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Imprinting Effects on Visual Attention to Faces and Judgments of Attractiveness

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ABSTRACT

Previous studies have shown that human mate-choice can be influenced by exposure to opposite-sex parent characteristics. In this study we examined whether there are sexual-imprinting effects of fathers on their daughter's partner-choice. To this end our participants were asked to bring a picture of their father to the laboratory, and next an eye-tracker was used to determine participants' gaze directions while they were judging male faces for attractiveness. Participants were single, female undergraduates (n = 50, *M* age = 22, *SD* = 2.36), and they were randomly assigned to one of two conditions. They were instructed to judge the stimuli faces on their attractiveness while imagining they were looking either for a short-term (ST) or a long-term (LT) relationship. After calculating percentage differences and similarities between fathers' faces and the stimuli pictures, the results showed that a sub-sample, which fulfilled imprinting criteria, did rate stimuli pictures with a high father resemblance as significantly more attractive.

KEYWORDS

Sexual imprinting, Eye-tracking, Attractiveness, Short-term relationship, Long-term Relationship, Partner-choice

The term *sexual imprinting* describes the resemblance between a potential partner and one's *genitors*, and is a phenomenon which has been well established in animal research (Pfaus, Kippin, & Centeno, 2001), e.g., in birds (Bateson, 1978), ungulates (Kendrick, Hinton, Atkins, Haupt, & Skinner, 1998), and macaques (Fujita et al., 1997). Sexual imprinting in humans refers to people using the physical appearance of their opposite-sex parent as a template to base partner preferences on (Marcinkowska, 2012). The existence of positive sexual imprinting in humans has been suggested by Perrett et al. (2002), who claim that the most influential characteristics for partner choice come from the opposite-sex parent. Their research

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revealed that when participants' parents' age was relatively high at child birth (> 30 years), women were more likely to judge *older* men as more attractive than when their parents were relatively young (< 30 years). However, this effect was only present when these women were looking for a long-term relationship. No influence of parental age on attractiveness judgments was shown for short-term relationships (Perrett et al., 2002).

When looking for a partner, men and women gather as much information about their new partner as possible. As Perrett et al. (2002) argue, the knowledge people gather in their childhood about which facial characteristics are related to specific behavioral traits will be their first reference on which to base partner choice. Indeed, facial characteristics reliably represent certain personality traits; for example, facial dominance has been shown to be an honest signal for dominant behavior (Mueller & Mazur, 1997). One feature that is often mentioned to express facial dominance is a square jaw, and at the same time a square jaw reliably signals high testosterone levels (Johnston, Hagel, Franklin, Fink & Grammer, 2001).

Moreover, visual experiences contribute to how faces are perceived (Little et al., 2005; Perrett et al., 2002; Rhodes, Jeffery, Watson, Clifford, Nakayama, 2003). For example, in a study by Rhodes et al. (2003), faces that had abnormally contracted features (e.g., very narrow eyes), were perceived as more normal when people had been exposed to faces containing these facial features before, even though the previously shown picture was a different one. More direct evidence for imprinting effects comes from research by Little, Penton-Voak, Burt, and Perrett (2003). These researchers recruited 697 participants (men and women) over the Internet, participants who fulfilled certain criteria, e.g., bi-parental upbringing and being in a serious heterosexual relationship. Participants were to select their own, ideal, partner, father, and mother hair and eye color on a pull-down menu which offered a variety of hair and eye colors. It could be shown that women's partners' eye-color was associated with their fathers' eye-color, and for men, these correlations were found between their mothers' eye-color and their partners' eye-color. Furthermore, paternal hair color was significantly related to partner hair color for women, while maternal hair color was only significantly related to partner hair color for men. The authors also state that the preference for the opposite sex parent characteristics in a partner may be influenced by parental traits, which they suggest might be a biased recall process.

To sum up, the existing literature suggests that imprinting effects do exist, and that they might influence a woman's partner choice. In addition to these learned influences on attractiveness perceptions, evolutionarily relevant preferences play a role in women's attractiveness ratings of men as well, such as symmetry and masculinity. Interestingly, a preference for masculine facial features was only found in women who were looking for a ST relationship (Penton-Voak et al., 2001). Moreover, especially during ovulation, when conception is most likely, these women preferred faces with exaggerated male traits. For women looking for a LT relationship, no preferences for masculine faces were found (Little, Cohen, Jones & Belsky, 2007). Thus, the social context in which women judge males' attractiveness seems to play a role, such that women judging men for a ST relationship tend to differ in their preferences from women rating males for a long-term relationship (DeBruin, 2005; Mollenhorst, Völker & Flap, 2008; Penton-Voak, Jacobson, &

Trivers, 2004). In the current study, therefore, we include this mating context as well, and we will instruct half our participants to rate male faces while imagining they are looking for a LT relationship, whereas the other group has to imagine that they are looking for a ST relationship.

The Current Study

Given the vast amount of literature about partner choice, evolutionary beneficial traits, and imprinting effects, the question arises how imprinting effects are shaped. In the current paper, we assume that imprinting effects are learned – at least to a certain extent – rather than inborn. We hypothesize that heterosexual, single women will judge men's attractiveness according to the resemblance of the male family member who raised them (e.g., father or stepfather). Furthermore, we investigate whether participants who are looking for a short-term (ST) relationship perceive men differently than participants who were looking for a long-term (LT) relationship. The last variable will be introduced via an experimental manipulation.

Moreover, in the current study, only single women will be recruited, because women in a committed relationship have been shown to pay less attention to (attractive) men (Maner et al., 2003). We hypothesized that women who were randomly assigned to the LT relationship condition will be most likely to rate those men as attractive, who resemble their father. These women should associate their fathers' facial features with good and reliable parental care – given they had a good relationship to their father – because as discussed before, facial features are related to personality traits (Mueller & Mazur, 1997) and thus women might expect men with similar features to possess good parenting skills as well. Women assigned to the ST condition should not favor men who resemble their father, because potential parenting skills are of less interest in a ST relationship.

To examine our research questions, the eye-tracker method will be used. Eye-tracking can investigate what participants perceive as physically attractive, since generally, longer gazing time is associated with higher attractiveness perception in infants (Langlois, Ritter, Roggman, & Vaughn, 1991) and adults (Fugita, Agle, Newmann, & Walfish, 1977). Using eye-tracking, we can also investigate whether facial areas that are particularly similar to the father's face are favored over areas that are less similar to the father's face, i.e., are gazed at more frequently and/or for longer periods of time. Thus far, eye-tracking methods have not often been used in facial attractiveness research (Hickman et al., 2010) in adults, and we believe they may be able to shine new light on the discussion about which features people focus on and perceive as attractive.

In the current study we will use the following areas of interest for our analysis: right face half, left face half, eyes, and mouth/chin region. These four areas were selected for different reasons. Firstly, this division is made to reassess the assumption that people generally prefer the left side of the face (from the viewer's perspective), especially when people have to judge faces for properties like attractiveness (Burt & Perrett, 1997). Secondly, the eyes were chosen as an area of interest because men have generally smaller eyes than women (Gangestad & Thornhill, 2003), which makes eye-size a sexually dimorphic characteristic and a selection criterion for women. Lastly, the mouth/chin region was chosen as an area

of interest as it is likely to display exaggerated male traits such as larger jaws and thinner lips (Penton-Voak et al., 2004) and longer chins (Waynforth, Delwadia, & Camm, 2005). Previous literature claims that apparent secondary male traits are preferred by women who are looking for a short-term relationship (Waynforth et al., 2005). We would like to reassess this aspect using the eye-tracker method, thereby investigating whether women who were assigned to the short-term group show longer fixation times on areas like the mouth/chin that provide information about masculine traits.

To sum up, our aim is to investigate whether we can identify imprinting effects in attractiveness judgments of male faces, and whether the mating context – i.e., imagining a long-term or a short-term relationship – also influences these ratings. Specifically, we expect that women, who judge male faces while imagining entering a long-term relationship with them, rate men as more attractive when the stimuli pictures display a high similarity to their father. We also expect these women to judge these males as more attractive than women who have been assigned to the ST relationship group. Further, we explore whether women spend more time looking at facial features (areas of interest) that have the strongest resemblance to their fathers' facial features, and whether duration and location gaze are influenced by mating context.

METHODS

Participants

Fifty-seven single, heterosexual women were recruited via the university participant pool at Maastricht University, The Netherlands. Seven participants were excluded due to technical problems. Mean age was 22 years (*SD* = 2.36). Forty-two percent of the participants were Dutch, 40% were German, and 18% reported having a different nationality.

Participants were instructed to bring a (portrait) photograph of their father to the laboratory. These photographs had recently been taken and therefore displayed the fathers at the age of approximately 50 years. It was explained to participants that they had to bring the picture because they would participate in two studies: One eye-tracking experiment and one – supposedly unrelated – study to investigate family relations, for which we needed a picture of the father.

Upon arrival in the laboratory, participants were randomly assigned to either the long-term condition (*n* = 25) or the short-term condition (*n* = 25). They received partial course credit or a 7.50 euro (around $10.24 USD) gift voucher for their participation. All materials and procedures were approved by the Ethics Committee Psychology of Maastricht University.

Materials and Procedure

All instructions and materials were provided in English. Before starting the eye-tracking experiment, participants answered some demographic questions (e.g., age, relationship status). Next, to measure the quality of the relationship between participants and their fathers, a questionnaire on the trust level within close

interpersonal relationships was administered (Rempel, Holmes, & Zanna, 1985). In this trust questionnaire we exchanged the word "partner" with the word "father." Participants answered 8 items on a 7-point scale [1 = not true at all, 7 = completely true]. An example is: "Though times may change and the future is uncertain, I know my [partner father] will always be ready and willing to offer me strength and support." Coefficient alpha = 0.83, *M* = 5.76 (*SD* = 0.94).

Next, the participants received the task instructions for the eye-tracker part of the study. They were asked to sit in front of a computer with a mounted head rest and the eye-tracker, which measured their overt attention and eye-movements while watching the presented pictures. We used the EyeLink® 1000 Tower Mount Head Support System (SR Research Ltd., Ontario, Canada). Before testing, the eye-tracker head set device was adjusted for each participant so that she could comfortably sit and participate in the experiment. Then the eye-tracker was calibrated with eleven fixation points which moved across the screen while the participants had to follow them with their eyes. This procedure was always repeated twice to validate participants' eye-movements.

All instructions were presented on the screen. Participants read that their task was to judge a number of male faces on attractiveness by pressing a key on the keyboard. At this point, the experimental manipulation was also presented to the participants. Participants in the long-term condition were instructed to judge the males for their attractiveness as a long-term partner, whereas participants in the short-term condition were to judge the males for their attractiveness as a short-term partner.

The stimuli consisted of 10 photographs from the Radboud Faces Database (Langner et al., 2010) and showed male faces from the front, with an emotionally neutral expression. After each stimulus picture, the participants were reminded of the experimental manipulation, and they could judge each stimulus picture on a scale ranging from 1 (not attractive at all) to 7 (very attractive). The ten pictures were presented sequentially. Each sequence was randomized for every participant, and every stimulus picture was presented for 6 seconds.

After the participants completed the eye-tracking part, they were probed for awareness of the research hypotheses, the experimenter asked them what they thought the study was about, and were debriefed about the purpose of the experiment. No subject indicated being aware of the relationship between the two "separate" studies or the research hypotheses. Subjects were thanked for their participation, and either awarded with 1 credit or with a 7.50 euro gift voucher.

Measurements and Calculations

The processing of eye-tracking data was done using Data Viewer eye-link software (Version 1.7). The data were first collected from *x* and *y* coordinates of gaze points on the presentation screen concluded from relations between pupil and cornea distance. Fixation points were determined by coordinate accumulations that were temporally as well as spatially similar. A fixation point was defined if the participant looked at one particular spot, within 40-pixel diameter, for more than 100ms. The eye-tracker EyeLink software calculated the duration of each fixation. The images were divided into four areas of interest: right face-half, left face-half,

eyes, and mouth region (including lips, jaw, and chin). These areas were designated post-hoc but based on theoretical considerations discussed previously (areas based on Hickman, 2010).

Each photo (both of participants' fathers, and of the stimuli) was measured with Inkscape, which is a free, open-source vector graphics editor, on different dimensions: (A1) face length, (A2) face width, (A3) eye width, (A4) eye height, (A5) eye width averaged for 2, (A6) interpupil distance, (A7) lip height, (A8) lip width, and (A9) jaw width (see Figure 1).

From these measurements we computed the following ratios: A1/A2 (face length / face width), A4/A5 (eye height / eye width averaged for 2), A7/A8 (lip height / lip width), A9/A2 (jaw width / face width), and A6/A2 (interpupil distance / face width). Percentage differences were calculated between the ratios of the father pictures and the stimulus pictures. These differences from each ratio of the father's picture were averaged, resulting in a mean difference score between each father picture and each stimulus picture (detailed information can be found in the Appendix, p. 17). Next, the maximum and minimum percentage differences between each father picture and each stimulus picture were determined for each participant. These percentages thus resulted in the similarity – or rather the difference – of proportion between pictures.

In order to test our hypotheses on imprinting effects, we focused on two sub-samples: Sub-sample 1 contained participants whose fathers displayed at least 90% similarity to the picture with the highest similarity and no more than 70% similarity to the least similar picture; n = 10. In Sub-sample 2 we included participants whose fathers displayed at least 89% similarity to the picture with the highest similarity and no more than 78.5% similarity to the least similar picture; n = 11. (A detailed explanation on how and why we selected or excluded participants can be found in the Appendix, Table 1- 5.) Included in data analyses were the ratings the participant had given to the picture with the highest percentage similarity to their father's photograph, as well as the participant's rating for the picture with the lowest similarity score to their father's photograph. These two attractiveness ratings, for the picture with the *maximum similarity* and the picture with the *minimum similarity*, were the main variables of interest in our analyses. We have provided more details on our procedure in the Appendix.

RESULTS

Attractiveness Ratings

We first performed a repeated measures ANOVA with the first sub-sample. The condition (LT vs. ST) was the between-subject factor, the similarity rating (high-similarity vs. low-similarity rating) the within-subject factor, and father relationship (FR) was entered as a covariate. This analysis revealed a significant interaction between attractiveness rating on high versus low-similarity pictures and mating condition (LT vs. ST) ($F_{(1, 7)} = 1.70$, $p < 0.05$, $\eta^2 = 0.43$), showing that participants in the LT mating condition rated pictures with a high-similarity to the father as more attractive ($M = 3.2$, $SD = 1.3$) than women from the ST mating condition ($M = 1.2$, $SD = 0.45$), while women in the ST mating condition rated men with low-similarity to

the father as more attractive (M = 2.2, SD = 0.84) than women in the LT mating condition (M = 1.8, SD = 1.3). A significant trend for condition was found ($F_{(1, 7)}$ = 4.23, p = 0.08, η^2 = 0.38); a post-hoc t-test with condition as the independent factor and high-similarity rating and low-similarity rating as dependent variables revealed a highly significant difference between LT and ST mating condition for the high-similarity rating ($t_{(8)}$ = 3,24, p < 0.01, Cohen's d = 2.29), but not for the low-similarity rating.

A repeated measures ANOVA was also performed for the second sub-sample, but no significant main effects or interactions were found (F's$_{(1, 8)}$ < 2.98, p's > 0.12).

Areas of Interest

We first looked at resemblance between stimulus pictures and fathers' faces. An independent t-test of the number of fixation points in those areas of interest that displayed the highest resemblance to the same areas of the father's face revealed no significant difference between the ST and LT group in terms of fixation points (Sub-sample 1: $t_{(8)}$ = 0.04, p = 0.91; Sub-sample 2: $t_{(9)}$ = 0.50, p = 0.63). However, even though the difference between groups was not significant, the general number of fixation points on areas that resembled participants' fathers' most were higher than on areas that resembled their fathers' least.

Regarding all areas of interest that we specified, we could not find a significant difference between the LT and the ST group on any of the specified areas (Sub-sample 1: t's$_{(8)}$ < 0.67, p's > 0.51; Sub-sample 2: t's$_{(9)}$ < 0.72, p's > 0.49).

DISCUSSION

The aim of the current study was to test whether women rate men as more attractive when they resemble their father than when they do not. Furthermore, we hypothesized that the type of relationship one is looking for, e.g., a long-term or short-term relationship, is an important variable to consider in this context. We therefore created two groups, one of which was told to judge male faces with the idea of forming a long-term (LT) relationship, whereas the other group would be judging the stimuli with the outlook of a short-term (ST) relationship. The most important reason for using the eye-tracker was to measure correlation between the areas of interest which display a high resemblance between stimuli picture and father picture, and to examine the fixation points of the participants. We expected to find a positive relation between resemblance of the pictures and fixation points.

Mating Strategy: Long-Term versus Short-Term

The current study included an experimental manipulation of mating strategy – that is, we assigned participants to either a long-term relationship group or a short-term relationship group. This division was based on previous research that claimed that women who are looking for a LT mate focus on different features than women who are looking for a ST mate (Maner et al., 2003). We did not find any evidence for

an imprinting effect in women who were looking for a short-term relationship, which is in line with previous research (Perrett et al., 2002).

Research has shown that faces which display a high resemblance to the father are judged as more attractive by women (Little et al., 2003) when women had a good relationship to their father (Wiszewska, 2007). However, research has also revealed that kin resemblance is not favored by women looking for a short-term relationship (DeBruine, 2005). This study was able to find that women rated men significantly more attractive when the resemblance from the father picture to a stimulus picture was high and the resemblance to the least similar picture was substantially lower.

We did not find a significant difference in attractiveness ratings between the LT and the ST group in the complete sample. But in the subgroup that was designed on the criteria of differences between father photos to stimuli pictures, we did find a significant difference on the ratings for the pictures that resembled the father most. Daughters who had been assigned to the LT group rated stimuli pictures that resembled their father most, as significantly more attractive than daughters who had been assigned to the ST relationship group. This is in line with previous research and indicates that imprinting effects may only occur when women are looking for a long-term mate (e.g., Perrett et al., 2002).

Areas of Interest

Regarding the areas of interest, participants focused mainly on the eyes. Remarkably, the eyes received more fixation points than the left or the right facial side, even though the area of interest which covers the eyes is substantially smaller. If we compare the mean fixation points between groups, we do not find significant differences between the LT and ST condition. Even though the mean fixation points for the LT condition is higher on the eyes, left and right, while it is lower on the mouth than the fixation points of participants in the ST condition, a significant difference could not be found. Either way it does indicate that there might be more interest on the mouth region from the women who have been assigned to the ST group. This could be the case because the mouth region conveys information about masculinity. A large jaw, for example, is a masculine facial feature which is associated with certain personality traits, e.g., dominance. As mentioned earlier, facial dominance has been shown to be a reliable signal for dominant behavior (Mueller & Mazur, 1997). Maner et al. (2003) have stated that women looking for a ST relationship prefer more masculine faces and that they are more likely to focus on exaggerated male face characteristics. However, the overall fixation on the mouth region was very low, indicating little interest. This finding is also in line with the assumption that nowadays, past stable attractiveness characteristics do not play such an important role anymore (Scott et al., 2010).

In general, our findings confirm those of Klin, Jones, Schultz, Volkmar, and Cohen (2002) who found that participants focused mainly on the eyes (areas of interest were eyes, mouth, body, and objects). When one is placed into a setting in which attractiveness and dating play an important role, then eye-contact is often the first form of communication. It is plausible, considering that our participants were told to imagine to be looking for a long-term or short-term relationship partner, that

they would dwell on fixating the eyes to build up communication, even though we only presented portrait pictures. Little research has been conducted in this area, but the eyes do reveal certain information, e.g., if a person is in a good mental state or not (Penzel, 2006), which can less easily be seen in other facial features.

As expected, we found a higher mean fixation point score on the owner's right face half, which is in accordance with previous literature (Burt & Perrett, 1997) stating that the left face side from the viewer's perspective was perceived as more attractive. Burt & Perrett (1997) suggested that we pay more attention to the left side (viewer's perspective) of the face, because it shows stronger motor outputs due to the predominant contralateral connections. This finding has so far only been tested with photographs that merged photos of face-halves together, e.g., left-left and right-right, which participants were supposed to judge. They had to say which merged picture version looked more like the actual person. In our experiment, an eye-tracker was used, which is a more ecologically valid way of assessing which face half people tend to focus on. In this way, this method was able to shine new light on the reassessment of the viewer's left side preference that Burt (1997) suggested. Using the eye-tracker method, information can be more clearly attributed to the participant rather than the changed photograph properties, because we can retrace the participant's gaze and directed attention.

Limitations and Suggestions

It would be advisable for future research to include a measure of participants' relationship with their fathers already in the recruiting process. This measurement should be based on the quality of this relationship, participants who have a good relationship and participants who have a bad relationship with their father could be invited to participate, in order to investigate the influence of this variable on attractiveness ratings and imprinting effects. Moreover, stimuli including more extreme differences or similarities with participants' fathers should be included. In order to have a bigger sample size, one would need to measure the father pictures and stimulus pictures first and then invite participants whose fathers display suitable similarity percentages to the stimuli pictures chosen.

To conclude, the current study was designed to investigate imprinting effects of fathers on their daughters, in the sense that women prefer male faces most when they resemble their father's face. A thorough investigation of our data involving more extreme differences between participants' fathers' faces and stimuli pictures revealed the imprinting effects we were looking for. This suggests that it is worthwhile to repeat the study with the recommended improvements.

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APPENDIX

Measurements and Calculations

Figure 1 displays an example stimuli picture and the measurements we computed of the following ratios: A1/A2 (face length / face width), A4/A5 (eye height/ eye width averaged for 2), A7/A8 (lip height / lip width), A9/A2 (jaw width/ face width), A6/A2 (interpupil distance / face width). If the mouth was slightly opened, we subtracted the open mouth space from the lip width. Percentage differences were calculated between the ratios of the father pictures and the stimulus pictures. These differences from each ratio of the father's picture have been added together for each stimulus picture, so that we had a mean difference score between each father picture and each stimulus picture.

$$\left[\frac{(\text{A4/ A5 stimuli picture}) - (\text{A4/ A5 father photo})}{(\text{A4/ A5 father photo})} + \frac{(\text{A1/ A2 stimuli picture}) - (\text{A1/ A2 father photo})}{(\text{A1/ A2 father photo})}\right] + \left[\frac{(\text{A7/ A8 simuli picture}) - (\text{A7/ A8 father photo})}{(\text{A4/ A5 father photo})} + \frac{(\text{A9/ A2 stimuli picture}) - (\text{A9/ A2 father photo})}{(\text{A1/ A2 father photo})}\right] / 4 = \text{Mean difference between father picture and stimulus picture}$$

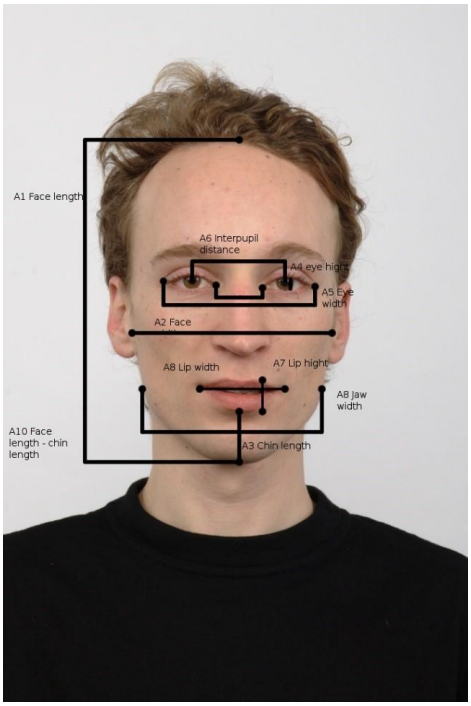

Figure 1: Stimulus picture

Tables

In Table 1 there are two examples, the father photographs (FP) of participant 12 and 13, of how faces were measured.

Table 1. Example Calculation: Percentage Differences (Measured with Inkscape) Between the Father Pictures and the Stimuli Pictures

	Picture 1									
	A 1 Face length	A2 Face width	A3 Chin length	A4 Eye height	A5 Eye width/2	A6 Interpupil distance	A7 Lip height	A8 Lip width	A9 Jaw width	A10 A1 – A3
FP_12	1088	909	196	60	183.5	375.5	149	337.5	819	892
FP_13	312	207	52	13	51	102	24	84	159	260

FP = father photograph

Table 2a displays two examples of father photograph ratios, while Table 2b shows the percentage difference of the two father photographs to stimulus picture number one. The average difference was calculated for each stimulus picture.

Table 2a. Ratios for the Father Pictures of Participant 12 and Participant 13

	A1/A2	A4/A5	A7/A8	A9/A2	A6/A2
FP_12	1.20	0.33	0.44	0.90	0.41
FP_13	1.51	0.25	0.29	0.77	0.49

FP = father photograph

Table 2b. The Percentage Differences of the Father Photos of Participant 12 and Participant 13 to the First Stimulus Picture

	Picture 1					
	A1/A2	A4/A5	A7/A8	A9/A2	A6/A2	Average Difference
FP_12	31.93	40.81	1.52	1.34	3.511	15.82
FP_13	4.77	24.07	52.18	15.72	13.22	21.99

FP = father photograph

The average difference from the participant's father photograph to each stimuli picture is shown for participant 12 and 13 in table 3a. The selection procedure of the ratings that were analyzed is displayed. The pictures with the *highest* and the *lowest* similarity degree were identified. In the next step, outlined in table 3b, the corresponding rating to the *most similar* and *least similar* picture was looked up and used for the final analysis.

Table 3a. Similarity Selection Procedure

	Pic 1	Pic 2	Pic 3	Pic 4	Pic 5	Pic 6	Pic 7	Pic 8	Pic 9	Pic 10
PP_12	15.82	18.4	11.08	16.37	14.59	13.11	13.66	18.5	20.4	15.82
PP_13	21.99	12.33	15.38	11.92	20.8	16.46	11.79	10.88	9.31	21.96

PP = participant

Table 3b. Participant Rating for the Picture that Resembles their Father Most and Least

PP	Highest similarity	Lowest similarity	Rating for pic with highest similarity	Rating for pic with lowest similarity
12	Pic 3	Pic 9	4	2
13	Pic 9	Pic 1	3	1

PP = participant

Determining Sub-samples: Table 4, Table 5a, and Table 5b

Regarding the analysis, it becomes apparent that the difference between the highest and lowest similarity of father and stimulus picture, is very important. If the difference between the most and least similarity percentage is too low, then the participant might not be able to observe any similarity differences between pictures at all. An example is given in Table 4. Participant 26 has a very low score for the percentage difference between the stimulus pictures that resembles her father most, while participant 33 displays a percentage difference that lies at 66.53%.

Keeping our hypothesis in mind, we would not expect participant 33 to rate the stimulus picture that resembles her father most as very attractive, because even though it is the picture out of the 10 stimulus pictures that resembles the father most, it still does not display a high similarity to the father. It is evident that the rating of participant 26 and participant 33 cannot be compared regarding our imprinting hypothesis, because even the stimulus picture that resembles the father of participant 26 least displays a *higher* similarity than the stimulus picture that resembles the father of participant 33 most. Therefore we designed two sub-samples based on similarity degrees between the father's photograph and the stimuli picture; these subgroups and their information is presented in table 5a and 5b.

Table 4. Exclusion Criteria of Participants

	Min Percentage Difference	Max Percentage Difference
FP_26	3.58	30.86
FP_33	66.53	95.2

FP = father photograph

Table 5a. Sub-sample 1

PP	Highest Similarity Difference	Lowest Similarity Difference
Sub-sample 1		
PP_03	90.79	69.66
PP_16	90.63	68.56
PP_18	90.14	69.69
PP_23	93.67	69.67
PP_26	96.15	69.17
PP_31	92.15	69.18
PP_40	92.85	69.88
PP_45	90.20	67.68
PP_50	91.51	66.85
PP_51	93.60	69.94

PP = participant

Table 5b. Sub-sample 2

PP	Highest Similarity Difference	Lowest Similarity Difference
Sub-sample 2		
PP_01	91.81	76.04
PP_05	95.99	78.20
PP_13	90.69	78.01
PP_14	93.15	76.27
PP_24	89.83	76.06
PP_28	91.00	78.49
PP_35	93.71	77.71
PP_37	93.35	74.95
PP_42	89.93	78.49
PP_54	92.17	76.25
PP_57	96.51	79.52

PP = participant