

# **Do evolutionary mechanisms apply for adoptive families?**

## **The link between physical resemblance, personality similarity and odor recognition on the parent-child relationship in adoptive families**



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### **Abstract**

From an evolutionary perspective, parental investment may be guided by psychological mechanisms which were shaped by natural selection and rely on certain cues of resemblance which could indicate kinship. This study investigates whether certain evolutionary mechanisms also apply for adoptive families. The influence of facial resemblance, personality similarity and odor recognition on the parent-child relationship was examined within 54 families with 76 children. A positive correlation between facial resemblance and time investment for adoptive mothers was found. For personality similarity a link to investment was found for both adoptive mothers and fathers. Increased personality similarity between mother and child was related to more maternal time investment and less use of corporal punishment. For adoptive fathers personality similarity was positively correlated to emotional closeness. Additionally, a relation between odor recognition and maternal investment was found, whereby the ability to recognize the child was linked to the increased use of corporal punishment. Taken together, these results indicate that underlying evolutionary mechanisms may also influence the parent-child relationship between adoptive parents and their children.

**Do evolutionary mechanisms apply for adoptive families? - The link between physical resemblance, personality similarity and odor recognition on the parent-child relationship in adoptive families**

According to the theory of inclusive fitness, parents care more for their biological children than for their “social” children (Schnettler & Steinbach, 2011). Does this mean that adoptive children receive worse care? According to Gibson (2009) the opposite is true and adoptive children receive more attention and investment from their parents than their biological children. These findings were also found by Hamilton, Cheng and Powell (2007). Which statement is true?

Based on evolutionary theory, kinship plays an important role for investment of parents. The theory of kin selection states that individuals contribute genetically to future generations by reproduction and favor kin above unrelated individuals through inclusive fitness to ensure their (genes) survival. It is even suggested that psychological mechanisms have evolved, due to natural selection, to protect parents from investing in unrelated offspring (Daly & Wilson, 1980). Parents would invest more in children they can be sure are theirs, based on certain cues of resemblance. From an evolutionary perspective, adoption appears to be a form of altruism, as it enhances the fitness of the recipient and lowers the fitness of the donor. According to kin selection theory, altruism is dependent of the probability of shared genes (Silk, 1990) and most adoption among animals occurs through relatives. Research confirmed that mammalian parents use a variety of mechanisms, like smell, to recognize their offspring. They are even able to distinguish between the more “fit” of their related offspring and bias investment towards them (Gibson, 2009).

However, according to Hartman and Laird (1990, in Hamilton et al., 2007) adoptive parents may increase their efforts to be “good parents” in order to compensate for the fear of shortcomings or to mask the fact that they are not the “real” parents. Some researchers even

found that adoptive parents tend to invest more in their children than biologically related parents (Hamilton, Cheng, & Powell, 2007).

According to the environment of evolutionary adaptedness theory (EEA), mechanisms behind parental investment may respond to cues in the modern environment and actually work against genetic fitness (Kaplan, 1996). Adoption is sometimes explained as the confusion of evolutionary impulses that once worked in a different context. This implies that the current context in which adoption occurs is so new that evolutionary predispositions may not have yet caught up, leaving adoptive parents vulnerable to the intrinsic desire for children (Hamilton et al., 2007). According to Silk (1990) humans seem to possess innate psychological predispositions that promote an intense desire for children and permit the formation of close relationships with infants and children of strangers. As a result, adoptive parents may invest in their adopted children as if they were their own biological children.

The main goal of this research is to investigate if the psychological mechanisms which influence parental investment can also be found to apply for the relationship between adoptive parents and their children. From an evolutionary perspective, parental investment may be guided by psychological mechanisms which were shaped by natural selection and rely on certain cues of resemblance which could indicate kinship. Self-referent phenotypic matching is a mechanism which underlies the resemblance. Parents may use this mechanism to compare their own phenotypes to those of their children to indicate kinship. In this study the focus lies on 3 aspects of kin recognition: facial resemblance, personality similarity and odor recognition. The influence of these three aspects on parental investment is investigated among adoptive parents.

### **The correlation between facial resemblance and parental investment**

The first focus of this study is on facial resemblance, which may seem unimportant when it comes to adoptive families, but research confirmed that perceived physical similarity

plays an important role for parental investment (Alvergne, Faurie, & Raymond, 2010; Platek, Raines, Gallup, Mohamed, Thomson et. al., 2004). It is even demonstrated that facial resemblance increases trustworthiness and leads to greater cooperation (DeBruine, 2002). Some brain areas are specifically involved in the recognition of familiar faces (Malone, Morris, Kay, & Levin, 1982). Facial resemblance is a physical visible cue which can act as an indicator for kinship (DeBruine, Smith, Jones, Roberts, Petrie, & Spector, 2009; Maloney & Dal Martello, 2006; Alvergne et. al., 2007). Indeed facial resemblance between individuals (assessed by unfamiliar judges) has been demonstrated to be a reliable indication of genetic relatedness (DeBruine et al., 2009; Maloney & Dal Martello, 2006; Alvergne et. al., 2007).

Fathers face uncertainty when it comes to paternity, therefore evolutionary theory suggests that they use physical cues to judge kinship (Alvergne et al., 2010). Research has confirmed that, especially for fathers, facial resemblance seems to act as a key for kin recognition (Platek, 2002). They therefore should invest more in children who resemble them. Adoptive parents do not face parental uncertainty and know that they are not genetically related to their children, so facial resemblance is less likely in this group. However, the evolutionary mechanism of parental investment that is linked to resemblance could also apply for adoptive parents. Even though the average similarity between adoptive parents and their children might be lower, this does not mean that there are no adoptive parents who resemble their children. Variation in resemblance can exist in adoptive families with some parent-child pairs having more resemblance than others.

Platek et al. (2004) found that only for males, a significant activation in the left frontal cortex, the part of the brain which is involved in the inhibition of negative responses (Colette, Van der Linden, Delfiore, Degueldre, Luxen, & Salomon In Platek et al, 2004), occurred when they were exposed to self resembling photos of children's faces (Platek et al., 2004). These results suggest that even on a cerebral level, facial resemblance plays a more important

role for males. These perceived facial resemblance could play a role unconsciously and influence the relationship between adoptive parent and child and therefore would be related to parental investment. There is no research yet available, that tested the link between facial resemblance and parental investment among adoptive parents and their children. However, research that tested adoption preference and hypothetical investment found significant effects for males based on children's self-resembling facial photographs (Platek et al., 2004). In accordance Volk and Quinsey (2002) found a significant correlation between facial resemblance and adoption preferences for males, where participants had to choose which child they would like to adopt, based on (self-resembling) child photographs. This correlation was significantly greater for males than for females. These findings suggest that facial resemblance is more important for males, but a study conducted by Bressan, Bertamini, Nalli and Zanutto (2009) showed the opposite. A significant preference for self-resembling children's faces (morphed photographs) for women, but not for men, was found. In contrast, a study conducted by Welling, Burris and Puts (2011) found evidence that both men and women preferred self-resemblance in children's faces. In accordance, DeBruine (2004) also found that children's facial resemblance increased hypothetical investment for both sexes.

The contradictory findings on parental investment and facial resemblance can be a result of methodological differences. Some studies used actual photos (Volk & Quinsey, 2002) where the participants and the photographed child were not even related, others used photos morphed with different methods, to simulate resemblance (Platek et al., 2004; Bressan et al., 2009; Welling et al., 2011; DeBruine, 2004). As the results concerning children's facial resemblance and hypothetical investment decisions are contradictory, more research is needed to clarify if facial resemblance of the child to self is important for parental investment.

Research which focused on actual parental investment, conducted with biologically related families confirmed that parental investment was significantly related to perceived

resemblance for father and child (Apicella & Marlowe, 2007; 2004). Mothers seem to feel this link intuitively, since they seem to stimulate parental investment in fathers by claiming facial resemblance shortly after birth even if this does not correspond to actual resemblance (Alvergne et al., 2007). However, the study of Apicella and Marlowe (2007) must be interpreted with caution, because the study conditions were not optimal. The participants were randomly recruited males at an airport with children between 0 years to 21 years old. Furthermore, the paternal resemblance only relied upon the judgment of the participating fathers, no control was used and mothers and children were not investigated. Also their measure of similarity is methodically weak, as personality and physical aspects were combined to one measure of similarity though these are different constructs and it is questionable if they can be treated as one measure.

A study conducted by Heijkoop, Dubas and van Aken (2009) confirmed that physical resemblance is important for the investment of fathers, but not for mothers. Father's emotional closeness was positively linked to physical resemblance. Alvergne et al. (2010) also found that emotional closeness between fathers and children was linked to physical similarity. Even self reported quality of the relationship between father and child was linked to physical similarity (Burch & Gallup, 2000 in Alvergne et. al., 2010). Yet, this link was not found for mothers. Besides in the study of Alvergne et al., (2010) investment is only measured by parental reports, which can be biased through social desirability. Also only thirty-seven families participated which is a small number to draw conclusions from.

On the one hand, research focusing on hypothetical investment decisions found contradictory results for males and females, concerning the link between hypothetical investment decisions and facial resemblance (Bressan et al., 2009; DeBruine, 2004; Platek et al., 2004, Volk & Quinsey, 2002; Welling et al., 2011), on the other hand, research conducted with genetically related families, which focused on the link between facial resemblance and

actual parental investment, confirmed this link for fathers but not for mothers (Alvergne et al., 2010; Apicella & Marlowe, 2007; 2004, Heijkoop et al., 2009).

The question that arises is whether facial resemblance has an effect on the investment of adoptive parents regarding their children and thus if facial resemblance has an influence on the parent-child relationship. If facial resemblance is linked to investment for adoptive parents towards their child, this could mean that some evolutionary mechanisms play a role in their relationship though they have no genetic link. It is expected that facial similarity is important for adoptive parents, although they know that they are not the biological parents. According to Howell et al., (2006) though transnationally adopted children cannot be mistaken for their parents' biological children, adoptive parents may feel a need to search for similarities with their adopted child, in an attempt to create meaningful resemblance between themselves and their children. This perceived similarity could influence their mutual relationship. If the link between facial similarity and investment is found it could be evidence that an underlying evolutionary mechanism also applies in the parent-child relationship of adoptive families, even without a genetic link.

### **The correlation between personality similarity and parental investment**

The second focus of this study is personality similarity as a marker for genetic relatedness. Research on parent-child relationship suggests that positive emotionality in the relationship is strongly affected by the genetically influenced personality of both parent and child (Prinzle, Stams, Deković, Reijntjes, & Belsky, 2009). Research results confirm that both parents' and children's personalities predict the quality of their mutual relationship. There is also evidence that personality similarity is linked to less problem behavior of adolescents and better parent-child relationships (van Tuijl, Branje, Dubas, Vermulst, & van Aken, 2005; Denissen et al., 2009; de Haan et al., 2012). Personality similarity could act as a cue for kin recognition and thus impact the quality of the parent child relationship, whereby parents would prefer



personality similarity in their children. According to Lerner (1993) personality similarity between parent and child is important and this “fit” influences the mutual relationship (in Rueter, Keyes, Iacono and McGue, 2009) and prevents problem behavior (Heijkoop et al., 2009; Prinzie, Deković, van den Akker, de Haan, Stoltz, & Hendriks, 2012; van Tuijl et al., 2005; Denissen et al., 2009; de Haan et al., 2012). A good fit is typically seen as the mix of similar characteristics in parents and children resulting in compatibility and positive adjustment (Rueter et al., 2009), this is known as the goodness-of-fit model. If the child’s behavior fits with the parents’ expectations then problems are less likely to occur (Heijkoop et al., 2009). Parenting is associated with goodness-of-fit relations between parent and child personality in which a match between parent and child characteristics is important (Prinzie et al., 2012). However, the research of Prinzie et al. (2012) only focused on fathers and no mothers were investigated.

Research which focused on parent-child personality similarity in biologically related and adoptive families, found a modest degree of similarities for the genetically related families but only minimal similarities for adoptive family members (Scarr, Webber, Weinberg, & Witting, 1981). Similar findings were reported by Loehlin, Willerman and Horn (1985), who also found “very little” personality similarity between adoptive parents and their adopted children (average correlations about .05). The average correlations are slightly positive which suggests that shared family life makes biologically unrelated individuals somewhat alike (Loehlin et al., 1985). This seems to suggest that personality is more affected by genetic influences than by environmental influences. These findings are supported in a ten year follow-up study, which investigated personality resemblance in adoptive families and found a near-zero influence of shared family environmental influences on personality (Loehlin et al., 1987).

Personality similarity could be a cue for kin recognition and therefore it should be related to parental investment. Research by Heijkoop et al., (2009), conducted with genetically related families, found a link between maternal investment and personality similarity. For mothers, but not for fathers, emotional closeness was linked to personality similarity. The personality similarity was calculated based on 30-items of the Big Five questionnaire using Q-Correlations.

Focusing on research with adoptive families, the only research known which investigated personality similarity, found a link between personality similarity and emotional closeness to the child for fathers (Loehlin, Horn, & Ernst, 2010). This link was not found for mothers. However, judgments of emotional closeness were retrospective and based on a single rating scale item, furthermore, the personality measures used were taken 10 years apart by the two generations and at different ages. This is the only study known, which investigated this link for adoptive families, so more research is needed to confirm or reject these findings.

On the one hand, research of biologically related families found a link between personality similarity and investment for mothers (Heijkoop et al., 2009; van Tuijl et al., 2005; Denissen et al., 2009) and fathers (Apicella & Marlowe, 2007; Prinzie et al., 2012). On the other hand, research with adopted families only found this link for fathers (Loehlin et al., 2010). Until now, the only research which investigated the link between personality similarity and parental investment for adoptive families, found a link for fathers, therefore more research is needed to draw further conclusions. If a link is found between personality similarity and parental investment for adoptive parents, this suggests that personality similarity is an important marker for kin recognition and is (unconsciously) used by parents to make investment decisions. Therefore evolutionary mechanisms may also influence the quality of the relationship between adoptive parents and their adopted children, although more proximal mechanism, such as goodness-of-fit cannot be ruled out.

### **The correlation between odor recognition and parental investment**

The third focus of this research is odor recognition. The role of olfaction in kin recognition and parental investment has frequently been confirmed for mammals (Mateo, 2002; Yamazaki, Beauchamp, Curran, Bard, & Boyse, 2000; Porter, Cernoch, & McLaughlin, 1983). Research also focused on the question whether humans are able to recognize family members with olfactory cues. Results confirmed that mothers were able to identify their infants by smell alone (Russel, Mendelson and Peeke, 1983; Porter, Cernoch and McLaughlin, 1982), however fathers could not identify their children by a higher rate than by chance. Other research results demonstrated that both mothers and fathers were able to distinguish between the odors of their children (siblings) (Porter & Moore, 1981). However, a study conducted by Weisfeld, Czilli, Phillips, Gall and Lichtman (2009) found that both mothers and fathers were able to distinguish their own child from a control child but that they were not able to distinguish between their children. Also, research conducted by Dubas, Heijkoop and van Aken (2009) demonstrated that mothers and fathers did not significantly differ in their ability to identify their child's odor.

No research, as far as known, focused on the question whether adoptive parents are able to recognize their child by odor. Weisfeld et al. (2003) found that mothers were able to identify their biological children but not their stepchildren. This could indicate that adoptive parents would not be able to recognize their child. However, if adoptive parents are also able to recognize their child by olfactory cues this could indicate an underlying psychological mechanism in the parent-child relationship, that applies for both biologically related and adoptive parents.

Olfactory recognition, as a self-referent phenotypic match between parent and child, can indicate kinship and impact the parent-child relationship. As mentioned earlier, there is evidence that olfactory recognition is linked to the quality of the relationship between parents

and their children. Research conducted by Dubas et al. (2009) found that mothers' olfactory recognition is linked to the use of physical punishment towards their children, mothers reported using more punishment toward children they could not recognize. They also found that fathers exhibited more affection and fewer ignoring behaviors towards children whose smell they could identify. These results suggest that olfactory recognition was more often related to parental investment for fathers than mothers, suggesting an underlying evolutionary mechanism which seems to be stronger when parental uncertainty is faced. Concerning olfactory recognition and the effect on paternal investment Alvergne et al. (2010) stated that fathers may use olfactory recognition to confirm kinship and thus invest more in children whose odor was similar to theirs. They found that senegalian fathers, who had a similar odor to their child, tended to invest more in this child.

Up to now there are no research results available that investigated the link between odor recognition and the quality of the parent-child relationship for adoptive parents and their children. If olfactory recognition is linked to investment for adoptive parents this could indicate that evolutionary mechanisms also apply for adoptive families. This would suggest that, even without a genetic link, evolutionary mechanisms can apply.

### **Research Questions**

From an evolutionary perspective, based on the asymmetry of parental certainty, fathers are expected to rely more on certain cues of resemblance, which could indicate kinship, than mothers. However, adoptive parents know that they are not genetically related to their child, so here parental uncertainty is not the issue, nevertheless evolutionary mechanisms could also apply for adoptive parents. According to Silk (1990) the innate psychological predispositions that promote an intense desire for children may guide parents to adopt and form as close relationships with these genetically unrelated children as they would with kin. These evolutionary mechanisms, which are not necessarily adaptive in the present, shaped

human behavior to ensure survival. Therefore it is expected that these psychological mechanisms are so strong that they also apply for adoptive parents. This research focuses on three cues, which would indicate kinship, namely: facial resemblance, personality similarity and odor recognition. The influence of these three factors on parental investment is investigated.

1. The first research question is: *Do adoptive parents use facial resemblance to make investment decisions?*

As far as is known, there is no research available, yet, that investigated the link between facial resemblance and investment for adoptive parents. Research on biologically related families found that facial resemblance is related to emotional closeness for fathers but not for mothers (Apicella & Marlowe, 2007; 2004; Alvergne et al, 2010; Heijkoop, Dubas, & van Aken, 2009). Research, which investigated hypothetical investment and adoption preferences, found various results: Some researchers found that facial resemblance increased hypothetical investment for both sexes (Welling, Burriss and Puts, 2011; DeBruine, 2004), others found only significant effects for females (Bressan, Bertamini, Nalli and Zanutto, 2009) or males (Platek et al., 2004; Volk and Quinsey, 2002). From an evolutionary point of view children's facial resemblance to self may be more important for males. However some studies also found effects for females. Therefore it is expected that the link between facial phenotypic resemblance and investment is important for both adoptive parents, but that this link is stronger for paternal investment than maternal investment.

2. The second research question focuses on the influence of personality similarity: *Do adoptive parents use personality similarity to make investment decisions?*

Research conducted with genetically related families found a link between personality similarity and parental investment for mothers (Heijkoop et al., 2009; van Tuijl et al., 2005;

Denissen et al., 2009) and fathers (Apicella & Marlowe, 2007; Prinzie et al., 2012). However, research conducted with adoptive families only found a link between personality similarity and emotional closeness for fathers and not for mothers (Loehlin et al., 2010). From an evolutionary point of view personality similarity would be more important for fathers than for mothers. In this study it is expected that personality similarity will be linked to investment for both, adoptive mothers and fathers.

3. The third research question focuses on odor recognition: *Do adoptive parents use odor recognition to make investment decisions?*

Research conducted with biologically related parents found a link between odor recognition and corporal punishment for mothers, and a link between odor recognition and more affection, less ignoring behavior and more investment by fathers (Dubas et al., 2009). Research on this link, as far as is known, has not yet been investigated for adoptive parents or with hypothetical investment decisions or adoption preferences. According to evolutionary principles, phenotypic matching would be more important for males than for females. Therefore, it is expected that the link between odor recognition and investment is stronger for fathers.

## Methods

### Participants

Families were recruited in the Netherlands, through newsletters of adoption organizations, posts on adoption-fora and through contact with schools or after school care. In total, 54 adoptive families participated with 76 children (42 girls and 34 boys). In 46 families both parents participated. Mean ages of participants were 41 years for mothers (SD = 4.36 , range =32-50), 43 years for fathers (SD = 4.27 , range = 36-57) and 7 years for the child (SD = 2.23, range = 4 - 12). In this study, 89% of the mothers and 97% of the fathers were married

or cohabitating, at that moment. Among the mothers, 53% completed a lower educational training, 32% completed a higher technical degree and 15% completed a university degree. Among the fathers, 43% completed lower educational training, 45% completed a higher technical degree and 12% completed a university degree. All participating children were adopted; 42% of the children came from South-America, 38% from Asia, 15% from Africa, 4% from Europe and 1% from North-America. Mean age of the children at the time of adoption was 2 years ( $SD = 2.27$ , range = 0-11).

## **Procedure**

### *Home visits*

All families were visited twice in their homes by two developmental psychology students. During the first visit parents completed questionnaires concerning the country of origin of their child, perceived similarity, personality measures for themselves and their child and parental investment. The child received a t-shirt and the smell task was explained. Parents were told that they would be tested on their ability to identify the t-shirt of their child at the next visit. During the second visit, three days later, the odor recognition task was conducted. The first visit lasted on average 90 minutes and the second visit lasted on average 40 minutes.

## **Measures**

### *Physical (facial) resemblance*

*Physical resemblance* was measured with the questionnaire “Ouder Kind Gelijkenissen” (parent-child resemblances). Parents reported the physical resemblance for 11 items on a 5 point Likert scale, ranging from 1 (not at all) to 5 (very much). An example item measuring physical resemblance is: “I think my child looks like me”. Cronbach’s alpha’s were good (Cronbach’s  $\alpha_{\text{mothers}} = .94$ ; Cronbach’s  $\alpha_{\text{fathers}} = .96$ ).

### ***Personality similarity***

*Personality similarity* was measured with a questionnaire whereby parents reported on perceived personality similarity for 4 items, ranging on a 5 point Likert scale from 1 (not at all) to 5 (very much). An example item is: "I think my child resembles me in personality", Cronbach's alphas were good (Cronbach's  $\alpha_{\text{mothers}} = .96$ ; Cronbach's  $\alpha_{\text{fathers}} = .94$ ).

Additionally, *personality similarity* was measured with a Dutch adaption of the Big Five Questionnaire (Goldberg, 1992) which was filled out by parents about themselves and their child. The original unipolar 100 markers were reduced to 30, six markers for each of the five personality factors (Gerris, Houtmans, Kwaaitaal-Roosen, de Schipper, Vermulst, & Jansen, 1998). The answers were reported on a 7 point Likert scale, ranging from 1 (not at all applicable) to 7 (very applicable). To calculate the personality similarity between parents and children the method of van Tuijl et al. (2005) was used. Q-correlations were calculated, these report results on a dyad and can indicate profile similarity. The Q-correlation was computed over the 30 items of each child for both parents separately. The similarity on personality ranged from -.36 to .85 for the mother-child dyads (Mean = .32, SD = .29, N= 75) and for the father-child dyads from -.66 to .93 (Mean = .37, SD = .32, N= 67).

### ***Odor recognition***

The procedure used is based on the procedure of Dubas et al. (2009). At the first home visit, each child received a new, 100% cotton t-shirt which was prewashed with neutral (odorless) laundry detergent. Parents were instructed to have their child wear the t-shirt as pajamas for three consecutive nights and store it in a sealed plastic bag during the day, immediately after getting up. Children wore the t-shirt directly on the skin and did not wear an undershirt. If it was cold they were told to wear something above the t-shirt. The children were given odorless soap for use, were instructed not to use deodorant or perfume and were told that pets were not allowed to sleep on their bed during the study. Parents were asked not



to wear perfume during the second visit and if they smoked, not to smoke in the children's room during the study and not to smoke one hour before the second home visit, because this could influence their odor recognition ability. At the second visit, after three nights of wear, the t-shirts were folded and rolled in such a manner that the axillary seams of the t-shirt were exposed. During all handling with the t-shirts, the researcher wore disposable vinyl gloves to avoid odor contamination. The t-shirt was then placed in a new plastic bag which was placed in a plastic beaker (25cm H x 10 cm D). Both parents were tested individually and were blindfolded. Two control children were used, (stranger 1 and stranger 2) whereby one child was matched by sex and age to their child (stranger 1) and another child (stranger 2) was randomly selected from the children who participated in these study. Two identical plastic beakers were presented to the parent, whereby one contained the t-shirt of their child and the other contained the t-shirt of the control child. The parent was asked to identify the beaker which contained the t-shirt of their child. Randomly, six pair wise comparisons were conducted per child, three with their child and stranger 1 and three with their child and stranger 2, to avoid sequence or chance effects. There was no time limit for the odor recognition task. The total correct score per child, for mothers and fathers separately, was used as the olfactory recognition score.

### ***Parental Investment***

*Parental Investment* was measured with questionnaires, focusing on time investment, emotional closeness and negative parenting.

*Time investment* was measured with a questionnaire (Dubas & Gerris, 2002), where parents reported on the approximate amount of time (minutes) they spent with their children on a daily basis, carrying out activities together. Engagement in six activities was measured (eating, watching TV, playing together, helping with homework, household tasks and going

out). The total amount of time investment with their child for one week (in minutes), was calculated for each parent separately, taking into account week and weekend days.

*Emotional closeness* was measured with the NOSI questionnaire (Nijmeegse Ouderlijke Stress Index - Nijmeegse Parental Stress Index) and contained eight items whereby four items tapped affection towards the child (Gerris, Vermulst, van Boxtel, Janssens, van Zutphen, & Felling, 1993) and four items tapped attachment (de Brock, Vermulst, Gerris, & Abidin, 1992). The questions were answered on a 7 point Likert scale, ranging from 1 (totally disagree) to 7 (totally agree). An example item measuring affection is “I often show my child that I love him/her”, an example item measuring attachment is “I feel that I have a close bond with this child”. Cronbach’s  $\alpha$  were good (*affection*: Cronbach’s  $\alpha_{\text{mothers}} = .89$ ; Cronbach’s  $\alpha_{\text{fathers}} = .92$ ; *attachment*: Cronbach’s  $\alpha_{\text{mothers}} = .86$ ; Cronbach’s  $\alpha_{\text{fathers}} = .85$ ).

*Negative parenting* was measured with the with the NOSI questionnaire, focusing on two constructs: corporal punishment and conflict. Corporal punishment was measured with the item: “I regularly give my child a slap”. The questions was answered on a 7 point Likert scale, ranging from 1 (totally disagree) to 7 (totally agree). Conflict was measured with 6 items (Pianta & Steinberg, 1991), on a 7 point Likert scale, ranging from 1 (totally disagree) to 7 (totally agree), an example item is: “My child and I often have conflicts”. Cronbach’s  $\alpha$  were good (Cronbach’s  $\alpha_{\text{mothers}} = .87$ ; Cronbach’s  $\alpha_{\text{fathers}} = .85$ ).

## Results

### *Descriptive Statistics*

The descriptive statistics for the measures of facial resemblance, personality similarity, odor recognition and the parental investment measures for mothers and fathers are presented in table 1.

### ***Correlations***

In table 2 the correlations between the different measures of parental investment and facial resemblance are reported. There is a significant correlation between facial resemblance and time investment for mothers ( $r = .24, p < .05$ ). The correlations between the measures of parental investment and personality similarity are reported in table 3. For mothers personality similarity was significantly correlated to time investment ( $r = .26, p < .05$ ), and for fathers personality similarity was significantly correlated to emotional closeness ( $r = .27, p < .05$ ). No significant effects with the q-correlation measures were found. In table 4 the correlations between the measures of parental investment and odor recognition are reported. No significant effects were found.

### ***Regression Analyses***

To investigate whether the facial resemblance, personality similarity and odor recognition could predict parental investment for adoptive parents, regression analyses were also conducted (Table 5). After controlling for age and gender of the child in the first step, in the second step of the analyses, facial resemblance, odor recognition and personality similarity were entered. For the models predicting maternal investment, no significant effects were found for child gender. The only significant effect for child age is found with corporal punishment, this is a negative link ( $\beta = -.15, p < .05$ ). This means that corporal punishment is lower as the age of the child increases. For mothers, personality similarity was positively linked to time investment ( $\beta = .58, p < .05$ ). Thus higher personality similarity is linked to more maternal time investment. For mothers odor recognition ( $\beta = .44, p < .05$ ) is positively related to corporal punishment. Thus, mothers who can recognize their child by odor seem to use more corporal punishment towards their child. Additionally there is a negative correlation between personality similarity and corporal punishment for mothers

( $\beta = -.46, p < .05$ ). This means that if mother and child personality similarity is higher, mothers use less corporal punishment. In the regression analyses no significant effects were found for fathers.

For the models predicting paternal investment, no significant effects were found for child's age. There is a significant effect between facial resemblance of fathers with the gender of the child ( $r = -.25, p < .05$ ). This means fathers seem to score facial resemblance higher for boys than for girls. However no significant effect, correlational or in the regression analysis, was found for facial resemblance of fathers with parental investment. Thus the correlational effect between facial resemblance of fathers with the gender of the child is of no consequence to the hypotheses.

### **Discussion**

From an evolutionary perspective, parental investment is shaped by natural selection and dependent on cues which could indicate kinship. Based on the asymmetry of parental certainty, fathers are expected to rely more on certain cues of resemblance which could indicate kinship than mothers. A mechanism, which underlies resemblance is self-referent phenotypic matching, whereby parents compare their phenotypes to those of their children and these resemblances have an impact on parental investment. Although adoptive parents know that they are not genetically related to their child, certain cues of resemblance could (unconsciously) trigger the evolutionary mechanisms or self-referent phenotype matching mechanisms and thereby impact parental investment. In this research the question was, whether certain evolutionary mechanisms also apply for adoptive parents. The influence of three aspects of kin recognition: facial resemblance, personality similarity and odor recognition, on parental investment of adoptive parents was investigated.

The results of this study indicate a link between facial resemblance and parental investment for adoptive mothers, whereby facial resemblance was linked to maternal time

investment. These physical resemblances, which do not impact investment in biological families (Heijkoop et al., 2009) possibly due to the fact that biological mothers are certain of maternity, seem to act as a cue of relatedness for adoptive mothers. However, although the link between facial resemblance and maternal time investment was significant in the correlation it did not appear in the regression analysis when personality similarity, child age and child gender were also included. As facial resemblance leads to more trustworthiness and greater cooperation (DeBruine, 2002), this could unconsciously influence adoptive mothers, resulting in the fact that mothers tend to spend more time with a child which resembles them facially. It also may be possible that adoptive mothers are more vulnerable to the 'kinning process', a process in which similarity is overestimated to enhance the incorporation of the child into the kin group (Howel, 2012), than fathers. Therefore this link needs further investigation. For further research, it is suggested to control for the possible effect of perceived resemblance, by adding an objective measure of facial similarity of parent and child. For example with photographs of parent and child which are rated on resemblance by trained judges and the partner.

The results of this research show a link between personality similarity and investment for mothers. These findings are consistent with research conducted with biological families (Heijkoop et al., 2009; van Tuil et al., 2005; Denissen et al., 2009). Our results suggest that higher personality similarity between mother and child is linked to more maternal time investment and a decrease in the use of corporal punishment. Taken together, these findings can be seen as evidence for the goodness-of-fit theory (Lerner, 1993; Prinzie et al., 2012), whereby a mix in similar personality characteristics in parent and child result in more compatibility and positive adjustment (Rueter et al., 2009). If the child's behavior fits the expectations of the parent, then problems are less likely to occur. For adoptive mothers personality similarity seems to be important and influences parental investment.

For adoptive fathers, no link between facial resemblance and investment was found. Although these findings are in contradiction with research conducted with biological families (Apicella & Marlowe, 2007; Alvergne et al., 2010; Heijkoop et al., 2009), they are in accordance with the findings of Bressan et al. (2009), who investigated hypothetical investment. They found a significant preference for self-resembling children's faces for women but not for men. From an evolutionary perspective it would be expected that facial resemblance is more important for fathers, however, the knowledge of genetic non relatedness could be so strong that it acts as a confound, whereby it could be possible that adoptive fathers fail to see a physical resemblance with their adoptive children, even when it does exist. However, personality similarity is linked to investment for adoptive fathers. A link was found between personality similarity and emotional closeness for adoptive fathers. This link was only found in the correlation and not in the regression analysis. Research conducted with adolescents and their parents (Denissen, et al., 2009; de Haan, et al., 2012; van Tuijl et al., 2005) found evidence that personality similarity is linked to a better parent-child relationship, so it may seem likely that more personality similarity leads to more emotional closeness. Besides, longitudinal research which investigated personality similarity in adoptive families (Loehlin, et al., 1985) found that in the absence of shared genes, nearly no resemblance in personality could be explained by the common environment families shared. Although research with biological families found no relation between personality similarity and investment for fathers (Heijkoop et al., 2009), research which was conducted with adoptive families (Loehlin et al., 2010) found similar results, whereby personality similarity between father and child was linked to emotional closeness. For adoptive fathers, contrary to genetically related fathers, personality similarity is important. As adoptive fathers and their children are not genetically related, and physical resemblance seems unlikely,

personality similarity could grow more important and acts as a cue for relatedness. Therefore these findings suggest that personality similarity is connected to paternal investment.

The influence of personality similarity between adoptive parents and their children on parental investment was investigated by measuring personality similarity in two different ways. The first way was with a questionnaire where parents reported on the perceived personality similarity, the second measure was obtained with a Q-correlation that was calculated with the answers on an adaption of the Big Five questionnaire. In this study there was an effect found with the first measure of personality similarity, but not with the Q-correlation measures. This could indicate that parents perceive and report more personality similarity with their child, when the questions are posed directly. Therefore it could be possible that the reported personality similarity in the questionnaire is linked to a feeling of connectedness between the parent and the child and that the perceived similarity is larger than the actual similarity. This is in accordance with findings of Howell (2012) who speaks in this context of a 'kinning process'. Therefore it would be interesting for further research to add a measure of connectedness between parent and child and investigate if this measure is linked to personality similarity.

Additionally the influence of odor recognition, as a cue for kin recognition, on parental investment was investigated. To our knowledge, this is the first study which investigated the link between odor recognition and parental investment for adoptive parents. For mothers a relation between odor recognition and corporal punishment was found, whereby the ability to recognize their child was related to an increased use of corporal punishment. This result contradicts findings of research conducted with biologically related families, where odor recognition was linked to less corporal punishment (Dubas et al., 2009). In the research of Dubas et al. (2009) also the hedonistic ratings of the parents were added and hereby a pleasant odor of the child was related to higher levels of physical punishment.

Research shows that children with an attractive odor tend to repel parents. From an evolutionary perspective this is logical, as there should be an olfactory aversion between parents and children to avoid attraction to kin and inbreeding (Weisfeld et al., 2003). It is possible that children with attractive odors are unconsciously perceived as a competitor and as a result they seem to be physically punished more frequently, than children whose odors are perceived less pleasant. As there is no olfactory-based repulsion, caused by genetic relatedness, present between adoptive parents and their children, they may actually like the odor of their children. As research results show, a pleasant odor of the child is related to increased use of corporal punishment by mothers (Dubas et al., 2009) and this could be an explanation for our findings. To investigate this further, research is needed which not only examines the link between odor recognition and investment for adoptive parents, but also adds the hedonistic ratings of parents on their children.

For fathers no link between olfactory recognition and investment was found. Our results are in contradiction with research by Dubas, et al. (2009) which was conducted with biological related families, where fathers exhibited more affection and attachment and fewer ignoring behaviors toward children whose smell they could identify than toward those whose smell they could not recognize. Based on these results it is not possible to link odor recognition to investment for adoptive fathers. Yet, as far as known, this is the only research available which investigated the link between olfactory recognition and paternal investment and further research is needed before firm conclusions can be drawn.

Some limitations need to be acknowledged. First, the results of this study are correlational and therefore the cause-effect direction of these findings cannot be firmly established. Second, only parent reports were used to investigate the degree of investment and further research should use additional methods, like observations, or partner's reports on investment, as using a multi-method measure gives a more objective impression of parental



investment. Also partner reports on physical resemblance and personality similarity could be examined, to compare the (self-)reports of the perceived resemblance and personality to those of the spouse or partner and to avoid the issue of shared method variance.

For further research it would be interesting to compare the findings of the adoptive families to a control group of biologically related families, or even investigate families with both, adoptive and genetically related children.

### **Conclusion**

The results of this research show that although adoptive parents are not genetically related to their child, some cues of resemblance seem to trigger evolutionary mechanisms of relatedness which have an impact on parental investment. For adoptive mothers a link between facial resemblance and time investment was found, which suggests that facial resemblance (unconsciously) has an impact on the time adoptive mothers invest in their child. For personality similarity a link to investment was found for both adoptive mothers and fathers. For mothers, increased parent-child personality similarity was related to more maternal time investment and less use of corporal punishment. For adoptive fathers, personality similarity was correlated to emotional closeness. To our knowledge, this was the first study which investigated the link between odor recognition and parental investment for adoptive parents. For adoptive mothers a relation between odor recognition and investment was found, whereby the ability to recognize the child was linked to the increased use of corporal punishment which could indicate that odor recognition acts as a cue for genetic relatedness. Taken together, the results of this study suggest that cues of resemblance are important even for adoptive parents and possibly trigger underlying evolutionary mechanisms which influence parental investment.

### **Samenvatting**

Vanuit evolutionair oogpunt, is het aannemelijk dat de ouderlijke investering gestuurd wordt door psychologische mechanismen welke door natuurlijke selectie zijn ontstaan en die afhankelijk zijn van bepaalde herkenningssignalen die verwantschap aanduiden. In deze studie is onderzocht of bepaalde evolutionaire mechanismen ook van toepassing zijn op adoptiegezinnen. De invloed van gezichtsgelijkenis, overeenkomst in persoonlijkheid en geurherkenning op de ouder-kind relatie is onderzocht binnen 54 gezinnen met 76 kinderen. Er is een positieve correlatie tussen gezichtsgelijkenis en tijdsinvestering door adoptiemoeders gevonden. Voor overeenkomsten in persoonlijkheid is een verband gevonden met ouderlijke investering voor zowel adoptievaders als –moeders. Hierbij bleek dat een verhoogde overeenkomst qua persoonlijkheid tussen moeder en kind leidt tot een hogere tijdsinvestering door de moeder en minder lichamelijke straffen. Voor adoptievaders was persoonlijkheidsovereenkomst positief gecorreleerd met emotionele verbondenheid. Verder is een verband gevonden tussen geurherkenning en moederlijke investering, waarbij een hogere geurherkenningsgraad verband lijkt te houden met meer lichamelijke straffen. Tezamen duiden deze resultaten erop dat ook in de relatie tussen adoptie ouders en hun kinderen, onderliggende evolutionaire mechanismen van invloed zijn.

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## Tables

**Table 1** Means and standard deviations of facial resemblance, personality similarity, odor recognition and the parental investment measures

	Mothers (N=54)		Fathers (N=46)	
	Mean	SD	Mean	SD
Facial resemblance	13.15	5.42	13.84	6.52
Personality similarity	8.11	4.00	7.78	3.60
Personality Q-similarity	0.32	0.29	0.37	0.32
Odor recognition	3.71	1.80	4.54	1.23
Time investment	1446.35	542.10	1113.65	407.71
Emotional Closeness	48.88	8.12	41.79	17.37
Conflict	16.29	7.03	15.97	6.37
Corporal Punishment	1.69	0.77	1.83	1.09

\*  $p < .05$

**Table 2** Correlations between parental investment and facial resemblance for mothers and fathers

Parental investment	Facial resemblance mothers	Facial resemblance fathers
Time investment	.24*	-.03
Emotional Closeness	.08	.09
Conflict	-.03	-.07
Corporal punishment	-.02	-.07

\*  $p < .05$

**Table 3** Correlations between parental investment and personality similarity for mothers and fathers

Parental investment	Personality similarity mothers	Q- Personality similarity mothers	Personality similarity fathers	Q-Personality similarity fathers
Time investment	.26*	-.06	.03	-.12
Emotional Closeness	-.03	-.05	.27*	-.01
Conflict	-.20	.13	-.20	.06
Corporal punishment	-.13	-.06	-.16	-.19

\*  $p < .05$

**Table 4** Correlations between parental investment and odor recognition for mothers and fathers

Parental investment	Odor recognition mothers	Odor recognition fathers
<b>Time investment</b>	.20	-.19
<b>Emotional Closeness</b>	-.06	.03
<b>Conflict</b>	-.08	-.11
<b>Corporal punishment</b>	.09	-.08

\*p &lt; .05

**Table 5** Regression analyses: Facial resemblance, odor recognition and personality similarity predicting parental investment

	Time investment		Emotional Closeness		Conflict		Corporal Punishment	
	$\Delta R^2$	$\beta$	$\Delta R^2$	$\beta$	$\Delta R^2$	$\beta$	$\Delta R^2$	$\beta$
<b>Mothers</b>								
<b>Model 1</b>	.06		.03		.04		.06	
Child age		.22		.00		-.06		.21
Child gender		-.21		-.16		-.16		.06
<b>Model 2</b>	.47*		.30		.30		.67**	
Child age		-.15		-.30		-.37		-.15*
Child gender		-.13		-.05		.07		.54
Facial resemblance		.38		-.51		.06		.21
Odor recognition		-.02		-.01		-.12		.44*
Personality Similarity		.58*		-.19		-.44		-.46*
Q-Personality Similarity		-.23		-.45		-.24		.21
<b>Fathers</b>								
<b>Model 1</b>	.02		.22		.03		.07	
Child age		-.06		-.43		-.01		.18
Child gender		-.12		.38		-.17		-.27
<b>Model 2</b>	.15		.06		.18		.21	
Child age		-.10		-.44		.19		.38
Child gender		.01		.34		-.13		-.40
Facial resemblance		-.24		-.03		.35		.13
Odor recognition		-.35		.15		-.23		.03
Personality Similarity		.34		.19		-.24		-.26
Q-Personality Similarity		-.08		-.08		-.17		-.07

\*p &lt; .05, \*\*p &lt; .00