Parental Investment in Couples who Conceived Spontaneously or with Assisted Reproductive Techniques

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Parental Investment in Couples who Conceived Spontaneously or with Assisted Reproductive Techniques

Running title: Parental Investment in the Child

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Abstract

BACKGROUND: It has been suggested that couples who conceive with Assisted Reproductive Technologies (ART) invest more in their child than couples who conceive spontaneously. This study examined how parental investment in the child varied as a function of method-of-conception, gender and other contextual variables, i.e. pre-natal depression, social support and satisfaction with the marital relationship. METHODS: 39 couples who conceived with ART and 34 couples who conceived spontaneously completed self-report questionnaires about depression, marital satisfaction and social support at their 24th pregnancy week and about parental investment in the child 4 months after the partum. Data were analysed with multilevel regression analyses. RESULTS: Results showed that method-of-conception and gender did not predict parental investment. There was a strong association between spouses on parental investment and investment was associated with couples' satisfaction with their marital relationship and the amount of support they perceived from their network. CONCLUSIONS: Investment in children depends on the marital relationship and support perceived from family members and friends and not on how the child was conceived nor on the gender of the parents.

KEYWORDS: assisted reproduction, depression, marital relationship, parental investment in the child, network support.

Introduction

About 9% of couples will experience fertility problems (Boivin et al., 2007) and many of them will use Assisted Reproductive Technologies (ART) to achieve parenthood. The latest statistics show that in western countries more than 200,000 children are conceived every year with ART (de Mouzon et al., 2009). Infertile couples are usually considered to be highly motivated to undergo infertility investigation and treatment and when these are successful there is high expectation that these couples will attach much more significance to the experience of parenthood and will be much more strongly involved in parenting (Repokari et al., 2006; van Balen, 1996) than parents who conceive spontaneously. Expectations that couples who conceive through ART are 'super moms and dads' may lead to the imposition on these parents of high parental standards while simultaneously leading to the undervaluation of their parenting difficulties and the provision of insufficient support, which in turn may have negative repercussions on parental functioning. Research shows mixed findings but his may be due to the methodological shortcomings of the studies (cf. Hammarberg et al., 2008). In order to investigate the issue of differential parental investment we used multilevel analyses to analyse whether parents who conceived through ART invested more in their child than parents with a spontaneous conception (SC) and whether parental investment in ART couples (versus SC couples) was more robust to known risk factors (i.e. parental depression, marital dissatisfaction, lack of social support) for diminished parenting investment.

Parental investment in the child

Parental investment in the child results from a desire to protect and strengthen filial ties and the formation of a parental identity. Bradley and colleagues (1997) proposed that the quality of the parents' investment in their child should manifest in the

acceptance of the child and of the parental role, which implies consistent choices on the parents' part to act in the best interest of the child, in the amount of joy or delight parents experience with the child and expressions of affection towards the child, and in sensitivity towards the child's needs and responsiveness to those needs. It is proposed that these aspects are likely to shape how parents feel as caregivers, the care-giving process in itself, and ultimately the child's developmental outcomes (Bradley et al., 1997; Greenberger et al., 1989; Whiteside-Mansell, 2001).

Parental investment in the child is said to be multiply determined and three important factors (also known to influence parenting generally) are parental well-being, the marital relationship and social support (e.g. Belsky et al., 1991; Cox et al., 2004; Parke, 2002). Past research (Bradley et al., 1997; Corwyn et al., 1999) has shown that more depressed mothers were less committed to their parental role, expressed less delight in being with their child and had a lower capability to act responsively and sensitively toward his/her needs (fathers were not analysed). Higher marital quality was associated with higher parental investment, this being especially true for men. Finally, social support was associated with higher maternal knowledge and sensitivity to the needs of the child but not with paternal knowledge and sensitivity.

These results suggest that parental investment is differently determined for mothers and fathers, however analyses were made separately for women and men and did not take into account the extent to which maternal and paternal investment in the child may be inter-correlated (Kelley et al., 1978). Despite this possible couple interdependence, it is also expected that mothers and fathers will differ in their attitudes and behaviours regarding child rearing because the biology of reproduction results in higher level of maternal investment (Geary, 2000) and because women still retain the primary responsibility for household tasks and childcare (Cowan et al., 2000).

Parental investment of parents that conceived through assisted reproduction

There are many reasons why couples who conceived via ART might invest more in their children. First, evolutionary perspectives would advance that previously infertile couples may regard their offspring as their only chance to guarantee the continuation of their unique genetic inheritance (Fox et al., 2001) and therefore invest more than couples conceiving naturally who intend and have at least two children (Berrington, 2004).

Second, the effort required to achieve conception is greater in previously infertile couples, coming as it does at the end of a long period of involuntary childlessness, infertility investigations and treatments (Colpin, 2002). Pregnancy itself also has increased obstetrical risks (Basso et al., 2003) and childbirth can be more difficult than initially anticipated by mothers (Hammarberg et al., 2008). It has been suggested that as a result previously infertile couples are more aware of the importance of parenthood and of having children (van Balen et al., 1996) and are thus more strongly involved in parenting (van Balen, 1996). These parents' perspective of the uniqueness of their children may also allow them to evaluate differently other life stressors and such experiences may therefore function like a buffer, neutralizing the negative impact of stressors on parenting experiences. For instance, Repokari et al. (2006) found that self-reported negative birth experiences predicted negative mothering and fathering among spontaneously conceiving parents but not among previously infertile parents conceiving through ART. Finally, an auto-selective mechanism may also be at work, as those couples who start and sustain in ART treatments (and are thus more likely to achieve parenthood) are expected to be more resilient than those who do not (Olivious et al., 2004; Repokari et al., 2005), therefore more likely to present positive functioning across different areas, including parenting.

There is support for and against greater investment by parents conceiving with ART. A cross cultural study with 462 families, in which a standardized interview to the mother was used to assess the quality of parenting, revealed that mothers who conceived through ART reported higher levels of emotional involvement with their child and that their partners contributed more to parenting when compared to mothers with a spontaneously conceived child (Golombok et al., 1995). In another large cross cultural study that included four European countries it was found that mothers who conceived with ICSI (but not IVF) reported fewer hostile or aggressive feelings towards the child and higher levels of commitment to parenting than mothers of naturally conceived child (Barnes et al., 2004). Other cross-sectional studies based on self-report questionnaires showed that previously infertile parents were more involved with, experienced more pleasure and reported significantly more positive feelings towards their child, compared with parents of spontaneously conceived children (van Balen, 1996; Weaver et al., 1993). However, when mother/father-infant attachment was assessed, also with self-report questionnaires, no group differences were found (Cohen et al., 2000; McMahon et al., 1997). Observation-based studies revealed that mothers who conceived through ART showed more care-taking (i.e., any action concerned with the infant's bodily needs or performed in order to calm distress) and play episodes (e.g. smiling, making exaggerated facial expressions, calling) during free play with their child (Papaligoura et al., 2001) and that fathers with a history of infertility spent more time interacting with their infant (Holditch-Davis et al., 1999), when compared with parents with a spontaneous conception. In contrast, when the mother-child interaction was assessed in a free play context and the Strange Situation procedure was conducted on a sample of dyads of mother-child conceived through ART and spontaneously, no significant group differences were found on maternal or child dimensions of interaction

during play and on the child's security of attachment (Gibson et al., 2000).

In summary, it seems clear from the literature that there is expectation that previously infertile parents might invest more in their child because of his/her difficult-to-achieve conception and thus show greater resilience in the face of typical transitional issues for new parents. Research does show mixed evidence but this may be due to methodological shortcomings such as not accounting for the dependency between maternal and paternal investment. Indeed, in a recent systematic review on the psychological and social aspects of pregnancy, childbirth and early parenting after assisted conception it was concluded that many findings were either inconclusive or contradictory and that this was probably due to the varied methods of investigation that have been employed (Hammarberg et al., 2008). Nonetheless, the authors do conclude that few differences have been found between ART and SC couples in terms of parent–infant attachment and interaction, maternal sensitivity and parental separation anxiety. No specific comments were made in relation to parental investment.

Objectives and hypotheses

In this prospective investigation we addressed methodological and conceptual issues noted in previous studies by considering both maternal and paternal reports on investment and by using multilevel modelling to examine the couple as the unit of analysis. The aims of the study were to investigate 1) differences in parental investment between parents who conceived spontaneously and with ART and between mothers and fathers; 2) associations between risk factors for diminished parental investment (i.e. parental depression, lack of marital satisfaction, lack of social support), assessed during pregnancy, and parental investment; and 3) possible moderation effects of method of conception and gender on the associations between risk factors and parental investment. It was hypothesized that couples that conceived with ART would report higher

investment in the child than couples that conceived spontaneously and that women would report higher investment than men. Higher depression, lower marital satisfaction and lower social support during pregnancy were expected to be associated with lower parental investment. Method of conception was expected to moderate the relationship between all risk factors and parental investment, associations being weaker or non significant for ART couples. Finally, the positive association between marital satisfaction and parental investment was expected to be stronger in men than in women and the positive association between social support and parental investment was expected to be stronger in women than in men.

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Materials and Methods

Design and procedures

The Ethics Committee of the University of Coimbra Hospital approved the study. Consecutive couples (ART or spontaneous conception) attending for their obstetrical consultation at the Genetics and Human Reproduction Service and at the Dr. Daniel de Matos Maternity (respectively), both in the University of Coimbra Hospitals, Portugal, were invited to participate in the study. Inclusion criteria were being married or cohabiting, more than 18 years of age, nulliparous, singleton pregnancy and literacy level sufficient to complete the assessment protocol. If participants agreed to collaborate they filled a consent form and were instructed to complete self-report questionnaires at their 24th pregnancy week (Time 1, T1) and at 4 months postpartum (Time 2, T2). For this second assessment questionnaires were sent by mail together with a preaddressed envelope and parents were instructed to post back to the research team.

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A total of 136 couples (66 who conceived through ART and 70 with a SC) agreed to be contacted about the study. For the ART group, 11 couples did not return

questionnaires, 8 couples had a multiple pregnancy and 3 had a miscarriage prior to the assessment. From the remaining 44 couples, 39 women and 35 men completed the questionnaires at T1 and T2, which corresponded to a completion rate of 59.1% for women and 53.0% for men. For the SC group, 20 couples did not return questionnaires and 33 women and 32 men completed T1 and T2 questionnaires, which corresponded to a completion rate of 47.1% for women and 41.6% for men. Women who did not return questionnaires after the partum were younger ($t(89) = -2.36$, $P = .021$) than those who did. No socio-demographic differences were found between those men who did and did not return the questionnaires at T2.

Materials

At T1 (week 24 of pregnancy), socio demographic and psychological data (depression, marital satisfaction, perceived social support) were collected. At T2 (four months post-partum) obstetrical and perinatal data were collected from the women's medical records (occurrence of obstetrical complications during pregnancy; mode of delivery; gender, gestational age and birth weight of the baby) and parental investment in the child was assessed.

Depression was assessed with the depression subscale (6 items, e.g. negative affect, lack of energy in the past two weeks) of the Brief Symptom Inventory (BSI-Depression, Derogatis, 1993). It is an averaged score that ranges from 0 to 3, with higher scores indicating the presence of more depressive symptoms. The Portuguese version of this scale presents good levels of internal consistency for the Depression subscale (.73), test-retest coefficient (.81) and construct and discriminant validity (Canavarro, 2007).

Marital satisfaction was assessed with the satisfaction subscale (10 items, e.g. "I feel happy with the way we deal with the responsibilities in our marriage") of the ENRICH marital inventory (ENRICH-Satisfaction; Olson et al., 1983). The Portuguese version of

the ENRICH inventory has been evaluated with satisfactory reliability and validity (Lourenço, 2006). The Satisfaction scale score is an averaged score that ranges from 1 to 5, with higher scores indicating higher satisfaction with the marital relationship.

Social support was assessed with the Convoy Model (Convoy – Network support,Kahn et al., 1980). First, information about the participant's social network was obtained by asking individuals to map their relations hierarchically onto a concentric circle diagram. Participants were asked to place in the innermost circle (C1) those individuals who are "so close that it's hard to imagine life without them", in the second circle (C2) "those that are not quite as close, but are still very important" and in the third circle (C3) those that are "not quite as close, but still important". After completing the Convoy diagram, participants were asked to rate perceived support regarding eight different support functions (e.g., confiding about important things, helping with household tasks) from each person included in C1 and C2 of the convoy (to a total maximum of 12 persons). The response scale ranged from 0 (minimum support) to 5 (maximum support) and the ratings for the eight support items were summed to create a support score for each member of the network. After, a network support score was calculated by averaging support scores from all the members of the network. This network support average ranged from 0 (no relations included in the convoy and/or no perceived support from included relations) to 40 (maximum perceived support).

Parental investment in the child was assessed with the Portuguese version of the Parental Investment in the Child scale (Bradley et al., 1997) that comprises 19 items designed to assess parents' socio-emotional investment in their children (e.g. "Raising a child is so demanding, ...", "Holding and cuddling my child is more fun than most other things I do"), rated on 4-point response scale. The PIC comprises three different subscales and one summed score was calculated for each with higher scores reflecting

higher investment in the child. The subscales are acceptance of parental role (PIC-Acceptance, 6 items, range of 6 to 24), delight (PIC-Delight, 7 items, range of 6 to 32) and knowledge and sensitivity (PIC-Knowledge/Sensitivity, 6 items, range of 6 to 24). Cronbach alpha coefficients for these scales ranged between .70 and .72. The construct validity of the PIC was validated against ratings obtained with other self-report questionnaires and observational methods of parental investment (i.e. the HOME Inventory; Caldwell et al., 1984) and, in general, the different subscales of the PIC correlated in meaningful ways with these different measures (Bradley et al., 1997). The Portuguese version of the scale revealed moderate to good indices of internal consistency for its subscales, good test-retest reliability and internal consistency (Gameiro et al., 2008).

In the present sample Cronbach alpha coefficients for all questionnaires and scales were higher than .70 for both men and women. The exception concerned the PIC scale, for which Cronbach alpha coefficients were between .61 and .75 for women and from .66 to .77 for men. Although some of these coefficients were only moderate, they were in line with results from the validation of the Portuguese version of the scale and previous studies conducted with the PIC scale (e.g. Corwyn et al., 1999).

Statistical Analyses

MLwiN (Rasbash et al., 2004) was used to analyse the data with multilevel regression analysis with couples as the unit of measurement. This analytic approach was chosen because it captures the dependence of the mother and father outcome data (in this study correlations were between .329, $P < .01$ and .592, $P < .01$). A total of three regression models were tested concerning the three dependent variables of parental investment in the child (i.e. PIC-Acceptance, PIC-Delight and PIC-Knowledge/Sensitivity). A two-level hierarchical structure was considered for the data,

with individuals (mother and fathers; level one) nested within couples (level two). As recommended by Kenny, Kashi and Cook (2006), the models were constrained to be equal across all dyads, i.e. they included only fixed effects. The purpose of hierarchical linear modelling is similar to traditional hierarchical regression analysis, but the variance is decomposed at the different levels. As such, preliminary univariate analyses were made to test for significant associations between socio-demographic and child related variables (i.e. parental age, years in current relationship, gender of the baby and the occurrence of complications during pregnancy), our predictor variables and the three dimensions of parental investment in the child. After, each of the three models was developed starting from a null single level model. A null two level model was then implemented, its adequacy tested and intra-class correlations calculated in order to estimate the proportion of variance found at each level (couple, individual). In the second analytical step all main effects were added to the multilevel regression model (*main effects model*) and in the third step interaction effects that corresponded to the hypotheses were also considered (*main and interaction effects model*). In the last analytical step, a final model was tested in which only the significant predictors identified in the univariate and multivariate analyses (significance level of $P < .01$) were retained (*final model*). This allows for a more precise calculation of the amount of variance explained by significant predictors (cf. Table II). Model significance was ascertained using χ^2 statistics and the significance of the regression weight for each independent variable was tested by *t*-tests.

Methods for assessing statistical power in multilevel modelling analyses are still being developed. Kreft and deLeeuw (1998), however, suggest that multilevel modelling power calculations are similar to multiple regression. Therefore, Cohen's (1992) estimates were used to assess the statistical power of the models. Post hoc power

calculations demonstrated that in testing the *saturated model* the achieved sample size allowed for the detection of medium to large effects (number of predictors = 11, effect size = .28, P < .05, power = .80, G * Power, Faul et al., 2007). The *main effects model* and the *final model* were expected to have higher power because they would have fewer parameters.

Results

Participants

The final sample consisted of 39 women and 35 men (39 couples) who conceived through ART (in vitro fertilization, IVF, and intracytoplasmic sperm injection, ICSI, using the couples' own gamete) and 33 women and 32 men (representing 34 couples) who conceived spontaneously. Table I presents sample socio-demographic, clinic and obstetrical and perinatal characteristics. Women and men who conceived with ART were older than women and men who conceived spontaneously and were with their partner for a longer time. There was a higher probability for the occurrence of problems during pregnancies achieved by ART and the frequency of male babies conceived spontaneously was significantly higher than that of male babies conceive by ART.

Table II presents mean scores of BSI-Depression, ENRICH-Satisfaction, Convoy-Network support, PIC-Acceptance, PIC-Delight and PIC-Knowledge/Sensitivity for women and men. Scores show that during pregnancy parents experienced low depression levels, high marital satisfaction and medium support from their family and friends. Scores also show a medium to high investment in the child four months after the birth.

Testing the Adequacy of a Two-Level Model

For the three dependent variables (PIC-Acceptance, PIC-Delight and PIC-Knowledge/Sensitivity) the total of variance was divided into two parts, referring to the

individual and couple levels. Table III indicates the proportion of estimated and explained variance at the individual and couple level for the *final model*. The estimated variance is the amount of variance (of each dependent variable) that occurs at each level (individual versus couple). The explained variance is the amount of variance (of each dependent variable) that is explained by predictor variables included in the model at each level.

For the three dependent variables considered it was observed that the two-level (individual, couple) models significantly decreased the badness of fit (PIC-Acceptance: *decrease in badness of fit* = 14.342; $P < .001$, PIC-Delight: *decrease in badness of fit* = 7.302; $P < 0.01$, PIC-Knowledge/Sensitivity: *decreased in badness of fit* = 28.168; $P < .001$) in relation to the single-level models (individual level only), thus indicating that the two-level models were a better fit to the data.

Predictors of parental investment in the child

Table IV presents the two-level fixed effects models developed concerning the three dimensions of parental investment in the child with predictor summary statistics. The design of the multivariate analysis is very similar to a multiple regression with one dependent variable and a set of predictor or independent variables, providing unstandardized estimates (β values) and standard errors (SEs) for each predictor.

Preliminary analyses made to investigate the necessity for controlling for socio-demographic and child related variables showed that the parents' age was statistically associated with PIC-Delight. We chose to present the PIC-Delight models without including age because we would be removing an essential feature of what means to be a parent conceiving with ART (i.e., association between age and fertility). However, we also tested these models controlling for age and the significant predictors found remained the same (data not shown).

Acceptance of parental role. The results of univariate analyses show that ENRICH-Satisfaction (β = 1.202, *SE* = 0.437, *P* < .01) was positively associated PIC-Acceptance, and BDI-depression (β = -0.581, *SE* = 0.330, *P* < .10) was negatively associated with it. Results from multivariate analyses show that ENRICH-Satisfaction was the only predictor of PIC-Acceptance in both the main effects model (*P* < .05) and in the final model (*P* < .05), explaining 13% of its total variance at the couple level. No significant interactions were found.

Delight. The results of univariate analyses show that ENRICH-Satisfaction (β = 1.352, *SE* = 0.584, *P* < .05) and Convoy-Network support (β = 0.085, *SE* = 0.042, *P* < .05) were positively associated with PIC-Delight. In the main effects model, Convoy-Network support (*P* < .10) was the only predictor of PIC-Delight, but in the final model ENRICH-Satisfaction also proved to be a significant predictor of PIC-Delight (*P* < .05) and together, these predictors explained 9% of its total variance at the couple level and 1% at the individual level. No significant interactions were found.

Knowledge and Sensitivity. The results of univariate analyses show that ENRICH-Satisfaction (β = 0.837, *SE* = 0.449, *P* < .10) was positively associated with PIC-Knowledge/Sensitivity. The main effects model did not reveal any significant predictors, however, when interactions were investigated, it was observed that only Convoy-Network support predicted PIC-Knowledge/Sensitivity (in both this, *P* < .05, and the final model, *P* < .10), being positively associated with it. An interaction effect between method of conception and ENRICH-Satisfaction was also found (*P* < .10). Simple slope analyses conducted in the final model showed that, while for couples that conceived spontaneously no association was found between ENRICH-Satisfaction and PIC-Knowledge/Sensitivity (β = -0.095, *SE* = 0.678, *P* = .888), for couples that conceived through ART higher ENRICH-Satisfaction was associated with higher PIC-

Knowledge/Sensitivity (β = 1.496, *SE* = 0.604, *P* = .013). Together these effects only explained 3% of the total variance of PIC-Delight at the individual level.

Discussion

This prospective study shows that previously infertile parents do not invest more in parenting and are not more robust to threats that could compromise parental investment. These findings are consistent across the three dimensions of parental investment in the child and represent genuine new knowledge in the field. In fact there was even some indication that ART parents might be less sensitive to child needs when in a less satisfying marriage. Pervasive beliefs and expectations of ART parents being 'super parents' are therefore unwarranted, and may lead to poorer outcomes for parents if it gives the impression these couples need less support during the transition to parenthood. For parents in this sample greater acceptance of the parenting role, delight in their children and sensitivity to their child's needs was dependent on the quality of the marital relationship and support from family and friends during pregnancy and not on how the child was conceived. In this respect ART parents are just like those who conceive spontaneously.

The finding that previously infertile couples did not invest more in their child than spontaneously conceiving couples is counterintuitive in light of previous work drawing on infertile couples' strong desire and investment in achieving parenthood (Golombok et al., 1996; van Balen, 1996). One possible explanation relates to the infant contribution to the parent-child relationship. Infants' difficult behaviour has been shown to be negatively associated with maternal investment (Bradley et al., 1997) and a previous study that compared couples using ART to couples that conceived spontaneously showed that child temperament ('soothability' in particular) was associated with parents' acceptance and attachment to the child (Repokari et al., 2006).

Prospective controlled observational studies have shown that infants conceived with ART have higher prevalence of difficult behaviours than spontaneously conceived infants (e.g. Cohen et al., 2000; McMahon et al., 1997) and this may, at least partially, explain why ART parents did not report higher investment despite greater effort in conceiving.

The lack of a gender difference in prediction of parental investment suggests that men and women seem to dedicate themselves equally to the wellbeing of their child, regardless of how the conception was achieved. Given the lack of studies examining parental investment that use the couple as the unit of analysis, it is difficult to compare current findings with those of previous research. It may be possible that by accounting for the dependency between the investment mothers and fathers make in their child gender differences were attenuated. This is consistent with both the theorization that ignoring dyadic interdependence increases the probability of the occurrence of type 1 errors, i.e. of considering non-significant associations to be significant (Kenny et al., 2006), and with the fact that a large interdependence between both members of the couple in their investment in their child was observed concerning all dimensions of parental investment (see estimated variance values on Table II). On a day-to-day basis many of couples' marital interactions occur while caretaking tasks are being discussed and implemented and therefore feelings emanating from interactions between spouses are likely to affect the way the couple, as a unit, relate to the child, which is also consistent with our finding of a strong effect of marriage on parental investment and with the broader literature on parenting (cf. Belsky et al., 2006).

Previous studies that focused on the determinants of maternal and paternal investment have concluded that these are differently determined (Bradley, 1998; Bradley et al., 1997; Corwyn et al., 1999). However, our results suggest a more

complex scenario in which predictor variables may have a different value in explaining individual versus couple investment, that is, some factors (e.g., support from family and friends) may only affect the investment of one member of the couple while others shared by both members of the couple (e.g., the marital relationship) may affect investment of both members simultaneously.

Knowledge and sensitivity to child needs was dependent on marital satisfaction during pregnancy in the ART group, but not in couples with a spontaneous conception as has been reported previously (Corwyn et al., 1999). Despite its statistical significance, this finding should not be emphasized due to several reasons. First, it only accounted for 3% of the variance in knowledge and sensitivity; second, knowledge and sensitivity proved to be the less reliable dimension of the PIC (i.e. only presented moderate alpha values, more specifically .61 for women and .69 for men); and finally, research has shown that the marital relationship of ART couples is at least as good as or better than the one of couples who conceived spontaneously (cf. Hammarberg et al., 2008).

This was a prospective study with typical parents experiencing a spontaneous or ART pregnancy. The sample size in combination with prospective design ensured sufficient power to detect medium to large effect sizes. The measures were reliable and valid measures of their construct and except for a few cases were obtained from both mothers and fathers. The parental risk factors were measured in advance (during pregnancy) of the assessment of parental investment (4 months postpartum). The use of multilevel regression increased the precision of the standard errors, therefore also of the calculation of significance tests, and results from univariate and multivariate analyses showed overall convergence. Finally, the use of multilevel regression analysis also allowed for a precise calculation of the total variance of parental investment explained

at the individual and couple level, which was a novel way of addressing the issue of parental investment. There were limitations and these consisted on some impacts of attrition (younger women less likely to complete postpartuum questionnaires) and use of a single study site in Portugal. While the sound methodological approach of this prospective study warrants confidence in the associations reported replication in other populations is required. Future research should also aim at investigating socio-emotional investment in children or other related dimensions of parental care and behaviour adopting a dyadic, but considering a more in-depth assessment of these constructs, based on interview techniques or observational assessment methodologies.

To conclude, results from this study do not support the view of ART couples as 'super parents' that are invulnerable to unfavourable circumstances or that they would need or benefit less from (professional and/or informal) support than other parents. If future research confirms that parental investment in the child is, to a considerable degree, a parent shared feature, then more attention should be paid to the interactions that occur between the spouses in their discussion and performance of the parental role and, further, preventive and/or intervention strategies directed at the promotion of adequate parental care should be directed at the couple as a unit. The fact that the marital relationship had a central role in explaining parental investment in the child strengthens this proposal, which is equally valid for couples conceiving with ART and spontaneously. Overall parents in this study (both mothers and fathers that conceive spontaneously or through ART) behaved alike in that their investment and commitment to parenthood and their child's wellbeing depended on whether their marriage was satisfying and whether they had friends and family who supported them, more than on how they achieved the birth.

Author's roles

S.G., M.C.C., M.M-R., I.S. and T.A.S. made substantial contributions to the conception and design of this study. S.G. was involved in the acquisition of data. S.G. and J.B. were involved in the analysis and interpretation of data. All authors were involved in drafting/revising and giving final approval of this paper.

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Table I

Mean (SD) or frequencies (%) for sample socio-demographic, clinic and obstetrical and perinatal characteristics (N=73 couples)

	SC (n = 34 couples)				ART (n = 39 couples)			
	Women n=33		Men n=32		Women n=39		Men n=35	
Socio-demographic								
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age [a]	26.55	4.671	28.91	4.645	33.56	3.119	35.11	3.802
Years in current relationship [a]	2.99	1.543	2.96	1.557	7.62	2.650	7.71	2.198
	n	%	n	%	n	%	n	%
Education								
Primary	5	15.2	5	16.1	3	7.7	5	14.3
Secondary Junior	4	12.1	11	35.5	6	15.4	5	14.3
Secondary Senior	11	33.3	9	29.0	9	23.1	16	45.7
University	13	39.4	6	19.4	21	53.8	9	25.7
Socioeconomic status								
Medium low	15	45.5	16	51.6	11	28.2	10	28.6
Medium	10	30.3	7	22.6	12	30.8	10	28.6
Medium high	8	24.2	8	25.8	16	41.0	15	42.9
Employment status (four months postpartum) - Working	10	31.2			9	25.7		
Clinic								
					Mean	SD		
Duration of infertility					5.45	2.88		
Number of previous unsuccessful treatments					1.19	1.09		
					n	%		
Cause of infertility								
Female					13	35.1		
Male					9	24.3		
Mixed					10	27.0		
Idiopathic					5	13.5		
Obstetrical and perinatal								
	n	%			n	%		
Baby gender - Male [b]	23	69.7			18	53.8		
Problems in pregnancy [c]	5	15.2			12	31.6		
Mode of delivery								
Vaginal delivery	20	60.6			22	57.9		
Caesarean section	6	18.2			3	7.9		
Urgent caesarean section	7	21.2			13	34.2		
	Mean	SD			Mean	SD		
Gestational age (weeks)	38.58	1.20			38.41	1.57		
Birth weight (grams)	3248.03	470.98			3139.48	372.95		

Note: ART : Assisted Reproductive Technologies, SC : Spontaneous conception, SD = standard deviation

[a] Significant group differences for both women and men ($P < .001$)

[b] Significant group differences ($P < .05$)

[c] Significant group differences ($P < .10$)

Table II

Mean and standard deviation of study variables for women and men (N=73 couples)

	SC (n = 34 couples)				ART (n = 39 couples)			
	Women n=33		Men n=32		Women n=39		Men n=35	
	M	SD	M	SD	M	SD	M	SD
Predictor variables (pregnancy)								
BSI-Depression	0.64	0.56	0.36	0.45	0.56	0.59	0.40	0.56
ENRICH-Satisfaction	4.18	0.39	4.13	0.51	4.08	0.555	4.14	0.44
Convoy-Network support	22.22	6.76	22.05	4.90	21.06	6.73	21.49	6.74
Parental Investment in the child (postpartum)								
PIC-Acceptance	18.36	2.00	18.24	2.06	17.74	2.44	18.31	2.77
PIC-Delight	22.36	2.55	22.21	2.47	21.85	3.48	21.26	3.57
PIC-Knowledge/Sensitivity	14.94	1.95	14.48	2.06	15.38	2.77	15.34	2.68

Note: *M* = mean, *SD* = standard deviation, ART = Assisted Reproductive Technologies, SC = spontaneous conception

Table III

Estimated and explained variance at the individual and couple level

	PIC-Acceptance		PIC-Delight		PIC-Knowledge/Sensitivity	
	Estimated Variance	Explained Variance	Estimated Variance	Explained Variance	Estimated Variance	Explained Variance
Level						
Couple	.45	.13	.33	.09	.59	.00
Individual	.55	.00	.67	.01	.41	.03
Total explained variance		.13		.10		.03

Table III

Predictors of Parental Investment in the Child in Multivariate Analyses (N=73 couples)

	PIC – Acceptance of parental role						PIC - Delight						PIC – Knowledge/Sensitivity					
	Main effects Model		Main & interaction effects Model		Final Model		Main effects Model		Main & interaction effects Model		Final Model		Main effects Model		Main & interaction effects Model		Final Model	
Predictors	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*
Constant	18.180***		18.179***		18.180***		22.454***		22.411***		21.953***		14.846 ***		14.844***		14.742***	
Couple level																		
Method of conception (MoC) [a]	-0.279	0.440	-0.279	0.437			-0.649	0.570	-0.627	0.556			0.705	0.511	0.712	0.513	0.717	0.509
Individual level																		
Gender [b]	0.243	0.322	0.255	0.323			-0.333	0.452	-0.276	0.452			-0.252	0.280	-0.257	0.267		
BSI-Depression	-0.281	0.359	0.043	0.539	-0.338	0.342	-0.519	0.489	0.342	0.727			-0.082	0.340	0.495	0.495		
ENRICH-Satisfaction	**1.100**	**0.458 ***	1.037	0.846	**1.087**	**0.451 ***	0.996	0.608	1.174	1.122	**1.237**	**0.576 ***	0.752	0.480	-0.403	0.836	-0.095	.0678
Convoy-Network support	0.020	0.030	0.018	0.050			**0.070**	**0.041 †**	0.099	0.067	**0.076**	**0.041 †**	0.045	0.030	**0.102**	**0.045 ***	**0.048**	**0.029 †**
Gender x ENRICH-Satisfaction			0.015	0.731					-0.654	1.014					0.367	0.625		
Gender x Convoy-Network support			-0.037	0.056					-0.070	0.077					-0.022	0.049		
MoC x BSI-Depression			-0.548	0.719					-1.497	0.970					-0.828	0.660		
MoC x ENRICH-Satisfaction			0.037	0.976					0.073	1.272					**1.695**	**1.021 †**	**1.591**	**0.906 †**
MoC x Convoy-Network support			0.031	0.062					-0.006	0.083					-0.066	0.058		
Decrease in badness of fit	36.022***		37.510***		30.264***		40.572***		44.749***		38.065***		27.955***		34.954***		30.179***	

Note: *SE* = standard error

[a] 0 = spontaneous conception, 1 = Assisted Reproductive Technologies, [b] 0 = Female, 1 = Male

† $P \leq .10$, * $P \leq .05$, ** $P \leq .01$, *** $P \leq .001$

Table I

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	Women n=33		Men n=32		Women n=39		Men n=35	
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	Mean	SD	Mean	SD	Mean	SD	Mean	SD
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Years in current relationship [a]	2.99	1.543	2.96	1.557	7.62	2.650	7.71	2.198
	n	%	n	%	n	%	n	%
Education								
Primary	5	15.2	5	16.1	3	7.7	5	14.3
Secondary Junior	4	12.1	11	35.5	6	15.4	5	14.3
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Socioeconomic status								
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Mixed					10	27.0		
Idiopathic					5	13.5		
Obstetrical and perinatal								
	n	%			n	%		
Baby gender - Male [b]	23	69.7			18	53.8		
Problems in pregnancy [c]	5	15.2			12	31.6		
Mode of delivery								
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Urgent caesarean section	7	21.2			13	34.2		
	Mean	SD			Mean	SD		
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Birth weight (grams)	3248.03	470.98			3139.48	372.95		

Note: ART : Assisted Reproductive Technologies, SC : Spontaneous conception, SD = standard deviation

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	Women n=33		Men n=32		Women n=39		Men n=35	
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	PIC-Acceptance		PIC-Delight		PIC-Knowledge/Sensitivity	
	Estimated Variance	Explained Variance	Estimated Variance	Explained Variance	Estimated Variance	Explained Variance
Level						
Couple	.45	.13	.33	.09	.59	.00
Individual	.55	.00	.67	.01	.41	.03
Total explained variance		.13		.10		.03

Table IV

Predictors of Parental Investment in the Child in Multivariate Analyses (N=73 couples)

Predictors	PIC – Acceptance of parental role						PIC - Delight						PIC – Knowledge/Sensitivity					
	Main effects Model		Main & interaction effects Model		Final Model		Main effects Model		Main & interaction effects Model		Final Model		Main effects Model		Main & interaction effects Model		Final Model	
	β	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*
Constant	18.180***		18.179***		18.180***		22.454***		22.411***		21.953***		14.846 ***		14.844***		14.742***	
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Gender x ENRICH-Satisfaction			0.015	0.731					-0.654	1.014					0.367	0.625		
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MoC x Convoy-Network support			0.031	0.062					-0.006	0.083					-0.066	0.058		
Decrease in badness of fit	36.022***		37.510***		30.264***		40.572***		44.749***		38.065***		27.955***		34.954***		30.179***	

Note: *SE* = standard error

[a] 0 = spontaneous conception, 1 = Assisted Reproductive Technologies, [b] 0 = Female, 1 = Male

† $P \leq .10$, * $P \leq .05$, ** $P \leq .01$, *** $P \leq .001$

Parental Investment in Couples who Conceived Spontaneously or with Assisted Reproductive Techniques

Running title: Parental Investment in the Child

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Abstract

BACKGROUND: It has been suggested that couples who conceive with Assisted Reproductive Technologies (ART) invest more in their child than couples who conceive spontaneously. This study examined how parental investment in the child varied as a function of method-of-conception, gender and other contextual variables, i.e. pre-natal depression, social support and satisfaction with the marital relationship. METHODS: 39 couples who conceived with ART and 34 couples who conceived spontaneously completed self-report questionnaires about depression, marital satisfaction and social support at their 24th pregnancy week and about parental investment in the child 4 months after the partum. Data were analysed with multilevel regression analyses. RESULTS: Results showed that method-of-conception and gender did not predict parental investment. There was a strong association between spouses on parental investment and investment was associated with couples' satisfaction with their marital relationship and the amount of support they perceived from their network. CONCLUSIONS: Investment in children depends on the marital relationship and support perceived from family members and friends and not on how the child was conceived nor on the gender of the parents.

KEYWORDS: assisted reproduction, depression, marital relationship, parental investment in the child, network support.

Introduction

About 9% of couples will experience fertility problems (Boivin et al., 2007) and many of them will use Assisted Reproductive Technologies (ART) to achieve parenthood. The latest statistics show that in western countries more than 200,000 children are conceived every year with ART (de Mouzon et al., 2009). Infertile couples are usually considered to be highly motivated to undergo infertility investigation and treatment and when these are successful there is high expectation that these couples will attach much more significance to the experience of parenthood and will be much more strongly involved in parenting (Repokari et al., 2006; van Balen, 1996) than parents who conceive spontaneously. Expectations that couples who conceive through ART are 'super moms and dads' may lead to the imposition on these parents of high parental standards while simultaneously leading to the undervaluation of their parenting difficulties and the provision of insufficient support, which in turn may have negative repercussions on parental functioning. Research shows mixed findings but his may be due to the methodological shortcomings of the studies (cf. Hammarberg et al., 2008). In order to investigate the issue of differential parental investment we used multilevel analyses to analyse whether parents who conceived through ART invested more in their child than parents with a spontaneous conception (SC) and whether parental investment in ART couples (versus SC couples) was more robust to known risk factors (i.e. parental depression, marital dissatisfaction, lack of social support) for diminished parenting investment.

Parental investment in the child

Parental investment in the child results from a desire to protect and strengthen filial ties and the formation of a parental identity. Bradley and colleagues (1997) proposed that the quality of the parents' investment in their child should manifest in the

acceptance of the child and of the parental role, which implies consistent choices on the parents' part to act in the best interest of the child, in the amount of joy or delight parents experience with the child and expressions of affection towards the child, and in sensitivity towards the child's needs and responsiveness to those needs. It is proposed that these aspects are likely to shape how parents feel as caregivers, the care-giving process in itself, and ultimately the child's developmental outcomes (Bradley et al., 1997; Greenberger et al., 1989; Whiteside-Mansell, 2001).

Parental investment in the child is said to be multiply determined and three important factors (also known to influence parenting generally) are parental well-being, the marital relationship and social support (e.g. Belsky et al., 1991; Cox et al., 2004; Parke, 2002). Past research (Bradley et al., 1997; Corwyn et al., 1999) has shown that more depressed mothers were less committed to their parental role, expressed less delight in being with their child and had a lower capability to act responsively and sensitively toward his/her needs (fathers were not analysed). Higher marital quality was associated with higher parental investment, this being especially true for men. Finally, social support was associated with higher maternal knowledge and sensitivity to the needs of the child but not with paternal knowledge and sensitivity.

These results suggest that parental investment is differently determined for mothers and fathers, however analyses were made separately for women and men and did not take into account the extent to which maternal and paternal investment in the child may be inter-correlated (Kelley et al., 1978). Despite this possible couple interdependence, it is also expected that mothers and fathers will differ in their attitudes and behaviours regarding child rearing because the biology of reproduction results in higher level of maternal investment (Geary, 2000) and because women still retain the primary responsibility for household tasks and childcare (Cowan et al., 2000).

Parental investment of parents that conceived through assisted reproduction

There are many reasons why couples who conceived via ART might invest more in their children. First, evolutionary perspectives would advance that previously infertile couples may regard their offspring as their only chance to guarantee the continuation of their unique genetic inheritance (Fox et al., 2001) and therefore invest more than couples conceiving naturally who intend and have at least two children (Berrington, 2004).

Second, the effort required to achieve conception is greater in previously infertile couples, coming as it does at the end of a long period of involuntary childlessness, infertility investigations and treatments (Colpin, 2002). Pregnancy itself also has increased obstetrical risks (Basso et al., 2003) and childbirth can be more difficult than initially anticipated by mothers (Hammarberg et al., 2008). It has been suggested that as a result previously infertile couples are more aware of the importance of parenthood and of having children (van Balen et al., 1996) and are thus more strongly involved in parenting (van Balen, 1996). These parents' perspective of the uniqueness of their children may also allow them to evaluate differently other life stressors and such experiences may therefore function like a buffer, neutralizing the negative impact of stressors on parenting experiences. For instance, Repokari et al. (2006) found that self-reported negative birth experiences predicted negative mothering and fathering among spontaneously conceiving parents but not among previously infertile parents conceiving through ART. Finally, an auto-selective mechanism may also be at work, as those couples who start and sustain in ART treatments (and are thus more likely to achieve parenthood) are expected to be more resilient than those who do not (Olivious et al., 2004; Repokari et al., 2005), therefore more likely to present positive functioning across different areas, including parenting.

There is support for and against greater investment by parents conceiving with ART. A cross cultural study with 462 families, in which a standardized interview to the mother was used to assess the quality of parenting, revealed that mothers who conceived through ART reported higher levels of emotional involvement with their child and that their partners contributed more to parenting when compared to mothers with a spontaneously conceived child (Golombok et al., 1995). In another large cross cultural study that included four European countries it was found that mothers who conceived with ICSI (but not IVF) reported fewer hostile or aggressive feelings towards the child and higher levels of commitment to parenting than mothers of naturally conceived child (Barnes et al., 2004). Other cross-sectional studies based on self-report questionnaires showed that previously infertile parents were more involved with, experienced more pleasure and reported significantly more positive feelings towards their child, compared with parents of spontaneously conceived children (van Balen, 1996; Weaver et al., 1993). However, when mother/father-infant attachment was assessed, also with self-report questionnaires, no group differences were found (Cohen et al., 2000; McMahon et al., 1997). Observation-based studies revealed that mothers who conceived through ART showed more care-taking (i.e., any action concerned with the infant's bodily needs or performed in order to calm distress) and play episodes (e.g. smiling, making exaggerated facial expressions, calling) during free play with their child (Papaligoura et al., 2001) and that fathers with a history of infertility spent more time interacting with their infant (Holditch-Davis et al., 1999), when compared with parents with a spontaneous conception. In contrast, when the mother-child interaction was assessed in a free play context and the Strange Situation procedure was conducted on a sample of dyads of mother-child conceived through ART and spontaneously, no significant group differences were found on maternal or child dimensions of interaction

during play and on the child's security of attachment (Gibson et al., 2000).

In summary, it seems clear from the literature that there is expectation that previously infertile parents might invest more in their child because of his/her difficult-to-achieve conception and thus show greater resilience in the face of typical transitional issues for new parents. Research does show mixed evidence but this may be due to methodological shortcomings such as not accounting for the dependency between maternal and paternal investment. Indeed, in a recent systematic review on the psychological and social aspects of pregnancy, childbirth and early parenting after assisted conception it was concluded that many findings were either inconclusive or contradictory and that this was probably due to the varied methods of investigation that have been employed (Hammarberg et al., 2008). Nonetheless, the authors do conclude that few differences have been found between ART and SC couples in terms of parent–infant attachment and interaction, maternal sensitivity and parental separation anxiety. No specific comments were made in relation to parental investment.

Objectives and hypotheses

In this prospective investigation we addressed methodological and conceptual issues noted in previous studies by considering both maternal and paternal reports on investment and by using multilevel modelling to examine the couple as the unit of analysis. The aims of the study were to investigate 1) differences in parental investment between parents who conceived spontaneously and with ART and between mothers and fathers; 2) associations between risk factors for diminished parental investment (i.e. parental depression, lack of marital satisfaction, lack of social support), assessed during pregnancy, and parental investment; and 3) possible moderation effects of method of conception and gender on the associations between risk factors and parental investment. It was hypothesized that couples that conceived with ART would report higher

investment in the child than couples that conceived spontaneously and that women would report higher investment than men. Higher depression, lower marital satisfaction and lower social support during pregnancy were expected to be associated with lower parental investment. Method of conception was expected to moderate the relationship between all risk factors and parental investment, associations being weaker or non significant for ART couples. Finally, the positive association between marital satisfaction and parental investment was expected to be stronger in men than in women and the positive association between social support and parental investment was expected to be stronger in women than in men.

Materials and Methods

Design and procedures

The Ethics Committee of the University of Coimbra Hospital approved the study. Consecutive couples (ART or spontaneous conception) attending for their obstetrical consultation at the Genetics and Human Reproduction Service and at the Dr. Daniel de Matos Maternity (respectively), both in the University of Coimbra Hospitals, Portugal, were invited to participate in the study. Inclusion criteria were being married or cohabiting, more than 18 years of age, nulliparous, singleton pregnancy and literacy level sufficient to complete the assessment protocol. If participants agreed to collaborate they filled a consent form and were instructed to complete self-report questionnaires at their 24th pregnancy week (Time 1, T1) and at 4 months postpartum (Time 2, T2). For this second assessment questionnaires were sent by mail together with a preaddressed envelope and parents were instructed to post back to the research team.

A total of 136 couples (66 who conceived through ART and 70 with a SC) agreed to be contacted about the study. For the ART group, 11 couples did not return questionnaires, 8 couples had a multiple pregnancy and 3 had a miscarriage prior to the

assessment. From the remaining 44 couples, 39 women and 35 men completed the questionnaires at T1 and T2, which corresponded to a completion rate of 59.1% for women and 53.0% for men. For the SC group, 20 couples did not return questionnaires and 33 women and 32 men completed T1 and T2 questionnaires, which corresponded to a completion rate of 47.1% for women and 41.6% for men. Women who did not return questionnaires after the partum were younger ($t(89) = -2.36$, $P = .021$) than those who did. No socio-demographic differences were found between those men who did and did not return the questionnaires at T2.

Materials

At T1 (week 24 of pregnancy), socio demographic and psychological data (depression, marital satisfaction, perceived social support) were collected. At T2 (four months post-partum) obstetrical and perinatal data were collected from the women's medical records (occurrence of obstetrical complications during pregnancy; mode of delivery; gender, gestational age and birth weight of the baby) and parental investment in the child was assessed.

Depression was assessed with the depression subscale (6 items, e.g. negative affect, lack of energy in the past two weeks) of the Brief Symptom Inventory (BSI-Depression, Derogatis, 1993). It is an averaged score that ranges from 0 to 3, with higher scores indicating the presence of more depressive symptoms. The Portuguese version of this scale presents good levels of internal consistency for the Depression subscale (.73), test-retest coefficient (.81) and construct and discriminant validity (Canavarro, 2007).

Marital satisfaction was assessed with the satisfaction subscale (10 items, e.g. "I feel happy with the way we deal with the responsibilities in our marriage") of the ENRICH marital inventory (ENRICH-Satisfaction; Olson et al., 1983). The Portuguese version of the ENRICH inventory has been evaluated with satisfactory reliability and validity

(Lourenço, 2006). The Satisfaction scale score is an averaged score that ranges from 1 to 5, with higher scores indicating higher satisfaction with the marital relationship.

Social support was assessed with the Convoy Model (Convoy – Network support,Kahn et al., 1980). First, information about the participant's social network was obtained by asking individuals to map their relations hierarchically onto a concentric circle diagram. Participants were asked to place in the innermost circle (C1) those individuals who are "so close that it's hard to imagine life without them", in the second circle (C2) "those that are not quite as close, but are still very important" and in the third circle (C3) those that are "not quite as close, but still important". After completing the Convoy diagram, participants were asked to rate perceived support regarding eight different support functions (e.g., confiding about important things, helping with household tasks) from each person included in C1 and C2 of the convoy (to a total maximum of 12 persons). The response scale ranged from 0 (minimum support) to 5 (maximum support) and the ratings for the eight support items were summed to create a support score for each member of the network. After, a network support score was calculated by averaging support scores from all the members of the network. This network support average ranged from 0 (no relations included in the convoy and/or no perceived support from included relations) to 40 (maximum perceived support).

Parental investment in the child was assessed with the Portuguese version of the Parental Investment in the Child scale (Bradley et al., 1997) that comprises 19 items designed to assess parents' socio-emotional investment in their children (e.g. "Raising a child is so demanding, ...", "Holding and cuddling my child is more fun than most other things I do"), rated on 4-point response scale. The PIC comprises three different subscales and one summed score was calculated for each with higher scores reflecting higher investment in the child. The subscales are acceptance of parental role (PIC-

Acceptance, 6 items, range of 6 to 24), delight (PIC-Delight, 7 items, range of 6 to 32) and knowledge and sensitivity (PIC-Knowledge/Sensitivity, 6 items, range of 6 to 24). Cronbach alpha coefficients for these scales ranged between .70 and .72. The construct validity of the PIC was validated against ratings obtained with other self-report questionnaires and observational methods of parental investment (i.e. the HOME Inventory; Caldwell et al., 1984) and, in general, the different subscales of the PIC correlated in meaningful ways with these different measures (Bradley et al., 1997). The Portuguese version of the scale revealed moderate to good indices of internal consistency for its subscales, good test-retest reliability and internal consistency (Gameiro et al., 2008).

In the present sample Cronbach alpha coefficients for all questionnaires and scales were higher than .70 for both men and women. The exception concerned the PIC scale, for which Cronbach alpha coefficients were between .61 and .75 for women and from .66 to .77 for men. Although some of these coefficients were only moderate, they were in line with results from the validation of the Portuguese version of the scale and previous studies conducted with the PIC scale (e.g. Corwyn et al., 1999).

Statistical Analyses

MLwiN (Rasbash et al., 2004) was used to analyse the data with multilevel regression analysis with couples as the unit of measurement. This analytic approach was chosen because it captures the dependence of the mother and father outcome data (in this study correlations were between .329, $P < .01$ and .592, $P < .01$). A total of three regression models were tested concerning the three dependent variables of parental investment in the child (i.e. PIC-Acceptance, PIC-Delight and PIC-Knowledge/Sensitivity). A two-level hierarchical structure was considered for the data, with individuals (mother and fathers; level one) nested within couples (level two). As

recommended by Kenny, Kashi and Cook (2006), the models were constrained to be equal across all dyads, i.e. they included only fixed effects. The purpose of hierarchical linear modelling is similar to traditional hierarchical regression analysis, but the variance is decomposed at the different levels. As such, preliminary univariate analyses were made to test for significant associations between socio-demographic and child related variables (i.e. parental age, years in current relationship, gender of the baby and the occurrence of complications during pregnancy), our predictor variables and the three dimensions of parental investment in the child. After, each of the three models was developed starting from a null single level model. A null two level model was then implemented, its adequacy tested and intra-class correlations calculated in order to estimate the proportion of variance found at each level (couple, individual). In the second analytical step all main effects were added to the multilevel regression model (*main effects model*) and in the third step interaction effects that corresponded to the hypotheses were also considered (*main and interaction effects model*). In the last analytical step, a final model was tested in which only the significant predictors identified in the univariate and multivariate analyses (significance level of $P < .01$) were retained (*final model*). This allows for a more precise calculation of the amount of variance explained by significant predictors (cf. Table II). Model significance was ascertained using χ^2 statistics and the significance of the regression weight for each independent variable was tested by *t*-tests.

Methods for assessing statistical power in multilevel modelling analyses are still being developed. Kreft and deLeeuw (1998), however, suggest that multilevel modelling power calculations are similar to multiple regression. Therefore, Cohen's (1992) estimates were used to assess the statistical power of the models. Post hoc power calculations demonstrated that in testing the *saturated model* the achieved sample size

allowed for the detection of medium to large effects (number of predictors = 11, effect size = .28, P < .05, power = .80, G * Power, Faul et al., 2007). The *main effects model* and the *final model* were expected to have higher power because they would have fewer parameters.

Results

Participants

The final sample consisted of 39 women and 35 men (39 couples) who conceived through ART (in vitro fertilization, IVF, and intracytoplasmic sperm injection, ICSI, using the couples' own gamete) and 33 women and 32 men (representing 34 couples) who conceived spontaneously. Table I presents sample socio-demographic, clinic and obstetrical and perinatal characteristics. Women and men who conceived with ART were older than women and men who conceived spontaneously and were with their partner for a longer time. There was a higher probability for the occurrence of problems during pregnancies achieved by ART and the frequency of male babies conceived spontaneously was significantly higher than that of male babies conceive by ART.

Table II presents mean scores of BSI-Depression, ENRICH-Satisfaction, Convoy-Network support, PIC-Acceptance, PIC-Delight and PIC-Knowledge/Sensitivity for women and men. Scores show that during pregnancy parents experienced low depression levels, high marital satisfaction and medium support from their family and friends. Scores also show a medium to high investment in the child four months after the birth.

Testing the Adequacy of a Two-Level Model

For the three dependent variables (PIC-Acceptance, PIC-Delight and PIC-Knowledge/Sensitivity) the total of variance was divided into two parts, referring to the individual and couple levels. Table III indicates the proportion of estimated and

explained variance at the individual and couple level for the *final model*. The estimated variance is the amount of variance (of each dependent variable) that occurs at each level (individual versus couple). The explained variance is the amount of variance (of each dependent variable) that is explained by predictor variables included in the model at each level.

For the three dependent variables considered it was observed that the two-level (individual, couple) models significantly decreased the badness of fit (PIC-Acceptance: *decrease in badness of fit* = 14.342; $P < .001$, PIC-Delight: *decrease in badness of fit* = 7.302; $P < 0.01$, PIC-Knowledge/Sensitivity: *decreased in badness of fit* = 28.168; $P < .001$) in relation to the single-level models (individual level only), thus indicating that the two-level models were a better fit to the data.

Predictors of parental investment in the child

Table IV presents the two-level fixed effects models developed concerning the three dimensions of parental investment in the child with predictor summary statistics. The design of the multivariate analysis is very similar to a multiple regression with one dependent variable and a set of predictor or independent variables, providing unstandardized estimates (β values) and standard errors (SEs) for each predictor.

Preliminary analyses made to investigate the necessity for controlling for socio-demographic and child related variables showed that the parents' age was statistically associated with PIC-Delight. We chose to present the PIC-Delight models without including age because we would be removing an essential feature of what means to be a parent conceiving with ART (i.e., association between age and fertility). However, we also tested these models controlling for age and the significant predictors found remained the same (data not shown).

Acceptance of parental role. The results of univariate analyses show that ENRICH-

Satisfaction (β = 1.202, *SE* = 0.437, *P* < .01) was positively associated PIC-Acceptance, and BDI-depression (β = -0.581, *SE* = 0.330, *P* < .10) was negatively associated with it. Results from multivariate analyses show that ENRICH-Satisfaction was the only predictor of PIC-Acceptance in both the main effects model (*P* < .05) and in the final model (*P* < .05), explaining 13% of its total variance at the couple level. No significant interactions were found.

Delight. The results of univariate analyses show that ENRICH-Satisfaction (β = 1.352, *SE* = 0.584, *P* < .05) and Convoy-Network support (β = 0.085, *SE* = 0.042, *P* < .05) were positively associated with PIC-Delight. In the main effects model, Convoy-Network support (*P* < .10) was the only predictor of PIC-Delight, but in the final model ENRICH-Satisfaction also proved to be a significant predictor of PIC-Delight (*P* < .05) and together, these predictors explained 9% of its total variance at the couple level and 1% at the individual level. No significant interactions were found.

Knowledge and Sensitivity. The results of univariate analyses show that ENRICH-Satisfaction (β = 0.837, *SE* = 0.449, *P* < .10) was positively associated with PIC-Knowledge/Sensitivity. The main effects model did not reveal any significant predictors, however, when interactions were investigated, it was observed that only Convoy-Network support predicted PIC-Knowledge/Sensitivity (in both this, *P* < .05, and the final model, *P* < .10), being positively associated with it. An interaction effect between method of conception and ENRICH-Satisfaction was also found (*P* < .10). Simple slope analyses conducted in the final model showed that, while for couples that conceived spontaneously no association was found between ENRICH-Satisfaction and PIC-Knowledge/Sensitivity (β = -0.095, *SE* = 0.678, *P* = .888), for couples that conceived through ART higher ENRICH-Satisfaction was associated with higher PIC-Knowledge/Sensitivity (β = 1.496, *SE* = 0.604, *P* = .013). Together these effects only

explained 3% of the total variance of PIC-Delight at the individual level.

Discussion

This prospective study shows that previously infertile parents do not invest more in parenting and are not more robust to threats that could compromise parental investment. These findings are consistent across the three dimensions of parental investment in the child and represent genuine new knowledge in the field. In fact there was even some indication that ART parents might be less sensitive to child needs when in a less satisfying marriage. Pervasive beliefs and expectations of ART parents being 'super parents' are therefore unwarranted, and may lead to poorer outcomes for parents if it gives the impression these couples need less support during the transition to parenthood. For parents in this sample greater acceptance of the parenting role, delight in their children and sensitivity to their child's needs was dependent on the quality of the marital relationship and support from family and friends during pregnancy and not on how the child was conceived. In this respect ART parents are just like those who conceive spontaneously.

The finding that previously infertile couples did not invest more in their child than spontaneously conceiving couples is counterintuitive in light of previous work drawing on infertile couples' strong desire and investment in achieving parenthood (Golombok et al., 1996; van Balen, 1996). One possible explanation relates to the infant contribution to the parent-child relationship. Infants' difficult behaviour has been shown to be negatively associated with maternal investment (Bradley et al., 1997) and a previous study that compared couples using ART to couples that conceived spontaneously showed that child temperament ('soothability' in particular) was associated with parents' acceptance and attachment to the child (Repokari et al., 2006). Prospective controlled observational studies have shown that infants conceived with

ART have higher prevalence of difficult behaviours than spontaneously conceived infants (e.g. Cohen et al., 2000; McMahon et al., 1997) and this may, at least partially, explain why ART parents did not report higher investment despite greater effort in conceiving.

The lack of a gender difference in prediction of parental investment suggests that men and women seem to dedicate themselves equally to the wellbeing of their child, regardless of how the conception was achieved. Given the lack of studies examining parental investment that use the couple as the unit of analysis, it is difficult to compare current findings with those of previous research. It may be possible that by accounting for the dependency between the investment mothers and fathers make in their child gender differences were attenuated. This is consistent with both the theorization that ignoring dyadic interdependence increases the probability of the occurrence of type 1 errors, i.e. of considering non-significant associations to be significant (Kenny et al., 2006), and with the fact that a large interdependence between both members of the couple in their investment in their child was observed concerning all dimensions of parental investment (see estimated variance values on Table II). On a day-to-day basis many of couples' marital interactions occur while caretaking tasks are being discussed and implemented and therefore feelings emanating from interactions between spouses are likely to affect the way the couple, as a unit, relate to the child, which is also consistent with our finding of a strong effect of marriage on parental investment and with the broader literature on parenting (cf. Belsky et al., 2006).

Previous studies that focused on the determinants of maternal and paternal investment have concluded that these are differently determined (Bradley, 1998; Bradley et al., 1997; Corwyn et al., 1999). However, our results suggest a more complex scenario in which predictor variables may have a different value in explaining

individual versus couple investment, that is, some factors (e.g., support from family and friends) may only affect the investment of one member of the couple while others shared by both members of the couple (e.g., the marital relationship) may affect investment of both members simultaneously.

Knowledge and sensitivity to child needs was dependent on marital satisfaction during pregnancy in the ART group, but not in couples with a spontaneous conception as has been reported previously (Corwyn et al., 1999). Despite its statistical significance, this finding should not be emphasized due to several reasons. First, it only accounted for 3% of the variance in knowledge and sensitivity; second, knowledge and sensitivity proved to be the less reliable dimension of the PIC (i.e. only presented moderate alpha values, more specifically .61 for women and .69 for men); and finally, research has shown that the marital relationship of ART couples is at least as good as or better than the one of couples who conceived spontaneously (cf. Hammarberg et al., 2008).

This was a prospective study with typical parents experiencing a spontaneous or ART pregnancy. The sample size in combination with prospective design ensured sufficient power to detect medium to large effect sizes. The measures were reliable and valid measures of their construct and except for a few cases were obtained from both mothers and fathers. The parental risk factors were measured in advance (during pregnancy) of the assessment of parental investment (4 months postpartum). The use of multilevel regression increased the precision of the standard errors, therefore also of the calculation of significance tests, and results from univariate and multivariate analyses showed overall convergence. Finally, the use of multilevel regression analysis also allowed for a precise calculation of the total variance of parental investment explained at the individual and couple level, which was a novel way of addressing the issue of

parental investment. There were limitations and these consisted on some impacts of attrition (younger women less likely to complete postpartuum questionnaires) and use of a single study site in Portugal. While the sound methodological approach of this prospective study warrants confidence in the associations reported replication in other populations is required. Future research should also aim at investigating socio-emotional investment in children or other related dimensions of parental care and behaviour adopting a dyadic, but considering a more in-depth assessment of these constructs, based on interview techniques or observational assessment methodologies.

To conclude, results from this study do not support the view of ART couples as 'super parents' that are invulnerable to unfavourable circumstances or that they would need or benefit less from (professional and/or informal) support than other parents. If future research confirms that parental investment in the child is, to a considerable degree, a parent shared feature, then more attention should be paid to the interactions that occur between the spouses in their discussion and performance of the parental role and, further, preventive and/or intervention strategies directed at the promotion of adequate parental care should be directed at the couple as a unit. The fact that the marital relationship had a central role in explaining parental investment in the child strengthens this proposal, which is equally valid for couples conceiving with ART and spontaneously. Overall parents in this study (both mothers and fathers that conceive spontaneously or through ART) behaved alike in that their investment and commitment to parenthood and their child's wellbeing depended on whether their marriage was satisfying and whether they had friends and family who supported them, more than on how they achieved the birth.

Author's roles

S.G., M.C.C., M.M-R., I.S. and T.A.S. made substantial contributions to the

conception and design of this study. S.G. was involved in the acquisition of data. S.G. and J.B. were involved in the analysis and interpretation of data. All authors were involved in drafting/revising and giving final approval of this paper.

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Table I

Mean (SD) or frequencies (%) for sample socio-demographic, clinic and obstetrical and perinatal characteristics (N=73 couples)

	SC (n = 34 couples)				ART (n = 39 couples)			
	Women n=33		Men n=32		Women n=39		Men n=35	
Socio-demographic								
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age [a]	26.55	4.671	28.91	4.645	33.56	3.119	35.11	3.802
Years in current relationship [a]	2.99	1.543	2.96	1.557	7.62	2.650	7.71	2.198
	n	%	n	%	n	%	n	%
Education								
Primary	5	15.2	5	16.1	3	7.7	5	14.3
Secondary Junior	4	12.1	11	35.5	6	15.4	5	14.3
Secondary Senior	11	33.3	9	29.0	9	23.1	16	45.7
University	13	39.4	6	19.4	21	53.8	9	25.7
Socioeconomic status								
Medium low	15	45.5	16	51.6	11	28.2	10	28.6
Medium	10	30.3	7	22.6	12	30.8	10	28.6
Medium high	8	24.2	8	25.8	16	41.0	15	42.9
Employment status (four months postpartum) - Working	10	31.2			9	25.7		
Clinic								
					Mean	SD		
Duration of infertility					5.45	2.88		
Number of previous unsuccessful treatments					1.19	1.09		
					n	%		
Cause of infertility								
Female					13	35.1		
Male					9	24.3		
Mixed					10	27.0		
Idiopathic					5	13.5		
Obstetrical and perinatal								
	n	%			n	%		
Baby gender - Male [b]	23	69.7			18	53.8		
Problems in pregnancy [c]	5	15.2			12	31.6		
Mode of delivery								
Vaginal delivery	20	60.6			22	57.9		
Caesarean section	6	18.2			3	7.9		
Urgent caesarean section	7	21.2			13	34.2		
	Mean	SD			Mean	SD		
Gestational age (weeks)	38.58	1.20			38.41	1.57		
Birth weight (grams)	3248.03	470.98			3139.48	372.95		

Note: ART : Assisted Reproductive Technologies, SC : Spontaneous conception, SD = standard deviation

[a] Significant group differences for both women and men ($P < .001$)

[b] Significant group differences ($P < .05$)

[c] Significant group differences ($P < .10$)

Table II

Mean and standard deviation of study variables for women and men (N=73 couples)

	SC (n = 34 couples)				ART (n = 39 couples)			
	Women n=33		Men n=32		Women n=39		Men n=35	
	M	SD	M	SD	M	SD	M	SD
Predictor variables (pregnancy)								
BSI-Depression	0.64	0.56	0.36	0.45	0.56	0.59	0.40	0.56
ENRICH-Satisfaction	4.18	0.39	4.13	0.51	4.08	0.555	4.14	0.44
Convoy-Network support	22.22	6.76	22.05	4.90	21.06	6.73	21.49	6.74
Parental Investment in the child (postpartum)								
PIC-Acceptance	18.36	2.00	18.24	2.06	17.74	2.44	18.31	2.77
PIC-Delight	22.36	2.55	22.21	2.47	21.85	3.48	21.26	3.57
PIC-Knowledge/Sensitivity	14.94	1.95	14.48	2.06	15.38	2.77	15.34	2.68

Note: *M* = mean, *SD* = standard deviation, ART = Assisted Reproductive Technologies, SC = spontaneous conception

Table III

Estimated and explained variance at the individual and couple level

	PIC-Acceptance		PIC-Delight		PIC-Knowledge/Sensitivity	
	Estimated Variance	Explained Variance	Estimated Variance	Explained Variance	Estimated Variance	Explained Variance
Level						
Couple	.45	.13	.33	.09	.59	.00
Individual	.55	.00	.67	.01	.41	.03
Total explained variance		.13		.10		.03

Table III

Predictors of Parental Investment in the Child in Multivariate Analyses (N=73 couples)

	PIC – Acceptance of parental role						PIC - Delight						PIC – Knowledge/Sensitivity					
	Main effects Model		Main & interaction effects Model		Final Model		Main effects Model		Main & interaction effects Model		Final Model		Main effects Model		Main & interaction effects Model		Final Model	
Predictors	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*
Constant	18.180***		18.179***		18.180***		22.454***		22.411***		21.953***		14.846 ***		14.844***		14.742***	
Couple level																		
Method of conception (MoC) [a]	-0.279	0.440	-0.279	0.437			-0.649	0.570	-0.627	0.556			0.705	0.511	0.712	0.513	0.717	0.509
Individual level																		
Gender [b]	0.243	0.322	0.255	0.323			-0.333	0.452	-0.276	0.452			-0.252	0.280	-0.257	0.267		
BSI-Depression	-0.281	0.359	0.043	0.539	-0.338	0.342	-0.519	0.489	0.342	0.727			-0.082	0.340	0.495	0.495		
ENRICH-Satisfaction	**1.100**	**0.458 ***	1.037	0.846	**1.087**	**0.451 ***	0.996	0.608	1.174	1.122	**1.237**	**0.576 ***	0.752	0.480	-0.403	0.836	-0.095	.0678
Convoy-Network support	0.020	0.030	0.018	0.050			**0.070**	**0.041** †	0.099	0.067	**0.076**	**0.041** †	0.045	0.030	**0.102**	**0.045 ***	**0.048**	**0.029** †
Gender x ENRICH-Satisfaction			0.015	0.731					-0.654	1.014					0.367	0.625		
Gender x Convoy-Network support			-0.037	0.056					-0.070	0.077					-0.022	0.049		
MoC x BSI-Depression			-0.548	0.719					-1.497	0.970					-0.828	0.660		
MoC x ENRICH-Satisfaction			0.037	0.976					0.073	1.272					**1.695**	**1.021** †	**1.591**	**0.906** †
MoC x Convoy-Network support			0.031	0.062					-0.006	0.083					-0.066	0.058		
Decrease in badness of fit	36.022***		37.510***		30.264***		40.572***		44.749***		38.065***		27.955***		34.954***		30.179***	

Note: *SE* = standard error

[a] 0 = spontaneous conception, 1 = Assisted Reproductive Technologies, [b] 0 = Female, 1 = Male

† $P \leq .10$, * $P \leq .05$, ** $P \leq .01$, *** $P \leq .001$