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Parenthood and the Concept of the Biological Tie

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Abstract
It is widely assumed that there is value in the biological tie between parent and child. An implication of this is that adoption is often considered less desirable than procreation. This paper offers a philosophical defense of adoptive parenthood as a valuable and authentic form of parenthood. While previous defenses have suggested that society's valorisation of the biological tie is unjustified, I argue herein that the conception of the biological tie that features in the normative discourse on parenthood is too narrowly genocentric. Against this genocentric conception, work in the philosophy of biology has emphasised the roles of joint determination by multiple causes, extended inheritance, and development as construction, which I suggest can substantiate a more inclusive conception of the biological tie. Accordingly, I propose that adoptive parents form a rich variety of biological ties with their children, some of which are as enduring and formative as genetic relatedness.

Keywords
Parenthood, Adoption, Biological Tie, Genetic Relatedness, Developmental System, Philosophy of Biology

Background

Genetic parenthood is characterised by a biological tie between parent and child, whereby the latter has inherited genetic material from the former. Most of us are familiar with the ancient proverb, 'blood is thicker than water', which reflects the common assumption in society that there is something valuable or even special about this biological tie between parent and child. In the present day, this valorisation of the biological tie is manifested in the increasing demand for and promotion of assisted reproductive technologies, such as *in vitro* fertilisation and surrogacy, which are intended to enable people suffering from infertility to become parents to genetically related children.

Various reasons have been given for why a biological tie might be valuable. Lonnie Aarssen (2007) suggests that a parent may value the biological tie with their child because the conservation of genetic information across generations is construed as achieving some sort of immortality. Brenda Almond (1999) suggests that a prospective parent might also wish to have a biological tie with their future child due to the belief that genetic relatedness will help ensure a resemblance between them and their child. With respect to the significance of the biological tie for the child, David Velleman (2005) argues that intimate familiarity with one's genetic parentage is important for developing a robust sense of identity.

Of course, not all parents are genetically related to their children. Notable examples are parents with adopted children and parents whose children were conceived using donor gametes. The present paper focuses on adoptive parenthood, although some of what is said could also apply to parenthood through donor conception. Given that I am interested in the value of parenthood in the absence of genetic relatedness, I will more narrowly be considering cases where the adoptive parents are not relatives of the adopted children. Moreover, given that I draw on the effect of parenting on development, I will be considering cases where the children are adopted as infants. While there are diverse variations in adoptive attitudes and practices across different cultures, the present paper is written with the United Kingdom and the United States in mind. This is because, despite adoption being recognised as a legitimate route to parenthood in these countries, social norms and attitudes in these countries continue to emphasise the value of the biological tie between parent and child.

An unfortunate implication of society's valorisation of the biological tie is that it has been associated with the relegation of adoptive parenthood to being considered a less desirable alternative to genetic parenthood. In a study on the stigmatising attitudes faced by adoptive families in North America, Charlene Miall (1987) found that adoptive bonding was considered to be 'second best', adopted children were considered to be 'second rate', and adoptive parents were not considered to be 'real' parents. All of these assumptions were underpinned by the assumption that the biological tie is an important feature of parenthood. In some respects, cultural attitudes to adoptive parenthood have changed since Miall's study and in some countries overt stigmatisation is no longer as much of a problem as it used to be. For example, research in Belgium has suggested that portrayals of adoption in the media have contributed to a generally positive stance toward adoption as a family building option (De Graeve, 2013). Nonetheless, this is by no means universal and the valorisation of the biological tie has continued to persist elsewhere. In the United States, research has shown that biological reproduction is widely considered to be more desirable than adoption (Dougherty, 2009). While adoption may no longer be as secretive as it used to be, it is reported that many 'still assume that natural or biological parents should raise their children' (Riley & Van Vleet, 2012, p. 15). Furthermore, adoptive parents are often burdened with finding ways to counter the widespread perception that adoption is inferior to procreation (Baxter et al., 2014). In the United Kingdom, the preference for genetic parenthood is reflected in the decreased number of people choosing to adopt, which has partly been attributed to the increased number of people opting for *in vitro* fertilisation (Pritchard, 2018).

And so, although overt stigmatisation of adoptive parenthood may not occur to the extent that it did three decades ago, the assumed significance of the biological tie between parent and child has continued to be manifested in ways that make it a worthwhile topic for

philosophical critique. In fact, philosophers have recently defended adoptive parenthood as being just as valuable as genetic parenthood. Usually, they have done so by arguing that the biological tie between parent and child is not as important as it commonly assumed to be (Haslanger, 2009; Levy & Lotz, 2005; Rulli, 2016). In this present paper, I provide further philosophical support for adoptive parenthood as a valuable and authentic form of parenthood. Unlike previous philosophical defences, though, my strategy is not to deny that a biological tie between parent and child can be of value. This is not because I think previous defences are incorrect. To the contrary, I believe that philosophers are correct to conclude that the privileging of the biological over the social is problematic. Nonetheless, while the above arguments may be philosophically sound, the intuition that there is something special about the biological tie between parent and child remains a strong influence in the normative discourse on parenthood.

My aim, then, is to address, on their own terms, those who continue to consider biological ties between parents and their children to be special. For the sake of argument, I take for granted that the biological tie between parent and child can be of value. However, I argue that the conception of the biological tie commonly assumed in the normative discourse on parenthood is too narrowly genocentric. Against this genocentric conception, recent work in the philosophy of biology has emphasised the roles of joint determination by multiple causes, extended inheritance, and development as construction (Griffiths & Gray, 1994; Oyama et al., 2001). These, I suggest, can substantiate a more inclusive and defensible conception of the biological tie. Drawing on these themes, I propose that adoptive parents form a rich variety of biological ties with their children through their childrearing interactions; some of which are as formative and enduring as genetic relatedness. I support this with reference to empirical evidence on the contributions of adoptive parents to the developmental trajectories of their children and the resemblances that obtain in adoptive families.

The philosophical analysis I am offering is not intended to be a mere academic exercise. It also aims to be a resource for challenging some of the social norms that negatively affect people who are perceived not to conform to the traditional image of the genetically related family. As recently argued by Angel Petropanagos (2017), reproductive decisions are often influenced by pronatalism and geneticism, - the bias toward procreation and toward genetic parenthood respectively. These norms promote the image of the genetically related family as the ideal and devalue those who do not conform to this image, including adoptive families, prospective parents who are in same-sex relationships, and couples suffering from infertility. Furthermore, these norms predominantly tend to devalue women, as noted by Sarah-Vaughn Brakman and Sally Scholz when they write that 'the bodies of adoptive mothers are often measured by their inability to reproduce biologically' (Brakman & Scholz, 2006, p. 62). Giulia Cavaliere also notes that these norms 'emphasise the value of having genetically related children over other forms of family formation—with women taking the biggest health risks' (Cavaliere, 2020). By debunking the genocentric conception of the biological tie, my analysis can challenge the image of the genetically related family as the only kind of family connected by biology, and so encourage us to value the diverse ways in which people can form families. Moreover, some of the themes it highlights can offer adoptive parents and their children further conceptual tools to interpret their experiences and legitimise their families in the face of stigmatisation.

Given that adoption is a complex and multifaceted topic, some concessions are required before proceeding. First, I focus on the role of adoption as a route to parenthood. Nonetheless, I fully recognise that adoption has another crucial role as a child welfare service. Although I do not intend to provide a detailed discussion of this latter role, this should not be seen as a denial of its importance. Rather, my reason for focusing specifically on the former is that this is the role which tends to get devalued by society's valorisation of the biological tie. The analysis, however, is not exclusively centred on the parent, as I do also consider how the biological tie may be significant for the development of the child's identity. Second, I

focus on the connection between the adoptive parent and the child, but this is not to deny that many other actors also have important roles in the child's development, including birth kin, foster carers, social workers, and the family court. Rather, my reason for focusing specifically on the relationship between the adoptive parent and the child is that this is the relationship whose value is brought under scrutiny by the emphasis on genetic relatedness. Hence, while I argue for the value of this relationship, this does not in any way devalue the child's relationships with birth kin, foster carers, and other actors. Third, I focus specifically on the genocentric conception of the biological tie as a factor contributing to the devaluing of adoptive parenthood, but this is not to suggest that it is the only factor. Adoption has been criticised for other reasons. For example, domestic adoption has been criticised for failing to respect the rights of adoptees and birth kin, while transnational adoption has been criticised for its tendency to reinforce colonial hierarchy (Blythe & Gribble, 2019; McCullough, 2012). These are important criticisms. However, for the consideration of scope, I will not address them in detail.

The genocentric conception of the biological tie

To further understand what underpins society's valorisation of the biological tie between parent and child, it is helpful to look more closely at how this biological tie is commonly conceptualised. The conception of the biological tie that is assumed in normative discourse on parenthood usually corresponds more narrowly to genetic relatedness. This is corroborated by an anthropological study by David Schneider (1980), which found that the majority of people in the United States consider genetic relatedness to be the defining feature of kinship. Dorothy Nelkin and Susan Lindee (1995) also argue that the genetically related family has become assumed by researchers, policy makers, and the public as the ideal family form. Such a genocentric conception of the biological tie is reflected in the increasing use of genetic tests to support claims for parental rights and responsibilities in custody and paternal support cases (Stevens, 2005).

The emphasis on 'blood' relatedness has a long history. However, in light of society's burgeoning fascination with genetic science, concerns for 'blood' relations have recently been reformulated in terms of genetics. We are frequently told, sometimes justifiably but sometimes misleadingly, that genes indicate our origins, explain our propensities, account for our similarities and differences, and are the 'blueprints' for who we are (Plomin, 2018). Richard Dawkins' bestselling book *The Selfish Gene* (1976) played a substantial part in stirring up this fascination and did much to popularise gene selection theory. Developed earlier by evolutionary biologist George Williams (1966), gene selection theory claims genes are the basic units of selection in evolution. That is to say, it purports that evolution proceeds via differential selection and replication of genetic information, with the frequencies of these conserved genetic variants increasing across generations. It is important to note that this does not entail genetic determinism, which is the claim that organisms' traits are exclusively determined by their genes. Genetic determinism is nowadays considered to be false and biologists widely accept that various factors other than genes play influential roles. Nonetheless, gene selection theory does privilege genes as the carriers of inherited information. Also, given the rhetorical style used by Dawkins, it has been commented that it is 'easy to read Dawkins' *The Selfish Gene* as a defence of the idea that only genes matter in evolution' (Sterelny and Griffiths, 1999, p. 61).

Gene selection theory considers genes to be the basic units of selection for the following reasons. First, genetic information has high copying fidelity. This genetic information is encoded in a sequence of nucleotides on a strand of deoxyribonucleic acid. When genetic material is copied from progenitor to offspring during reproduction, the sequence of nucleotides is conserved fairly accurately, although some changes in the sequence can occur through mutations. Second, genes are claimed to have consistent phenotypic effects. It is suggested that a particular sequence of nucleotides, given a certain set of conditions, codes for a particular chain of amino acids which, given a certain set of

conditions, has a particular effect on the phenotypic outcome of the organism. In turn, the phenotypic outcome, by affecting the survival and reproductive prospects of the organism, influences the probability of subsequent copies of the sequence of nucleotides.

We can see how these theoretical considerations might be taken to support a genocentric conception of the biological tie between parent and child. To be clear, I am not claiming that scientists such as Dawkins and Williams themselves endorsed such a genocentric conception of the biological tie, nor am I claiming that people were led to a genocentric conception by the works of these scientists. Rather, these works were parts of a much wider public fascination with genetic science, which then became discursively linked with the notion of 'blood' relatedness to support a genocentric approach to parenthood. Genetic information is supposed to be the ingredient conserved between progenitor and offspring during reproduction. This conserved genetic information is then supposed to explain whatever phenotypic resemblance the progenitor and offspring might have. Hence, the biological tie between parent and child is often characterised as comprising mostly of genetic relatedness.

Also, we can see how commonplace arguments to value the biological tie appeal to the aforementioned properties that genes are purported to have. As noted earlier, three of these reasons are that the biological tie is believed to achieve a form of immortality, increase the likelihood of family resemblance, and is important for developing a sense of identity. The belief about immortality appeals to the high copying fidelity of genetic information. A parent is construed as achieving immortality insofar their genetic information is accurately conserved in the genome of their genetically related child (Aarssen, 2007). The belief in the increased likelihood of resemblance between parent and child appeals to both the high copying fidelity of genetic information and the supposed consistent phenotypic effects of genes. A parent and their genetically related child may be expected to resemble each other because they share many of the same genes, and because it is assumed that these genes have similar effects on their phenotypes (Almond, 1999). The belief that the biological tie is important to develop a sense of identity also appeals to the high copying fidelity of genetic information and the supposed consistent phenotypic effects of genes, insofar as this sense of identity is suggested to be partly derived from perceived family resemblance and knowledge of shared ancestry. That is to say, the genetic legacy shared with ancestors, which is supposed to explain similarities shared with these ancestors, is supposed to help one 'understand what it means to be like this' (Velleman, 2005, p. 376).

Of course, these cannot be the only reasons why genetic parenthood is considered desirable. Otherwise, cloning could be considered preferable to sexual reproduction. Other reasons, which are more obviously applicable to sexual reproduction than to cloning, are that procreation contributes to sexual intimacy and that bringing a child into the world together affirms a couple's reciprocal love (Strong, 2000). For considerations of scope, I will not address these additional reasons in this paper. But, detailed criticisms have been given by Neil Levy and Mianna Lotz (2005). Furthermore, I do not claim that genetic relatedness is the only reason why procreation gets considered preferable to adoption. Another aspect of procreation is gestation, which is highly valued for its role in development and its contribution to bonding. This is an important part of the biological connection between parent and child that is not necessarily reducible to genetic relatedness. However, my focus in this paper is on the perceived significance of genetic relatedness, and so, for considerations of scope, I will not address the topic of gestation in detail.

The above highlights some of the ways in which attitudes towards biological ties between parent and child reflect a wider cultural influence of genetic science. The properties that are purported to make genes the principal carriers of inherited information are often taken to support a narrowly genocentric conception of this biological tie. Their supposed contributions to immortality, family resemblance, and the sense of identity are also sometimes considered to explain and vindicate desires to have a biological tie with one's child.

Criticisms of the emphasis on genetic relatedness

The above emphasis on the biological tie between parent and child has been criticised from feminist and moral philosophy perspectives. As noted before, scholars have commented on how society's valorisation of the biological tie constrains women's reproductive choices (Brakman & Scholz, 2006; Cavaliere, 2020; Petropanagos, 2017). Additionally, Brakman and Scholz (2006) argue that the emphasis on biological reproduction unduly constrains how the maternal body is experienced. The maternal body, they argue, becomes narrowly characterised by its ability to reproduce biologically, neglecting many other aspects central to the experience of maternity. As an alternative, they propose an embodied approach to maternity that appreciates 'the nurturing and physical contact of adoptive mothers, as well as the communal nature of adoption itself' (Brakman and Scholz, 2006, p. 62).

In moral philosophy literature, specific criticisms have also been raised against the considerations of immortality, resemblance, and identity as reasons for preferring genetic parenthood. The notion that a form of immortality is achieved through genetic parenthood is criticised by Levy and Lotz (2005), who note that the genetic proportion for which anyone is causally responsible is actually very low and will continually get lower with successive generations. A given individual shares the overwhelming majority of their genetic information with all other humans and even with other primates. Of the small proportion of their genetic information that varies between humans, they will pass down half to their genetic child, who in turn will pass down half of this to their genetic child, and so on. Therefore, after a few generations, the genetic contribution of the initial progenitor is negligible. Furthermore, another way of achieving immortality is social, as children inherit not only genes from their parents, but also values, interests, attitudes, beliefs, and customs. In other words, genetic information is not the only inherited resource with high copying fidelity.

The perceived significance of genetic inheritance to immortality is also scrutinised in Janet Carsten's (2000) study on adoptees in the United Kingdom who have sought reunions with their birth kin. The research reports that even though the desire to search for biological continuity may have partly motivated the adoptee to seek their birth kin, this became much less important after the reunion. Rather, what was considered central to the sense of permanence was not genetic kinship, but the parental relationship which was actively produced over time. Accordingly, Carsten concludes 'that biology does not imply endurance, since duration in time necessarily authenticates adoptive kinship' (Carsten, 2000, p. 700).

Regarding the desire for family resemblance, Levy and Lotz (2005) criticise the assumption that genes have consistent phenotypic effects. While they acknowledge that genotypes clearly contribute something to phenotypic outcomes, they stress that social and environmental factors also influence this phenotypic outcome significantly. Indeed, as the psychologist Eleanor Maccoby (2000) notes, genetic similarities can contribute to behavioural similarities, but observed disparities between genetic siblings and empirically established effects of parenting interventions indicate that children's social interactions with their parents also have significant effects on their later development. After all, any trait depends on both genetic and environmental resources in order to develop at all. Hence, merely sharing some of the same genes does not guarantee resemblance.

The influences of shared social factors are primarily obvious for resemblances in 'our most important individual characteristics', including our moral values, political attitudes, spiritual beliefs, and common interests (Levy & Lotz, 2005, p. 238). Accordingly, Levy and Lotz repudiate Almond's suggestion that genetic relatedness results in parent and child sharing 'attitudes, appraisals, interests, tendencies, common qualities of character, a common *Weltanschauung*—a characteristic way of looking at the world' (Almond, 1999, p. 104). Instead, they propose that it 'is extremely unlikely that a child's genes determine its fundamental outlook, its *Weltanschauung*' (Levy & Lotz, 2005 p. 237). Tina Rulli also proposes that there are resemblances between adoptive parents and their children which 'are

not exclusively genetically explained, such as mannerisms, body language, facial expressions, behaviour, speech patterns, accents, interests, hobbies, and so on' (Rulli, 2016, p. 683).

Regarding the sense of identity, Sally Haslanger (2009) notes that one's sense of identity has various possible sources beyond the genetic legacy shared with ancestors. Many of these sources are social, including relations with others, linguistic practices, and shared cultural meanings. Moreover, which sources are considered relevant for one's sense of identity are contingent, with context encompassing the immediate family and the wider society. A child raised in a family that emphasises the value of the biological tie may consider genetic ancestry to be important for their sense of identity. But a child raised in a family less preoccupied with the biological tie may consider their genetic ancestry to be less important than other sources for their sense of identity. Again, this is corroborated by the aforementioned research by Carsten (2000), who found that even though being reunited with their birth kin allowed some adoptees to appreciate certain traits they possessed, they felt that their overall identities had been shaped primarily by their upbringing.

The above criticisms of society's emphasis on genetic relatedness all express a common message: the normative discourse on parenthood places 'an unwarranted emphasis on the importance of biological as opposed to social connectedness' (Levy & Lotz, 2005, p. 243). Not only do biological facts about genes often fail to justify people's desires for biological ties with their children. Social ties between parents and their children can account for many of the desired features of parenthood too. This is reflected in Susan Bordo's personal account of becoming an adoptive mother, wherein she reports that 'biological connection … felt utterly superfluous; adoption felt wonderfully right' (Bordo, 2005, p. 230). The implication here is that the absence of a biological connection in adoptive parenthood is irrelevant, because it is the social connection formed between parent and child that is valuable. It is in recognition of this social connection that adoptive parenthood is usually argued to be as valuable and legitimate as genetic parenthood.

While I agree with this message, I suggest that characterising adoptive parenthood as involving purely social connections concedes too much to advocates of genetic parenthood. In debates about the value of biological ties, advocates and critics alike presuppose that ties between adoptive parents and their children are only social and not biological. However, this is not entirely accurate. In addition to their connection by social ties, I argue that some ties formed between adoptive parents and their children can be properly described as biological. In what follows, we shall see that the narrowly genocentric conception of the biological tie commonly assumed in normative discourse on parenthood is out of touch with contemporary biological thought. Instead, I will show that work in the philosophy of biology lends support to more inclusive conceptions of the biological tie that acknowledges other formative and inheritable links between parent and child aside from genetic relatedness.

Expanding the conception of the biological tie

As noted earlier, there are two major reasons why genes are traditionally considered principal carriers of inherited information and basic units of selection. First, genetic information is suggested to be unique with respect to its high copying fidelity. Second, genes are thought to have consistent phenotypic effects.

However, both claims have been challenged in the philosophy of biology. Philosophers have proposed alternative ways to understand inheritance, development, and evolution that reject the centrality of genetic transmission, including multilevel selection theory and group selection theory (Okasha, 2006; Sober and Wilson, 1998). Perhaps the most ambitious and fully developed of such approaches is developmental systems theory. This philosophical framework developed by Susan Oyama, Paul Griffiths, and Russell Gray emphasises how the development of an organism is a dynamic process that depends on contingent interactions between diverse internal and external resources (Griffiths & Gray,

1994; Oyama et al., 2001). Oyama and colleagues list a number of themes that characterise developmental systems theory, which are joint determination by multiple causes, context sensitivity and contingency, extended inheritance, development as construction, distributed control, and evolution as construction (Oyama et al., 2001, p. 2).

Developmental systems theory is by no means uncontroversial. While it provides a plausible philosophical framework to understand inheritance, development, and evolution in general, it is yet to establish a full repertoire of methods to produce empirical data that support specific hypotheses (Longino, 2013). Nonetheless, the framework is still very valuable for underscoring how the genocentric view is inadequate. Some highlighted features, like joint determination by multiple causes, extended inheritance, and development as construction, are plausible in their own rights, and accepting them does not necessitate fully committing to the strong program. Hence, while I draw on them in my analysis, this does not require us to accept other, more contentious aspects of developmental systems theory. Below, we shall see how some of these features undermine the genocentric view.

The claim that genetic information is unique due to its high copying fidelity is challenged by the notion of extended inheritance. Instead of privileging any single kind of resource as the carrier of inherited information, it is recognised that various developmental resources are inherited across generations. We have already seen that many social resources are inherited, including linguistic conventions, accents, interests, values attitudes, and cultural practices (Levy and Lotz, 2005; Rulli, 2016). To these, we can also add resources like education, housing, and wealth. In addition to these social resources, some biological resources are inherited or reconstructed across generations. Epigenetic modifications are changes on chromosomal regions, often environmentally triggered, that influence phenotypic traits by altering the activities of genes without altering the sequences of nucleotides (Gottlieb, 1991). Biological resemblances may also be reconstructed across generations through interactions with other inherited factors. For example, metabolic similarities may form because parents and children share dietary practices, while immunological and microbiotic similarities may emerge due to parents and children' exposure to similar microorganisms (Garn et al., 1976; Mukherjee et al., 2020). Therefore, genetic information is not unique with respect to high copying fidelity.

The claim that genes have consistent phenotypic effects is challenged by the themes of joint determination by multiple causes and development as construction. Instead of privileging genes as determining causes of phenotypic traits and relegating environmental factors to mere enabling conditions, phenotypic traits are recognised as contingent products of multiple interdependent resources. No single resource controls the process of development. Instead, the process of development is dependent on all resources interacting with one another. Such interactions are context sensitive, and the particular causal role of any given resource varies with the state of the rest of the developmental system, which includes organism, environment, and the interaction between them. It is inaccurate, then, to think of genes as 'blueprints' for phenotypes. Rather, phenotypes are contingent outcomes of a process of construction involving dynamic interactions of multiple interdependent resources. Therefore, the phenotypic effects of genes are no more consistent than the phenotypic effects of other factors.

The above suggests that genetic information is neither as unique with respect to its high copying fidelity nor as consistent with respect to its phenotypic effect as commonly assumed. This troubles privileging genetic relatedness as a unique marker of inherited biological influence. To be clear, the claim here is not that genetic inheritance is irrelevant to phenotypic outcome. It is clearly a major factor. Rather, the claim is that while genetic information is one kind of inherited resource, parents share many other developmental resources with their children. These contribute to their phenotypic outcomes, account for resemblances between them, and are conserved across generations. What this suggests is that the genocentric conception of the biological assumed in normative discourse on parenthood is inadequate. By parity of reasoning, if inherited genetic information is to be included in the

conception of the biological tie, other inherited developmental resources should be included too. In what follows, I explore how this revised and more inclusive conception of the biological tie applies to adoptive parenthood.

The biological tie in the adoptive family

An implication of moving beyond genocentric conceptions to a more inclusive understandings of the biological tie is that it enables an appreciation of the variety of biological ties formed between adoptive parents and their genetically unrelated children. It is uncontroversial that adoptive parents and their children are connected by strong social ties. However, the discussion above indicates that they also share many enduring and formative ties which can be properly called biological. Many of these ties, I argue, are relevant to the considerations of immortality, family resemblance, and the sense of identity, which are traditionally suggested as reasons to value genetic relatedness. As we shall see, these can be achieved even with adoption, partly because the biological effects of parenting transcend mere genetic inheritance.

The notion of development as construction emphasises that phenotypic outcomes do not result from the unfolding of a predetermined genetic program, but is constructed through dynamic interactions of internal and external resources over time. Parents influences their child biologically, not only by transferring genetic material in reproduction, but do so continually throughout development via childrearing. This process includes feeding, bodily contact, sensory stimulation, and behavioural reinforcement. Just as any organism is predominantly constituted by external factors, infants depend on childrearing interactions for biological and psychological development. Consequently, adoptive parents, insofar they provide their children with the biological and psychological resources required in order for them to develop, are crucial parts of the developmental systems of their adopted children. Biological ties are forged between adoptive parents and their children through their joint construction of these developmental systems.

These formative childrearing interactions can result in resemblances between adoptive parents and their children. We have already seen how they might come to share behavioural resemblances, like 'mannerisms, body language, facial expressions, behaviour, speech patterns, accents, interests, hobbies, and so on' (Rulli, 2016, p. 683). This is supported by anecdotal reports of children adopting the facial expressions and mannerisms of their adoptive parents (American Adoptions, 2011; Simpson, 2014). A study by Kenneth Kendler and colleagues provides further evidence for psychological similarity; they demonstrate that adopted children come to resemble their adoptive parents with respect to their cognitive abilities (Kendler et al., 2015). Many of the developmental resources that contribute to these resemblances are social, including communicative styles, parental interests, educational practices, and economic circumstances. However, in order to develop, these cognitive abilities also depend on paradigmatically biological interactions. The effects of bodily contact, sensory stimulation, and positive reinforcement on the neurodevelopmental processes occasion the aforementioned cognitive resemblances.

Again, the claim here is not that connections between parents and their children ordinarily described as social should be reclassified as biological. Rather, it is that some of the psychological resemblances between adoptive parents and their children depend developmentally on nongenetic biological effects of parenting in addition to transmitted social resources. Of course, some scholars might consider that the interdependence of biological and social resources suggest the dichotomy between these categories should be abandoned altogether. Admittedly, proponents of developmental systems theory sometimes approximate this suggestion, insofar they refuse dividing developmental resources into nature and nurture (Griffiths & Gray, 1994; Oyama et al., 2001). Recent feminist scholars have also suggested novel ways of undermining the traditional dichotomy between nature and culture in even wider contexts beyond developmental biology (Braidotti, 2013; Haraway, 2003). However, the analysis I offer here does not necessitate such radical revisions of commonplace

concepts. While it does advocate moving beyond a narrowly genocentric conception of the biological tie, it does not require us to widen the category beyond what would still ordinarily be recognised as paradigmatically biological, albeit nongenetic. Indeed, the domain of the social need not be reduced to the domain of the biological for the nongenetic biological effects of parenting to be appreciated.

In addition to psychological resemblances developed between adoptive parents and their children, some suggest that nongenetic biological effects of parenting could contribute to physiological resemblances. A study by Stanley Garn and colleagues (Garn et al., 1976) compared resemblances in adoptive families and genetically related families. It found that adopted children tend to resemble their adoptive parents with respect to height, weight, and subcutaneous fat distribution to extents that parallel the resemblances in height, weight, and subcutaneous fat distribution in genetically related families. Accordingly, the researchers note that 'parents and their children share more than genes in common, and some part of parent-child resemblances in stature and other dimensions may reflect nutritional level, dietary habits and learned patterns of energy expenditure and conservation' (Garn et al., 1976, p. 539). Other biological resemblances that might form in adoptive families include microbiotic resemblances, which concern strains of microorganisms that constitute the commensal and symbiotic communities in our bodies. Findings are yet to be replicated, but a preliminary study shows that the oral microbiota of adopted children come to resemble the oral microbiota of their adoptive parents to extents that parallel the oral microbiotic resemblances formed in genetically related families, 'indicating no effect of host genetics on the fidelity of transmission' and 'suggesting that contact and shared environment were the major factors shaping the oral microbiota' (Mukherjee et al., 2020, pp. 2–3). The significance of this for development is yet to be established, but given that commensal and symbiotic microorganisms are thought to have significant immunological and metabolic effects on their hosts, it is at least plausible that microbiotic resemblances could be formative influences on certain physiological characteristics of the adoptees.

The above shows how resemblances between adoptive parents and their children can be achieved through nongenetic biological effects of parenting in conjunction with effects of transmitted social resources. Furthermore, I suggest that the notion of extended inheritance draws attention to the ways in which the biological and social resources underpinning these resemblances can be copied across generations. Some mechanisms of inheritance may be behavioural, like learned dietary patterns imparted from parents to their children that contribute to the physiological resemblances obtained in adoptive families. Other mechanisms may be more obviously biological, such as the aforementioned effects of childrearing interactions on neurodevelopmental processes that occasion cognitive resemblances. More tentatively, childrearing interactions between adoptive parents and their children may result in epigenetic changes on chromosomal regions that influence phenotypic traits, although we must concede that molecular evidence is yet to be found for the role of epigenetic inheritance in adoptive families.

Given that some developmental resources are copied across generations, they could articulate a sense of immortality. As noted before, this sense of immortality sometimes legitimises privileging genetic parenthood. However, we have seen that intergenerational effects of parenting transcend mere genetic inheritance. In conjunction with social resources transmitted from adoptive parents to their children, biological interactions such as feeding, bodily contact, sensory stimulation, and behavioural reinforcement have formative effects that can be reconstructed across generations. Recall, for example, the aforementioned study demonstrating that adopted children come to resemble their adoptive parents' cognitive abilities (Kendler et al., 2015). Plausibly, the cognitive abilities acquired by the adoptees later enable them to interact with their children in ways that again reproduce the development of similar cognitive abilities. Additionally Luke Hyde and colleagues examined the effects of parenting interventions on the subsequent developmental trajectories of children exhibiting antisocial traits in a recent study (Hyde et al., 2016). The research found that positive

reinforcement from an adoptive parent significantly alleviated antisocial behaviour and prevented the development of further antisocial behaviour. This suggests that appropriate caregiving by adoptive parents can have a neurodevelopmental action that curtails the harmful effect of previous childhood trauma. This could have a lasting influence on the adoptee's subsequent developmental trajectory, which in turn could provide the schema for how the adoptee subsequently interacts with and developmentally influences their own child.

And so, the notions of development as construction and extended inheritance allow us to appreciate how enduring social and biological ties form between adoptive parents and their children. Given that these social and biological resources are significantly and causally influence how children develop, they are as relevant to one's sense of identity as one's genetic background. Indeed, as noted in the aforementioned study by Carsten (2000), adoptees often report that while they consider their birth kin to be important, their overall identities had significantly been shaped by their upbringing. However, what I have shown in my analysis is that these upbringings do not merely involve sharing social interests and resources, but also involve the biological effects of parental care and nurturance which go beyond genes.

Conclusion

We have seen that the biological tie between parent and child is widely assumed to have special value. In normative discourse on parenthood, this biological tie tends to be narrowly conceptualised as genetic relatedness. This is partly because the inheritance of genetic information is believed to achieve a form of immortality, increase the likelihood of family resemblance, and stimulate developing a sense of identity. Here, I have argued that this narrowly genocentric conception of the biological tie does not withstand scrutiny. Recent work in the philosophy of biology demonstrates that genetic information is not unique in its inheritability or effect on development. Rather, there are many inherited biological influences apart from genes which are imparted from parents to their children. Given that these influences are also relevant to the aforementioned considerations of immortality, resemblance, and identity, they warrant inclusion in the conception of the biological tie. If we accept this revised conception, we can appreciate the rich variety of biological ties formed between adoptive parents and their children through their developmental interactions. In addition to the social ties formed through interpersonal relations and shared cultural practices, childrearing interactions like feeding, bodily contact, sensory stimulation, and positive reinforcement can have enduring biological effects, which can occasion resemblances and contribute to the children's identities. Adoptive parents and their children, then, are biologically tied through their joint construction of developmental systems.

The philosophical analysis I have offered is intended to complement, not challenge, previous critical discussions of the biological tie in normative discourse on parenthood. As noted before, philosophers have convincingly argued for the recognition of social ties between parents and their children as equally, or even more, valuable than biological ties. I consider this broadly valid. Nonetheless, what my analysis shows is that some arguments in favour of genetic parenthood are also applicable to adoptive parenthood. As we have seen, lacking genetic relatedness does not preclude adoptive parents and their children from sharing various biological ties. The benefits of this philosophical analysis are twofold. First, by drawing attention to the biological ties that are formed between adoptive parents and their children, it casts adoptive parenthood in a more positive light for prospective parents who value biological ties. Second, the notions of extended inheritance and development as construction offers adoptive parents further conceptual resources to interpret their childrearing experiences and legitimise their families in the face of stigmatisation.

Declaration

The author declares no conflicts of interest.

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