attachment has been found between childhood and adulthood (Waters et al., 2000), it was predicted that higher quality relationships with mothers in childhood and adolescence would be associated with higher quality mother–child relationships in adulthood, and more positive psychological adjustment, in both assisted and unassisted reproduction families.

Method

Participants

The seventh phase of the study involved 117 mothers[1] (M_{age} = 56.24 years, SD = 4.44 years) and their 20-year-old children (M_{age} = 20.50 years, SD = .56 years, 61 female and 56 male), including 22 families with children born through surrogacy, 17 families with children conceived by egg donation, 26 families with children conceived by sperm donation, and a comparison group of 52 families formed through unassisted conception. For details on the recruitment process, see Golombok, Lycett, et al. (2004) and Golombok, Murray, et al. (2004). Of the 117 mothers who took part in interviews, the majority completed questionnaires (78%, n = 91). Under half had completed tertiary education (43.6% had an undergraduate or graduate degree) and a minority of mothers were from ethnic minority backgrounds (4.3%, n = 5).

The sample of mothers in Phase 7 represents 83% of the families who took part in Phase 6 when the children were aged 14 (Golombok et al., 2017). Specifically, of the 24 families who did not take part, 13 were unable to be traced and 11 declined to participate. Excluding those who could not be traced, the retention rate from Phase 6 was more than 90%. Retention was lower for egg donation families compared to the other family types, $\chi^2(3) = 11.24$, $p = .010$, Cramer's $V = .31$. However, with respect to the main variables of interest in the current phase of the study, the retained sample did not differ from those who did not participate (Phase 6 child adjustment, Cohen's $d = 0.11$, and maternal mental health, couple relationship quality, and parenting quality, mean $t < 1.7$, $p > .05$). In terms of disclosure status, families who dropped out between Phases 6 and 7 were marginally less likely to have told their child about the nature of their conception by age 14 than those who were retained, $\chi^2(1) = 2.89$, $p = .089$, Cramer's $V = .19$.

As illustrated in Table 1, mothers were, on average, older in egg donation families than in donor insemination and unassisted conception families, Cohen's $d = 1.05$, and fewer children in assisted reproduction families had siblings, Cohen's $d = 0.75$. Couples in egg donation families were less likely to have separated or divorced than couples in the other family types, Cramer's $V = .25$, and mothers in surrogacy and egg donation families were less likely to have completed tertiary education than unassisted conception or donor insemination mothers, Cramer's $V = .41$. However, they did not significantly differ in working status, Cramer's $V = .21$, or whether the young adult lived with their parent, Cramer's $V = .20$.

For ethical reasons, the protocol required that adult children who were unaware of their assisted conception did not participate in the study. Thus, only the adult children born through assisted reproduction who were aware of the method of their conception and those born through unassisted conception (n = 98), were invited to take part in the study, and 76 young adults (42 female, 34 male) did so (n = 15 surrogacy, n = 11 egg donation, n = 9 donor insemination, n = 41 unassisted conception), representing a response rate of 78%. Most young adults self-identified as White British and a minority as from an ethnic minority background (n = 7, 9.2%). According to the mothers, the majority were studying (n = 37, 48.7%), although a significant number were combining paid work with studying (n = 24, 34.3%), and a minority reported working full time (n = 11, 15.7%), or were not in education or employment (n = 4, 5.7%). Of the 76 young adults who took part in an interview, 92.1% completed questionnaires (n = 70; n = 14 surrogacy, n = 9 egg donation, n = 8 donor insemination, n = 39 unassisted conception). The present paper focuses on the young adults' questionnaire data only.

Procedure

The University of Cambridge Research Ethics Committee approved the study protocol (PRE.2019.066). In the previous phase, parents

[1] In two families, the father participated as the mother was ill or deceased.

Table 1
Sociodemographic Information by Family Type

	Surrogacy		Egg donation		Donor insemination		Unassisted conception		Group difference	
Demographic variable	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*
Age of parent (years)	58.44	4.52	61.22	6.13	56.26	3.54	55.06	2.78	11.95	.000
Age of young adult (years)	20.42	0.68	20.38	0.58	20.62	0.51	20.53	0.48	0.79	.500
	N	%	*N*	%	*N*	%	*N*	%	χ^2	*p*
Young adult gender									3.19	.363
Male	9	40.9	9	52.9	16	61.5	22	42.3		
Female	13	59.1	8	47.1	10	38.5	30	57.8		
Siblings									26.07	.000
0	10	45.5	9	52.9	8	30.8	2	3.8		
1	11	50.0	7	41.2	14	53.8	43	82.7		
2+	1	4.5	1	5.9	4	15.4	7	13.5		
Ethic group									6.57	.681
White	21	95.5	17	100	25	96.2	49	94.2		
Non-White	1	4.5	0		1	3.8	3	5.8		
Parent marital status									14.08	.029
Married/cohabiting	15	68.2	16	94.1	14	53.9	43	82.7		
Separated/divorced	5	22.7	0		9	34.6	7	13.5		
Other (e.g., bereaved)	2	9.1	1	5.9	3	11.5	2	3.8		
Mother employment									10.16	.118
Not working	7	31.8	4	23.5	2	7.7	7	13.5		
Part time	7	31.8	6	35.3	15	57.7	17	32.7		
Full time	8	36.4	7	41.2	9	34.6	28	53.8		
Mother educational level										
No university degree	19	86.4	11	64.7	11	42.3	17	32.7	18.10	.000
University degree	3	13.6	5	29.4	11	42.3	32	61.5		
Young adult residence									9.84	.132
Family home	9	40.9	8	41.2	9	34.6	9	17.3		
University/home	4	18.2	2	11.8	2	7.7	12	23.1		
Outside family home	9	40.9	7	47.0	15	57.7	31	59.6		

provided informed consent to be contacted again regarding their participation in a future phase of the study. At each prior phase (ages 1, 2, 3, 7, 10, and 14), families were visited at home and mothers and children completed separate interviews, as well as questionnaires, about their well-being and family background, and were filmed together in a structured play activity. In Phase 7, due to COVID-19 restrictions, data collection was completed online. The parents and young adults received an information sheet and provided written informed consent beforehand. The researchers were fully trained in the administration and coding of the measures.

Measures

Maternal Well-Being

Anxiety. The Trait Anxiety Inventory (TAI: Spielberger, 1983), a 20-item scale, with higher scores reflecting higher levels of anxiety, was completed by mothers. A meta-analytic review found the average reliability coefficients for both test–retest and internal consistency to be acceptable (Barnes et al., 2002). At the current phase of the study, Cronbach's $\alpha = .91$.

Depression. The mothers also completed the Edinburgh Depression Scale (EDS; Thorpe, 1993), a 10-item self-report scale, with higher scores indicating higher levels of depression. The EDS was originally developed to screen for symptoms of postnatal depression in women (Cox et al., 1987), but has since been validated in samples outside the postnatal period and the general population (Matijasevich et al., 2014). At this phase of the study, Cronbach's $\alpha = .77$.

Relationship Quality. To assess the quality of the couple's relationship, mothers completed the Golombok Rust Inventory of Marital State (GRIMS; Rust et al., 1990). For this questionnaire, higher scores indicate poorer relationship quality. Split-half reliability for the measure is 0.87 for women. The GRIMS has been shown to discriminate significantly between couples who are about to separate and those who are not. Cronbach's $\alpha = .91$ at the present phase of the study.

Family Relationships

Interview With Mother. The mothers were interviewed using an adaptation of a semi-structured interview designed to assess the quality of the mother–child relationship. This interview has been validated against observational ratings of mother–child relationships (Quinton & Rutter, 1988), and the adolescent version of the interview has been used successfully in a previous study of assisted reproduction families (Golombok et al., 2009, 2002). Detailed accounts are obtained of the young person's behavior, and the mother's response to it, with particular reference to interactions relating to warmth and conflict. A flexible style of questioning is used to elicit sufficient information for each variable to be rated by a trained researcher using a standardized coding scheme based upon a

detailed coding manual. Thus, ratings are carried out by the researcher using in-depth information obtained from the mother rather than by the mother herself.

The following variables were coded at Phases 3, 4, 5, 6, and 7 of the study when the children were ages 3, 7, 10, 14, and 20 years, respectively: (a) *expressed warmth* from 1 (*little*) to 5 (*high*) took account of the mother's tone of voice, facial expressions, and gestures in addition to what the mother said about the child; (b) *sensitivity* from 1 (*low*) to 4 (*high*) represented the mother's ability to recognize and respond appropriately to her child's needs; (c) *quality of interaction* from 1 (*low*) to 4 (*very high*) was based on the extent to which the mother and child wanted to be with each other and enjoyed each other's company; (d) *frequency of battles* from 0 (*never/rarely*) to 5 (*a few times daily*) assessed the frequency of mother–child conflict; (e) *severity of battles* from 0 (*none*) to 3 (*major*) assessed the severity of mother–child conflict; and (f) *resolution of conflict* from 0 (*full resolution*) to 3 (*no resolution*) assessed the attempt made to resolve the conflict. To establish interrater reliability, 30 randomly selected interviews were coded by a second interviewer and the interclass correlation coefficients were as follows: *expressed warmth* .81, *sensitive responding* .86, *quality of interaction* .76, *frequency of battles* .92, *level of battles* .95, and *resolution of conflict* .99.

Parental Acceptance Rejection Questionnaire (PARQ). The short 24-item version of this questionnaire was administered to mothers and young adults to provide total scores of maternal acceptance/rejection (Rohner, 2001). Mothers completed the questionnaire regarding their feelings toward their adult children and the young adults completed the questionnaire regarding their perceptions of their mothers' feelings toward them. Higher scores represent greater rejection whereas lower scores represent greater acceptance, with scores above 60 representing higher levels of rejection than acceptance. The PARQ has been reported to have good internal consistency, with a Cronbach's α of .91. The internal consistencies for the current study were $\alpha = .66$ and $\alpha = .92$ for mothers and young adults, respectively.

Index of Family Relationships (IFR). Mothers and young adults completed this 25-item questionnaire designed to measure problems in family relationships (Hudson, 1989). The total score, which ranges from 0 to 100, gives an assessment of family relationship difficulties, with higher scores representing greater difficulties. Internal consistencies for the original sample ranged from .91 to .98, and for the present sample were $\alpha = .93$ and $\alpha = .96$ for the mother and young adult questionnaires, respectively. The IFR has been found to show good discriminant validity and to distinguish between families with and without clinical problems.

Family Assessment Measure (FAM). The communication subscale of the Family Assessment Measure (Skinner et al., 2000) was administered to mothers and young adults to provide a measure of the extent to which they feel listened to, know what is happening in their family, and receive honest answers to their questions, with higher scores representing poorer communication. In the present study, Cronbach's α was $\alpha = .71$ and $\alpha = .74$ for mothers and young adults, respectively.

Young Adult Adjustment

Strengths and Difficulties Questionnaire. The presence of psychological problems in young adults was assessed with the adult version of the Strengths and Difficulties Questionnaire (SDQ; Goodman, 2001) administered to mothers and young adults. The mothers had completed the SDQ from Phase 3 onward. The SDQ produces an overall score of psychological adjustment with scores of 13 or below classified as within the normal range, scores of 14–16 classified as borderline, and scores of 17 or above classified as indicating psychological disorder.

The SDQ has been shown to have good internal consistency, test–retest and interrater reliability, and concurrent and discriminative validity (Goodman, 2001). For example, based on an epidemiological sample of more than 10,000 children in the UK (Goodman, 2001), internal consistency (Cronbach's α) was found to be .73, test–retest reliability after 4–6 months was 0.62 and, in terms of validity, scores above the 90th centile predicted a substantially raised probability of independently diagnosed psychiatric disorders. Internal consistencies for mothers and young adults, respectively, in the current study were $\alpha = .82$ and $\alpha = .82$. In a review of the reliability and validity of the SDQ based on 48 studies involving more than 130,000 children, Stone et al. (2010) found the psychometric properties of the SDQ to be strong.

Ratings of Psychiatric Disorder. The presence of psychiatric disorder in young adults was assessed during the interview with the mother using a standardized procedure (Rutter et al., 1975). Detailed descriptions were obtained of any emotional or behavioral problems shown by the young person since the previous interview. These descriptions of actual behavior, which included information about where the behavior was shown, severity of the behavior, frequency, precipitants, and course of the behavior over the past year, were transcribed verbatim and rated by a child psychiatrist who was unaware of the nature of the study. A high level of reliability ($r = .85$) between ratings made by social scientists and those made "blindly" by a child psychiatrist has been demonstrated for this procedure, and validity has been established through a high level of agreement between interview ratings of children's psychological problems and mothers' assessments of whether their children had emotional or behavioral difficulties (Rutter et al., 1975). Psychological problems, when identified, were rated according to *severity* on a 4-point scale ranging from 0 (*no disorder*) through 1 (*slight disorder*), 2 (*definite disorder*) to 3 (*marked disorder*), and type (emotional disorder, conduct disorder, mixed emotional and conduct disorder, developmental disorder, ADHD, psychotic disorder, or other disorder).

The Flourishing Scale. The young adults were administered the Flourishing Scale, a measure of self-perceived success in relationships, self-esteem, purpose, and optimism (Diener et al., 2010), with higher scores reflecting greater well-being. The Flourishing Scale has been shown to have high internal consistency (.86) and test–retest reliability (.71), and moderate to strong convergent validity with related scales. Cronbach's α in the present study was $\alpha = .89$.

Analysis Plan

Structural equation modeling in M*plus* version 8 (Muthén & Muthén, 1998–2017) was used to analyze the data. Prior to addressing the research questions, confirmatory factor analysis (CFA) was conducted on the parenting interview variables. A two-factor solution, reflecting dimensions of positive (warmth, sensitivity, and quality of interaction) and negative (frequency of battles, severity

of battles, and failed resolutions) parenting, was tested. Model fit was evaluated using three criteria: comparative fit index (CFI) > 0.90, Tucker–Lewis index (TLI) > 0.90, and root mean square error of approximation (RMSEA) < .08 (Brown, 2015). Tests of longitudinal measurement invariance were also carried out (Byrne, 2012). This involved systematically adding equality constraints to the model (i.e., equality of form, item loadings, and item intercepts) and testing the change in the model fit of these nested models (Byrne, 2012). Nested model comparisons were judged to be significant if the CFI decreased by >0.002 and there were significant changes in the Sartorra–Bentler scaled chi-square difference test (Meade et al., 2008). Finally, if scalar, or partial scalar, invariance (i.e., equivalence of item intercepts) was established then mean levels of negative and positive parenting over time were compared (Byrne, 2012).

To address the hypotheses regarding differences between family types in the key study measures at age 20, univariate and multivariate analyses of variance were used, and demographic co-variates were included when they differed by family type and were associated with the outcome measure. Any significant overall differences between family types were followed by Helmert contrasts. First, the families formed through reproductive donation were compared with the unassisted conception families to examine whether families who lacked a gestational and/or genetic connection between parents and children differed from families in which the children and parents were biologically related. Second, the surrogacy families were compared with the gamete donation families to examine the impact of the absence of a gestational link between parents and children versus the absence of a genetic link. Finally, the egg donation families were compared with the sperm donation families to examine whether families with children who lacked a genetic connection to their mother differed from families with children who lacked a genetic connection to their father. For the comparisons between the assisted reproduction families and the unassisted conception families, the sample size was large enough to detect an effect size of 0.50 for a power of 0.80, and the sample sizes for the comparisons between the assisted reproduction families were large enough to detect an effect size of 0.80 (Cohen, 1992).

In the assisted reproduction families, chi-square tests were used to establish whether there were significant differences between family types according to whether the young adults had been told about their biological origins by age 7. Chi-square tests were also used to examine whether there were differences according to disclosure status at age 7 in maternal well-being, family relationships, and adult adjustment at age 20.

Finally, the nature of associations between parenting and child adjustment from 3 to 20 years were examined by applying autoregressive cross-lagged models, with a robust maximum likelihood estimator. To establish whether the association between parenting and child adjustment varied by family type, these models were compared for assisted reproduction versus unassisted conception families. As a robust maximum likelihood estimator was used in the analyses, the chi-square difference between each nested model and the comparison model was calculated using the Satorra–Bentler chi-square difference test (Satorra & Bentler, 2010). A full information approach was adopted so that all eligible families were analyzed (Enders, 2001).

Results

Preliminary Analysis: Measurement Equivalence of Parenting Over Time

The longitudinal invariance of the two-factor model solution, reflecting dimensions of positive and negative parenting from Phases 3 to 7 (i.e., ages 3, 7, 10, 14, and 20), was tested. A partially scalar invariant model, in which some factor intercepts were free to vary, provided a good fit to the data; RMSEA = .023, 90% CI [.00, .062], CFI = .981, TLI = .966, thus suggesting conceptual equivalence of mothers' positive and negative parenting across an 18-year-period.

Wald chi-square test of model constraints revealed that mothers were rated as more positive at age 20 compared to the age 10, $w(1) = 6.93$, $p = .009$, and age 7 phases, $w(1) = 4.63$, $p = .032$. In line with this finding, mothers displayed significantly less negativity at age 20 compared to each of the previous phases—age 20 versus age 14: $w(1) = 27.23$, $p < .001$; age 20 versus age 10: $w(1) = 50.30$, $p < .001$; age 20 versus age 7: $w(1) = 80.57$, $p < .001$; age 20 versus age 3: $w(1) = 13.12$, $p < .001$.

Maternal Well-Being, Family Relationships, and Young Adult Adjustment at Age 20

Maternal Well-Being

A multivariate analysis of variance (MANOVA) testing for differences in mothers' mental health demonstrated no significant differences in either anxiety, $F(3, 88) = 1.27$, $p = .288$, $\eta_p^2 = .04$, or depression, $F(3, 88) = 0.34$, $p = .800$, $\eta_p^2 = .01$. Similarly, an analysis of variance (ANOVA) found no differences in couple relationship quality, $F(3, 88) = 0.16$, $p = .924$, $\eta_p^2 = .01$.

Family Relationships

A MANOVA testing for differences in parenting by family type found no significant differences in the negative parenting latent factor, $F(3, 88) = 2.11$, $p = .105$, $\eta_p^2 = .07$, or the positive parenting latent factor, $F(3, 88) = 0.67$, $p = .576$, $\eta_p^2 = .02$.

There were marginal differences by family type in mothers' reports of maternal acceptance, $F(3, 88) = 2.19$, $p = .095$, $\eta^2 = .07$. Given the moderate effect size, the direction of any potential differences was explored via Helmert contrasts. Helmert contrasts showed no significant differences between groups. Young adults' reports of maternal acceptance showed no significant differences by family type, $F = 0.46$, $p = .709$, $\eta_p^2 = .02$.

A MANOVA, controlling for maternal age, demonstrated a modest difference for mothers' Index of Family Relationships scores, $F(3, 88) = 1.82$, $p = .150$, $\eta_p^2 = .08$. Helmert contrasts showed a significant difference between the gamete donation groups, reflecting higher scores among the mothers of children conceived by egg donation than among the sperm donation mothers ($p = .015$). For the young adults, a MANOVA found no significant differences by family type for the Index of Family Relationships, $F(3, 65) = 1.39$, $p = .253$, $\eta_p^2 = .06$, and no significant differences were identified by the Helmert contrasts.

Regarding the communication scale of the Family Assessment Measure, a MANOVA controlling for maternal age, found no difference between family types for mothers, $F(3, 88) = 0.30$, $p = .828$, $\eta_p^2 = .01$, or for the young adults, $F(3, 65) = 1.66$, $p = .185$,

$\eta_p^2 = .07$. Helmert contrasts found a significant difference between young adults in gamete donation families, with those conceived by sperm donation reporting poorer family communication than those conceived by egg donation ($p = .038$).

Young Adult Adjustment

As illustrated in Table 2, an ANOVA showed no significant differences by family type in mothers' SDQ ratings, $F(3, 88) = 0.42$, $p = .741$, $\eta_p^2 = .01$. Overall, the sample appeared well adjusted ($M = 5.85$, $SD = 4.58$), with only 5% ($n = 6$) scoring above the normal range, including 3 in the slightly raised category (scores of 14–16), 2 in the high category (scores of 17–19), and 1 in the very high category (scores of 20–40). Of those scoring beyond the cut-offs, 4 were young adults from unassisted conception families and 2 were from surrogacy families.

Regarding the young adults' self-reports, a MANOVA demonstrated no significant differences by family type in SDQ ratings, $F(3, 65) = 0.26$, $p = .856$, $\eta_p^2 = .01$, or in flourishing, $F(3, 65) = 0.26$, $p = .947$, $\eta_p^2 = .01$. Overall, the average SDQ score was within the normal range ($M = 12.09$; $SD = 5.85$), with 30% ($n = 22$) falling above the cut-off, including 11 in the slightly raised category (scores of 15–17), 2 in the high category (scores of 18–19), and 9 in the very high category. Of those scoring beyond the cut-offs, 11 were young adults from unassisted conception families, 3 were from surrogacy families, 5 were from egg donation families, and 2 were from donor insemination families.

With respect to the child psychiatrist's ratings, there was a modest difference in the severity of psychiatric problems (i.e., no disorder/slight, definite, or marked) by family type, $\chi^2(3) = 11.54$, $p = .073$, Cramer's $V = .22$. The direction of any potential differences was explored and highlighted a marginal difference between the assisted reproduction and the unassisted conception families, $\chi^2(2) = 5.89$, $p = .053$, Cramer's $V = .22$. There was no significant difference between the surrogacy and gamete donation families, $\chi^2(2) = 1.99$, $p = .370$, Cramer's $V = .18$. However, there was a larger proportion of marked difficulties in the egg donation (47%) than the donor insemination families (19%), $\chi^2(2) = 3.44$, $p = .179$, Cramer's $V = .28$. The five young adults with marked problems in the donor insemination families had emotional problems, and of the seven young adults with marked problems in the egg donation families, five had emotional problems, one had developmental problems, and one had a psychotic disorder.

For the entire sample, 24.9% ($n = 28$) of the children were rated as having a marked problem and 13.7% ($n = 16$) were rated as having a definite problem. Of those who were rated as having a marked psychiatric problem, 75% ($n = 20$) showed emotional problems, 20.4% ($n = 6$) had developmental or mixed problems, and 3.6% ($n = 1$) were rated as experiencing psychosis.

Disclosure of Conception

Focusing solely on the assisted reproduction families, 37 sets of parents had told their child about the nature of their conception by age 7, 11 sets of parents had told their child after age 7, and 17 sets of parents had not disclosed by age 20. There was a significant difference between family types in whether parents had told their children about their conception by age 20, $\chi^2(2) = 23.00$, $p < .011$, Cramer's $V = .60$. All the surrogacy parents, 88% of the egg donation parents, but only 42% of the donor insemination parents had done so. Excluding those who had not disclosed, family type influenced the likelihood of disclosure before age 7, $\chi^2(2) = 9.11$, $p < .011$, Cramer's $V = .44$. As illustrated in Table 3, almost

Table 2
Descriptive Statistics for Main Phase 7 Study Variables by Family Type

	Surrogacy		Egg donation		Donor insemination		Unassisted conception				
Well-being and family relationship variable	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*	η_p^2
Maternal well-being											
Anxiety	31.95	7.36	37.08	8.76	35.39	9.02	34.70	7.36	1.27	.288	.04
Depression	3.79	3.25	4.38	3.86	3.83	3.36	4.56	3.25	0.34	.800	.01
Couple relationship	24.80	13.53	25.41	9.25	23.58	13.45	23.11	10.98	0.16	.924	.01
Family relationships											
Negative parenting[a]	−0.15	0.79	0.42	0.85	−0.19	0.65	−0.09	0.77	2.11	.105	.07
Positive parenting[a]	0.11	0.59	−0.17	0.73	0.19	0.57	0.02	0.84	0.47	.703	.02
Parental acceptance											
Mother	26.42	2.32	29.54	5.49	27.71	3.87	28.74	3.91	2.19	.095	.07
Young adult	30.71	6.88	29.63	8.53	29.13	6.29	32.28	9.45	0.46	.709	.02
Index of family relationships											
Mother	10.94	10.60	17.00	13.08	8.67	7.10	9.58	7.99	1.82	.150	.08
Young adult	16.29	11.17	25.56	23.81	12.88	14.11	22.69	15.52	1.39	.253	.06
Family communication											
Mother[b]	44.11	9.29	47.54	9.32	42.56	10.12	43.07	10.03	0.30	.828	.01
Young adult	49.08	7.28	54.67	16.46	43.25	11.61	51.08	10.57	1.66	.185	.07
Young adult adjustment											
SDQ[b]	6.84	4.50	5.15	3.69	5.78	3.41	5.65	5.330	0.42	.741	.01
SDQ[c]	11.50	5.00	13.50	7.35	11.75	4.80	11.72	5.56	0.26	.856	.01
Flourishing[c]	46.50	5.88	46.63	4.53	47.13	8.20	47.56	6.39	0.12	.947	.01

Note. SDQ = Strengths and Difficulties Questionnaire.
[a]Factor scores. [b]Parent report. [c]Self-report.

Table 3
Disclosure of Conception by Family Type Before and After Age 7

	Disclosure of conception	
Family type	Before age 7	After age 7
Surrogacy	21	1
Egg donation	8	7
Donor insemination	8	3

all surrogacy parents had told their child by age 7, approximately half of the egg donation parents had done so (8 told vs. 7 not told), as had most donor insemination parents (8 told vs. 3 not told). However, it is important to emphasize that 15 of the 17 sets of parents who had not disclosed by age 20 were donor insemination parents.

Excluding those who had not disclosed by age 20, mothers who had disclosed by age 7 showed significantly higher levels of well-being compared to those who had not disclosed by age 7, including reduced anxiety, Cohen's $d = 0.58$, and depression, Cohen's $d = 0.52$, but there was no difference in couple relationship quality, Cohen's $d = 0.11$. Moreover, mothers who had told their child about their conception by age 7 showed significantly lower levels of negative parenting at age 20 than parents who had not disclosed by age 7, Cohen's $d = 0.83$. There were no significant differences on the other measures of family relationships at age 20 according to whether the parents had disclosed this information to their child by age 7, specifically, positive parenting, Cohen's $d = 0.02$, and mothers' reports of parental acceptance, Cohen's $d = 0.38$, the Index of Family Relationships, Cohen's $d = 0.34$, and the communication scale of the Family Assessment Measure, Cohen's $d = 0.40$. However, the less positive mothers' scores on the measures of parental acceptance, quality of family relationships, and family communication for families in which parents had not disclosed by age 7 reflected modest effects. Although there were no significant differences for the young adults' questionnaires between those told before and after age 7, the effect sizes indicated more negative outcomes for those told after age 7 for parental acceptance, Cohen's $d = 0.21$, the Index of Family Relationships, Cohen's $d = 0.77$, and the communication scale of the Family Assessment Measure, Cohen's $d = 0.43$.

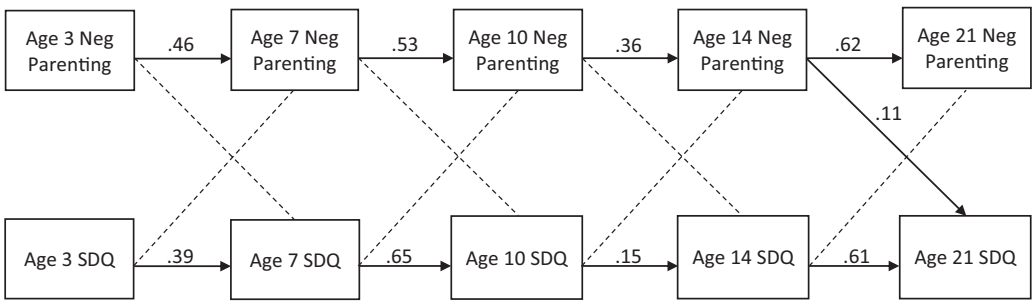
In terms of psychological adjustment, mothers' SDQ scores for young adults who had been told about their biological origins by age 7 did not differ significantly from those for young adults who had been told after age 7, Cohen's $d = 0.18$, and disclosure by age 7 was not significantly associated with the severity of psychiatric disorder as rated by a child psychiatrist, Cramer's $V = .16$, but was associated with the type of psychiatric disorder as rated by a child psychiatrist, Cramer's $V = .34$, with those told after age 7 more likely to have a developmental disorder. With respect to the young adults' questionnaires, there were no significant differences between those told before and after age 7 for the SDQ or the Flourishing Scale. However, for those told after age 7, the more negative SDQ scores reflected a moderate effect, Cohen's $d = 0.46$, and the lower levels of flourishing reflected a small effect, Cohen's $d = 0.21$.

Longitudinal Predictors of Young Adult Adjustment

After establishing partial longitudinal scalar invariance of the negative parenting latent factor over time, an autoregressive cross-lagged model was tested, which regressed later child adjustment and negative parenting scores onto prior scores to examine stability and reciprocal influences between constructs over time. The model controlled for child gender and age. This model provided a good fit to the data, RMSEA = .084, 90% CI [.045, .111], CFI = .948, TLI = .913. As illustrated in Figure 1, there was rank-order stability in negative parenting and child adjustment difficulties over time. The cross-lagged paths indicated an asymmetric developmental link as age 14 negative parenting was associated with young adult adjustment difficulties at age 20, but not vice versa, which suggested that negative parenting at adolescence was a causative factor in the adjustment difficulties shown by the young adults.

Next, a multiple-group procedure was adopted to test whether the auto-regressive and cross-lagged associations between negative parenting and child adjustment differed by family type (assisted reproduction vs. unassisted conception). There was a significant reduction in model fit when all paths were constrained to be equal across family type, $\Delta\chi^2(16) = 36.66$, $p = .002$, suggesting a pathway(s) in the model differed in magnitude by group. Inspection of the modification indices suggested freeing the equality constraint between the autoregressive path between age 20 and age 14 SDQ. Allowing

Figure 1
Simplified Path Diagram Illustrating Standardized Robust Maximum Likelihood Estimates



Note. Neg Parenting = negative parenting latent factor scores; SDQ = Strengths and Difficulties Questionnaire.

this pathway to vary led to a significant improvement in model fit, $\Delta\chi^2(15) = 17.36$, $p = .298$. These results suggest that the magnitude of the association differed for the stability of young adult adjustment between ages 14 and 20 years old. That is, for young adults from unassisted conception families, there was stability in adjustment difficulties between Phases 6 and 7 of the study, Unstd Est = 1.00, $SE = .17$, $p < .001$, but this was not the case for young adults from families who used assisted reproduction, Unstd Est = 0.15, $SE = .14$, $p = .302$. However, there were no other differences by family type suggesting that the stability in negative parenting over time, and the association between negative parenting at age 14 and adjustment difficulties at age 20, did not differ according to family type.

Subsequently, a similar autoregressive cross-lagged model was tested for positive parenting and child adjustment. The model controlled for child gender and age. This model provided a good fit to the data, RMSEA = .087, 90% CI [.053, .120], CFI = .946, TLI = .915. As illustrated in Figure 2, there was rank-order stability in positive parenting and child adjustment difficulties over time. The cross-lagged paths indicated an asymmetric developmental link as age 7 child adjustment difficulties were associated with reduced positive parenting at age 10, but not vice versa, indicating that children's adjustment difficulties at age 7 resulted in less positive parenting when the children were 10 years old. Multiple-group procedure was used to test whether the auto-regressive positive parenting pathways and cross-lagged associations between positive parenting and child adjustment, differed by family type (assisted reproduction vs. unassisted conception). Aside from the difference between age 14 and 20 adjustment difficulties, there were no other differences by family type, indicating that the stability in positive parenting over time, and the cross-lagged associations, did not differ according to family type.

Discussion

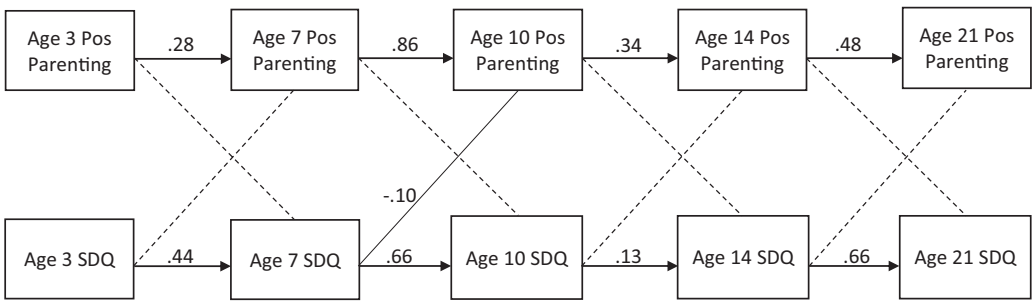
When the first phase of the present study was initiated, there was concern that the absence of a biological connection between children and their parents would have an adverse effect on the functioning of families formed through third-party assisted reproduction. However, previous phases of this study, from infancy to adolescence, generally found positive parent–child relationships and high levels of child adjustment in such families (Golombok, 2021). Contrary to the hypothesis that assisted reproduction families would show greater difficulties when the children reached adulthood, especially those created by egg and sperm donation, the results of the present phase of the study, when the children reached age 20, were consistent with the earlier findings. Specifically, there were no differences between families formed by egg donation, sperm donation, surrogacy, and unassisted conception in maternal anxiety or depression, or in the quality of mothers' relationships with their partners. Neither were differences identified in positive or negative parenting, mothers' reports of their acceptance of their adult children, the quality of family relationships, or the openness of family communication.

Regarding the young adults, no differences were found in their perceptions of maternal acceptance, or in the quality of family relationships, according to family type. With respect to psychological well-being, no differences between family types were identified in psychological adjustment, as assessed either by the Strengths and Difficulties Questionnaire, completed separately by mothers and young adults, or by a child psychiatrist's ratings of mothers' interview transcripts, or in flourishing. Overall, the young adults showed high levels of psychological adjustment in terms of mothers' SDQ scores, and comparable levels of psychological adjustment to general population norms for young people aged 17–23 years (Newlove-Delgado et al., 2021).

The similarly positive outcomes for families formed through egg donation, sperm donation, surrogacy, and unassisted conception suggest that the absence of a biological connection between children and their parents does not have a negative effect on the quality of mother–child relationships, or on the psychological adjustment of children, even when they have acquired an adult understanding of what it means to lack a genetic and/or gestational connection to their parents. Thus, the concerns that have been raised about the negative psychological consequences of third-party assisted reproduction were not borne out by the findings of this study when the children reached adulthood. Although in other family types in which children lack a biological connection to their parents—adoptive families and stepfamilies—raised levels of difficulties in parent–child relationships and child adjustment problems have been identified, families created through third-party assisted reproduction are not exposed to the same risk factors. Instead, children born through assisted reproduction are raised from the start by parents who see

Figure 2

Simplified Path Diagram Illustrating Standardized Robust Maximum Likelihood Estimates



Note. Pos Parenting = positive parenting latent factor scores; SDQ = Strengths and Difficulties Questionnaire.

them as their own children, and who went to great lengths to have them, often experiencing years of infertility, and failed fertility treatment, beforehand.

An exception to the lack of differences in family functioning involved the families created through gamete donation. Mothers in families formed by egg donation reported less positive family relationships on the Index of Family Relationships than mothers in families formed through sperm donation. Although it is important to bear in mind the small sample sizes for this comparison and, consequently, the reduced statistical power, it is noteworthy that this replicated the finding from the previous phase of the study on the same measure when the children were adolescents, which was attributed to the absence of a genetic link between mothers and their children presenting greater difficulties for mother–child relationships than the absence of a genetic link between fathers and their children (Golombok et al., 2017). It is perhaps not surprising that the egg donation mothers, who lacked a genetic connection to their children, obtained higher scores on this measure than the sperm donation mothers, who did not. In the recent study of mothers of children born using an identifiable egg donor, some mothers reported anxiety during pregnancy about whether they would bond with their baby (Imrie et al., 2020), and when the children reached age five, some perceived their child's ability to access the donor's identity as a direct threat to their relationship with their child, and to their identity as their child's mother (Lysons et al., 2022). Egg donation mothers' ratings of less positive family relationships are notable given the absence of separated or divorced egg donation mothers in the present phase of the study, perhaps reflecting a tendency for mothers who do not have a genetic tie to their children to remain with their children's father even when experiencing an unsatisfactory marriage. Interestingly, the corresponding difference between adolescents conceived by egg and sperm donation in the previous phase of the study on the Index of Family Relations (Golombok et al., 2017) was not replicated at age 20. Thus, it was only the mothers of genetically unrelated adult children who were more negative about their family relationships, and not the adult children themselves, possibly reflecting mothers' perceptions of poorer family functioning arising from their own insecurities as mothers.

A further exception to the absence of differences between family types was that the young adults conceived by sperm donation reported poorer family communication than those conceived by egg donation. Although the sample sizes for this comparison were again small, this finding is in line with parents' greater secrecy about sperm donation than egg donation, which is sometimes driven by the greater reluctance of fathers than mothers to disclose to their child that they are not their genetic parent (Cook et al., 1995; Readings et al., 2011), and their greater reluctance to talk about it once they have disclosed (Blake et al., 2010; Readings et al., 2011).

The finding that young adults who learned about the circumstances of their birth before age 7—with almost all having been told by age 4 (Ilioi et al., 2017)—had less negative relationships with their mothers at age 20 than those told after age 7, is again consistent with previous phases of the study (Golombok, 2021), and it adds further weight to the conclusion that the earlier children born through third-party assisted reproduction are told about their biological origins, the better the outcomes in terms of the quality of mother–child relationships. The present phase suggests that the beneficial effects of early disclosure are apparent up to age 20. Moreover, in families where parents had disclosed their biological origins to their child by age 7, mothers showed lower levels of anxiety and depression, and, although not statistically significant, there were modest effects for mothers' ratings of parental acceptance, the Index of Family Relationships, and the communication scale of the Family Assessment Measure (Cohen, 1992), reflecting more positive relationships in families where parents had disclosed before age 7. The young adults' questionnaires reflected a similar trend toward more positive outcomes for those told before age 7. Although not statistically significant, there was a large effect for the Index of Family Relationships, moderate effects for communication and the SDQ, and small effects for parental acceptance and flourishing. These findings are all in the same direction, and correspond with studies of adoption, which have found that openness at an early age is associated with more positive outcomes for parent–child relationships in adoptive families (Brodzinsky, 2011; Grotevant & Von Korff, 2011).

A possible explanation for the association between early disclosure and less negative mother–child relationships may be found in research on children's understanding of biological inheritance, which shows that it is not until around age 7 years that children begin to develop a biological concept of family (Richards, 2000; Williams & Smith, 2010) and understand the role of genetic mechanisms (Gregg et al., 1996; Williams & Smith, 2010). It seems that children born through third-party assisted reproduction may be more accepting of information about their biological origins when told before age 7, that is, before they develop a more complex understanding of the meaning of the absence of a genetic and/or gestational connection to their parents. Moreover, like adoptive parents (Brodzinsky, 2011), parents of children born through third-party assisted reproduction who are open with their children about their biological origins at an early age no longer need to worry about their child's reaction to disclosure, or about keeping this information secret. Thus, telling children about their origins when they are young may be beneficial to both children and parents, which may explain the lower levels of negative parenting, higher levels of maternal psychological well-being, and the trend toward more positive parental acceptance, family relationships, and communication, in families in which parents began the disclosure process at an early age. Qualitative studies (Turner & Coyle, 2000) and surveys of adolescents and adults conceived by sperm donation (Jadva et al., 2010), have pointed to the benefits for parent–child relationships of telling children about their donor conception at an early age. In particular, it was found that some donor-conceived people who find out about the nature of their conception in adolescence or adulthood feel anger toward their parents, deceived by them, and highly distressed. The likelihood of donor-conceived people discovering their genetic origins by accident has increased in recent years through the widespread use of websites such as Ancestry.com, either when searching for genetic relatives, or when genetic relatives search for them. This is the first investigation to have reliable data on the child's age at the time of disclosure, and to examine the impact of age at disclosure on family functioning from childhood through to adult life. The findings of this study lend support to the recommendations of the Ethics Committee of the American Society for Reproductive Medicine (2018) that parents should be open with their children about the use of donor gametes in their conception.

In terms of the longitudinal analyses, both positive parenting and negative parenting remained stable over time, showing that mothers

who exhibited higher levels of warmth, sensitivity, and quality of interaction in early childhood continued to do so from middle childhood through to early adulthood, and that the same was true of mothers who showed higher levels of conflict with their children. Overall, there was an increase in positive parenting, and a decrease in negative parenting, from childhood to adulthood. In addition, there was stability in children's adjustment, such that children who showed greater emotional and behavioral difficulties in early childhood continued to do so up to early adulthood. Comparisons between the assisted and unassisted reproduction families found no differences between them in the stability and influence of positive and negative parenting, indicating that the quality of mother–child relationships from early childhood to adulthood was unrelated to the absence of genetic or gestational connections between parents and their children. Regarding the stability of child adjustment, there were no differences between children from assisted and unassisted reproduction families from early childhood to adolescence. However, children in unassisted reproduction families who showed adjustment difficulties at adolescence continued to do so in early adulthood, whereas the assisted reproduction adolescents who exhibited adjustment difficulties were not necessarily those who did so in early adulthood. It seemed from inspection of the data that this may have resulted from a small number of outliers, and from some of the young adults in assisted reproduction families showing a reduction in adjustment difficulties following adolescence. Irrespective of the reason for this discrepancy in adjustment, it is important to emphasize that the associations between positive parenting and child adjustment (with children's adjustment difficulties at age 7 associated with less positive parenting at age 10), and negative parenting and child adjustment (with negative parenting in adolescence associated with adjustment difficulties at age 20), did not differ between the assisted and unassisted reproduction families from age 3 to 20. Thus, the mothers and children in assisted reproduction families appeared to influence each other in similar ways to mothers and children in families formed through unassisted reproduction.

The main limitation of the study was the modest sample size. However, the numbers of families in the comparisons between the assisted and unassisted reproduction groups were sufficient to detect moderate effects. Although the sample sizes for the comparisons between the different types of assisted reproduction families, and between the disclosing and nondisclosing families, were smaller, they had 80% power at $\alpha = .05$ to detect large effect sizes, and the differences identified were in line with the hypotheses and replicated those of the previous phase of the study when the children were adolescents. Nevertheless, the findings should be interpreted with caution. A further limitation was that some families were lost to follow-up between age 14 and age 20. However, more than half of the mothers who did not participate at age 20 could not be traced, so only a small proportion of mothers declined to take part. Most of the families who did not remain in the study from the start dropped out in the preschool years due to their concern that participation might jeopardize their decision to keep their child's origins secret (Golombok, Readings, Blake, Casey, Mellish, et al., 2011).

This is the only study to have examined the long-term effects of different types of third-party assisted reproduction on parenting and child adjustment. The repeated, in-depth, standardized assessments at seven time-points from age 1 until age 20, with measurement invariance in positive and negative parenting demonstrated across all phases of the study and the use of a cross-lagged design, enabled the impact of third-party assisted reproduction on parenting and child adjustment to be examined from infancy to adult life. The present study replicated the findings of a previous longitudinal study by the same research team of families created through sperm donation only (Golombok et al., 1995, 2002, 2009). However, the earlier study could not examine the effects of disclosure of donor insemination as few parents had been open with their children.

From a theoretical perspective, the findings are compatible with a relational developmental systems framework (Osher et al., 2020; Overton, 2015), and contribute toward the understanding of the role of biological relatedness in parenting and child adjustment. Despite the concerns that have been expressed regarding the potentially negative consequences of third-party assisted reproduction for family functioning, and bearing in mind the constraints arising from the modest sample sizes, the findings of this study suggest that the absence of a biological connection between children and their parents does not interfere with the development of positive mother–child relationships or the psychological well-being of the children. Moreover, this conclusion appears to hold whether children lack a genetic link to their mother or their father, or a gestational connection to their mother. It seems that the absence of biological relatedness is not in itself detrimental to positive family relationships for children who are raised by their nonbiological parents from the start. Instead, in such families, it appears that the absence of a biological link matters less for children than the quality of family relationships.

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