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Measuring grandparental investment. Do grandparents invest more when genetic relatedness is more certain?

ABSTRACT

This report attempted to determine the effect on grandparental investment of Hamilton's Rule, which predicts altruistic investment will vary in part depending on degree of relatedness between the benefactor and recipient. A measurement study of students, aged between 17 and 23, was used to compile information relating to grandparental investment. A group of 43 psychology students each interviewed ten volunteer participants, on a variety of topics relating to their perceived relationship with their surviving grandparents. Participant scores in two series of questions, series A (relating to financial and emotional investment) and series B (relating to recency and frequency of contact), were examined in detail, and related to the degree of average certainty of relatedness in each case. It was predicted that on all measures of grandparental investment, maternal grandmothers would show the highest degree of investment, whilst paternal grandfathers would demonstrate the lowest. Wilcoxen T tests of significance were carried out on both question series. Maternal grandmothers were determined to have scored significantly more highly on all series A measures of investment, and on the Series B measure of recency of contact. However no significant relationship was found between the series B measure of annual frequency of contact with grandparents, and degree of relatedness. Potential methodological and statistical flaws with this study were suggested, in addition to potential future research.

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INTRODUCTION

Darwin's theory of natural selection (Darwin, 1898, cited in Buss 2004), described how adaptation through the course of evolution had shaped the development and specification of all living organisms. Darwin proposed two forms of selection, by which variations in reproductive success had shaped the development of species. Natural selection, the process by which inherited variations contributed to an organism's ability to survive to reproduce within an environment, and sexual selection, the competition between individuals of the same sex over access to potential mates (intrasexual), and by individuals of one sex to attract the attentions of members of the other (intersexual). Darwin's theory explained the adaptive forms and diversity apparent within and between species, however it lacked an explanation of the mechanism of inheritance that allowed organisms to transmit elements of their evolved forms to their descendants. Such a mechanism was provided by Mendel (Likely, 1998), who proposed that parents transmitted a myriad of genes, each containing an indivisible chunk of instructions, which provided a predisposition or diathesis for a specific developmental process to occur, given a specific environmental input.

Thus natural selection provided an explanation for an organism's evolved form and instincts, selected for by natural and sexual selection, and transmitted genetically through reproduction. However as an explanation of behaviour, Darwinian selection was inadequate, as it failed to explain aspects of interspecies competition which varied depending on relatedness, such as the guarding and raising of offspring by parents, reciprocal altruism, group habitation and nepotism. Several theories developed since the 1960's have provided explanations for these puzzles and allowed evolutionary psychology to develop into an insightful and predictive tool for the study of behaviour. Hamilton (1964) theorised that it was the degree to which an individuals genes were successfully reproduced that determined their ultimate reproductive success, not merely their success at producing viable offspring. Thus contributions to the reproductive success of a relative, based on the degree to which they were related, in combination with an individual's direct reproductive success, produced their ultimate level of 'inclusive fitness' (Hamilton, 1971).

Inclusive fitness has been utilised to hypothesise evolved psychological mechanisms, genetically transmitted diathesis for patterns of behaviour, which evolved like physical characteristics, to solve adaptive problems in the environment of evolutionary adaptedness (EEA) (Janicki, 2004). Many theorists have developed predictive models and hypothesis based on the concept of evolved psychological mechanisms.

One such hypothesis is related to the probable effects on the evolved psychological mechanism of the uncertainty of paternity in human mating.

In the EEA, in which humans developed, a mother was always sure that fifty percent of her child's genetic material had been inherited directly from her own. However a father was never as certain. Whilst in any individual case a child's father was either the woman's mate or a stranger, due to the uncertainty of paternity, on average any 'father' passed on a degree of his genetic compliment less than 50%.

Several different sources of evidence indicate that extra pair mating historically resulted in degree of paternity obfuscation. Tests of sperm production have revealed that when humans copulate after a period of separation from their mates, males release almost double the amount of sperm usually ejaculated (Baker, & Bellis, 1993). Measurements of the size of the testes of a variety of primates relative to body size, have revealed that the size of human testes are indicative of a degree of sperm competition in the EEA (Wrangham, 1993, cited in Buss, 2004). Finally, evolutionary research has identified methods which may have evolved for females to influence which one of a number of sexual partners succeeded in impregnating them (Baker and Bellis, cited in Buss, 2004). Irrespective of the reasons for historical paternity uncertainty, Hamilton's (1964) theory of inclusive fitness predicts that it will have an effect on parental and grandparental investment.

This study attempted to replicate a series of studies (DeKay, 1995, cited in Buss 2004)(Euler & Weitxel, 1996, cited in Buss), which confirmed this prediction; finding that maternal grandmothers and grandfathers both contributed more to their grandchildren (in self reported surveys by grandchildren) than paternal grandmothers and grandfathers. For the purposes of this study, an arbitrary figure of 40% average relatedness was assumed for paternity. Following this, it was predicted that on all measures of

grandparental investment, maternal grandmothers would show the highest degree of investment, whilst paternal grandfathers would demonstrate the lowest.

METHOD

Design

A repeated measures study. Interviewers presented participants with a questionnaire entitled 'People's relationships with their grandparents', containing 37 questions. 3 measures of grandparental investments, and 2 measures of recency and frequency of contact, were recorded and subdivided by grandparent.

Participants

426 non psychology students, primarily from Trinity collage Dublin, completed the questionnaire. Participants were recruited from amongst the peer groups of psychology students carrying out this study. When invalid and incomplete data were removed 330 valid data points were found, 130 of these participants were male and 200 female. Participants were aged between 17 and 20, and participated on a volunteer basis.

Apparatus / Materials

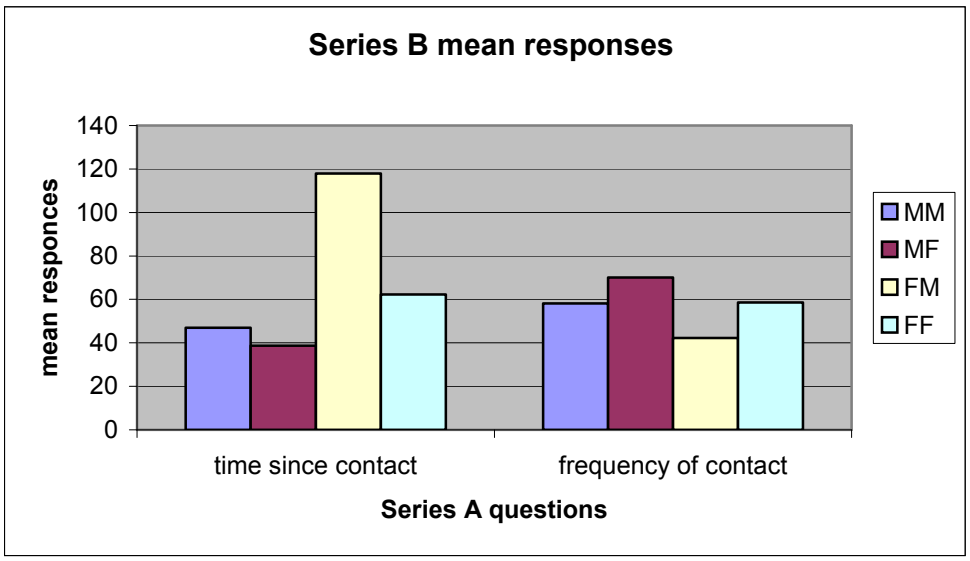
A pen and paper questionnaire comprised of 37 questions. Questions consisted of multiple choice, and absolute value.

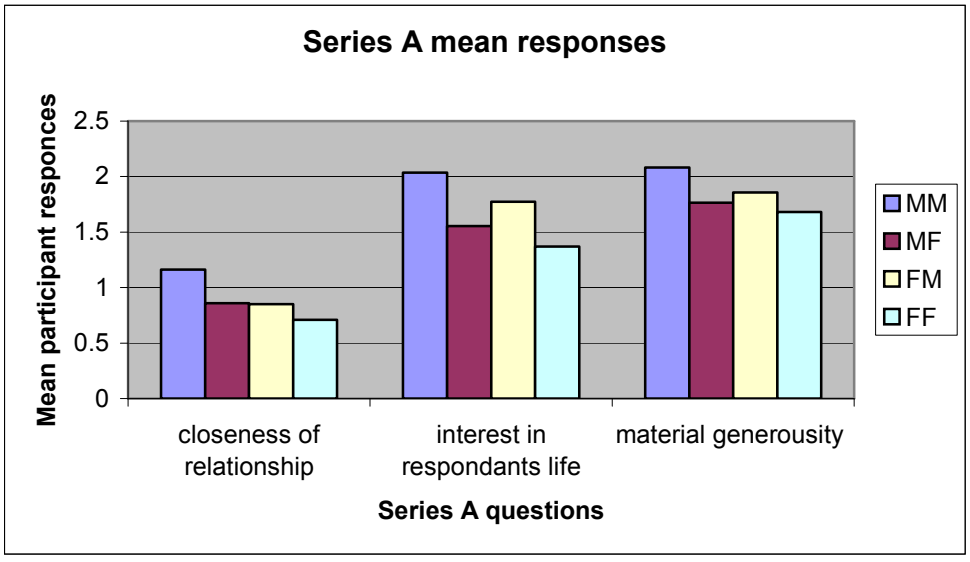
Procedure

Interviewers provided participants with a brief introduction to the nature of the research, before carrying out a verbal interview. The questionnaire used in this study consisted of two series of questions. Series B, which addressed the physical proximity, recency and frequency of participant's contact with each surviving grandparent; and series A, which focused on the interest and closeness demonstrated, and material contribution made by participants grandparents to their lives. Questions were subdivided by grandparent. Answer data was collected by each interviewer, and collated by instructors. Finally each student received a file containing all collated responses. Erroneous data points were removed, resulting in 330 valid data points. Measures of central tendency and variance were recorded for each question in series A and B, and Wilcoxen T tests were performed to assess the significance of differences in overall results for each measure of investment and contact between maternal grandmothers and paternal grandfathers.

RESULTS

Before data could be analysed and statistics produced, invalid responses and erroneously inputted information were eliminated and corrected by this participant, reducing the data set from 426 to 330 participants. Details of this process are provided in appendix 1. Means and standard deviations were found for all data points in series A and series B. See below.





Tests of skewness and kurtosis were applied to all questions requiring an absolute value answer (series B), to determine whether non-parametric statistics could be applied. In all cases skewness, kurtosis or both indicated the data were not normally distributed (see appendix 2). Data collected in series A was ordinal, and hence parametric statistics could not be applied.

Non-parametric related samples Wilcoxen T tests were carried out on both sets of data (series A and B), in order to establish the significance of the differences between scores as related to grandparental relationship.

Participants rated their fathers father as significantly lower in perceived closeness, $T=270$, $p<0.01$, two-tailed, Q35(ff) m=.71, sd=.71, Q11(mm) m=1.16, sd=.69; significantly lower in demonstrated interest, $T=147$, $p<.001$, two tailed, Q36(ff) m=1.37, sd=.92, Q12(mm) m=2.04, sd=.85; and significantly lower in material generosity, $T=186$, $p<.001$, two-tailed, Q37(ff) m=1.68, sd=.95, Q13(mm) m=2.08, sd=.81, than their mothers mother.

Analysis of series B data revealed participants had not seen their fathers father for significantly longer, $T=518$, $p<.05$, two-tailed, Q33(ff) m=62.32, sd=133.05, Q9(mm) m=46.95, sd=130.04 than there mothers mother. However no significant difference was found in the frequency of contact per year between participants and their paternal grandfather and maternal grandmother, $T=795.5$, $p>0.5$, two-tailed, Q34(ff) m=58.62, sd=109.06, Q10(mm) m=58.10, sd=109.07.

DISCUSSION

The significantly higher degree of closeness, material investment, and interest reported by participants, from their maternal grandmothers (as compared to their paternal grandfathers), provided support for this studies hypothesis. Participants felt that the mothers of their mothers, those grandparents with the highest degree of certainty of relatedness, had invested more emotionally and financially in their lives. Additionally, measurement of the means and standard deviations of the remaining two grandparents (see graphs above), indicated that the grandparents gender alone did not determine the investment perceived by their grandchildren. According to Hamilton's (1964) theory of inclusive fitness, such behaviour would have evolved due to the fitness benefit created by gene's providing a predisposition for such selective altruism. Assuming some degree of mate cuckoldry occurred in the environment of evolutionary adaptedness, a strong selective pressure would have existed towards traits that determined altruistic behaviour partially on the basis of average certainty of relatedness.

Potential confounding variables in this research included the qualitative nature of series A questions, which recorded only participants impressions of grandparental investment. Additional research could record quantitative measures of investment, such as contributions from grandparent to child during religious initiations (confirmation, bar mitzvah etc), presence at the birth of grandchildren, and contributions by grandparents towards the cost of college / home purchases etc.

A potential difficulty was created by this participants decision to utilize inferential related samples tests. As each participant had a variety of combinations of surviving grandparents, it may have been more appropriate to utilize a between groups measure of significance.

Additional tests should also have been carried out to ensure that the gender of participants did not distort the degree of closeness measured, for example by indicating a tendency of women to remain closer to their family of parentage than men, rather than a greater investment by maternal grandmothers.

Potential future research could examine the mechanisms which have evolved in humans to unconsciously identify genetic relatedness. This would determine whether a specific

evolved mechanism exists for the identification and increased investment in the children of daughters; or whether some alternative mechanism such as female preference for high status mates could be this trigger (in combination with increased grandparental investment in higher status children, who might tend to be those of daughters mating with higher status males).

Whilst a significant difference was found in the recency of participants contact with their maternal grandmothers, as compared to paternal grandfathers, no significant difference was found in their frequency of contact. This disparity could imply an over estimation by participants of contact with their paternal grandfathers, or be an effect of the greater number of surviving female grandparents. Additional inferential statistics would be required to identify the source of this discrepancy.

REFERENCES

Baker R., Bellis. M. (1993) Human sperm competition: ejaculate adjustment by males and the function of masturbation. Animal Behaviour, 46, 861-65.

Buss, D (2004). Evolutionary Psychology: The New Science of the Mind. Boston: Pearson Education.

Hamilton, W.D. (1964). The genetical evolution of social behaviour I and II. Journal of Theoretical Biology, 7, 1–52.

Janicki, M (2004). The Simson Fraser University Evolutionary Psychology Research Group Home Page. Definition of Evolutionary Psychology. Retrieved 15 March from http://www.sfu.ca/~janicki/defn.htm

Likely, D (1998) University of New Brunswick, Canada: Gregor Mendel and the Discovery of Genetics.Retrieved 25 March, 2004 from http://www.unbf.ca/psychology/likely/evolution/mendel.htm

Trivers, R.L. (1972) Parental investment and sexual selection. In Campbell, B. (Ed) Sexual Selection and the Descent of Man. (pp.136-179.) Chicago: Aldine Press.

APPENDIX 1

Corrections carried out on data set

Initially experimental co-ordinators removed from the data set answers which indicated any grandparent was very ill (Q7~=3&Q15~=3& Q23~=3&Q31~=3), as this could have biased relationship / contact. All participants who filled in the questionnaire providing 0 living grandparents were removed (Q5~=0). All multiple choice questions were checked for values exceeding those allowed. All participants who provided data exceeding allowed values in multiple choice questions were removed, in cases where this had lead to later results being disordered. All participants who answered that they lived in the same house as a given grandparent, had frequency of contact information altered to 356, as indicated by experimental instructions (Q8=0 to Q10 = 365, Q16=0 to Q18 = 365, Q24=0 to Q26=365). The column comprised of participants answers to question 30 was changed from a string to numeric variable in SPSS. Several responses were corrected where participants had mistakenly indicated a living grandparent, but not entered information in response successive questions about that grandparent and vice versa (Q6, Q14, Q22. Q30).

APPENDIX 2

Skewness and Kurtosis results for series B data

Q9. s=9.85, k=120.03, Q10. s=2.37, k=4.35, Q17. s=3.80, k=15.67, Q18. s=1.994, k=2.53, Q25. s=7.06, k=55.96, Q33. s=4.84, k=27.93, Q34. s=2.16, k=3.037