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Measuring Paternal Certainty Using Cross-Cultural Data¹

Brad R. Huber

Department of Sociology and Anthropology, College of Charleston. HuberB@cofc.edu

Vendula Linhartova

Department of Sociology and Anthropology, College of Charleston.

Dana Cope

Department of Sociology and Anthropology, College of Charleston.

1. INTRODUCTION

This presentation discusses the development of a new measure of paternal certainty² using cross-cultural data. At the level of the individual, paternal certainty can be conceptually defined as the probability that a man is the genitor of his putative children. When a society is the unit of analysis, its level of paternal certainty can be very low (men are uncertain they are genitors of their putative children), very high, or somewhere in between. As was the case with previous research, our cross-cultural measure of paternal certainty is operationalized as an ordinal variable.

Our paper begins with a discussion of previous efforts that developed a cross-cultural measure of paternal certainty. This is followed by an overview of the coding criteria and the four sub-scales that we employed to develop a measure of paternal certainty in the sixty cultures that comprise the HRAF (Human Relations Area Files) Probability sample³. We conclude with a discussion of the potential uses of a reliable cross-cultural measure of paternal certainty.

2. PREVIOUS CROSS-CULTURAL RESEARCH ON PATERNAL CERTAINTY

The first empirical research that examined paternal certainty across cultures was that of Gaulin and Schlegel (1980). They developed an index of paternal certainty by combining three variables previously coded by Broude and Greene (1976): 1) presence or absence of a double standard for extramarital sex, 2) frequency of extramarital sex by females, and 3) the frequency of wife sharing. The resulting dichotomous index ranked paternal confidence as either high or low for 135 societies of the 186 pre-industrial societies that comprise the Standard Cross-Cultural Sample. Gaulin and Schlegel's treatment of missing data proved to

be problematic (see Wolfe and Gray 1981), but the three indicators they chose to measure paternal certainty seem reasonable.

Mark Flinn's (1981) operationalization of paternal certainty is somewhat similar to the one proposed by us. Flinn used a five point ordinal scale to rank paternal certainty in 303 societies. For 150 societies, he consulted the ethnographic materials under two OCM (Outline of Cultural Materials) subject codes used in the HRAF: #837-Extramarital Sex, and #684-Sex and Marital Offenses. For the remaining societies, paternal certainty was evaluated by "checking material [in original sources] indexed under appropriate categories (e.g., adultery), or by searching through the text" (1981: 444). In addition to adultery, he looked for information on cuckoldry, secrecy of affairs, and frequency of premarital sex (personal communication). Flinn used several techniques to check data reliability. For example, another researcher independently coded paternal certainty in 20 societies. Inter-coder reliability was found to be satisfactory.

3. CODING PATERNAL CERTAINTY USING THE HRAF PROBABILITY SAMPLE

We designed our measure of paternal certainty by using ethnographic data from the updated, web-based version of the 60-culture Probability Sample files (PSF) of the HRAF (<http://ets.umdl.umich.edu/e/ehrafe/>). The Probability Sample was designed to ensure representative coverage of traditional and peasant cultures of the world. One well-described culture from each of 60 world regions was randomly selected by the developers of the PSF (Lagacé 1979). Even though we relied upon the PSF for development, our operational procedures should work with other HRAF samples, including the Standard Cross-Cultural Sample.

Our measure of paternal certainty is a composite index that grew out of our development of four potential paternal certainty sub-scales: the 1) frequency of premarital sex, 2) the frequency of extramarital sex, 3) the level at which premarital sex is deterred, and 4) the deterrence level of extramarital sex. Since premarital and extramarital sexual patterns in a given culture vary over time, and are related to socio-economic status, we stipulated a time focus for each culture and focused on free people of lower socio-economic status. In general, our time focus was the most recent time period for which adequate ethnographic information on pre- and extramarital sex⁴ was available. We also thought it important to clearly define premarital and extramarital sex. Premarital sex was defined as voluntary sexual intercourse of an unmarried person with an unmarried individual of the opposite sex. Extramarital sex was conceptualized as voluntary, sexual intercourse of a married man or married woman with an individual of the opposite sex, whether unmarried or married. Both definitions exclude incest, prostitution, homosexuality, or sex that involves individuals from other societies or castes.

We developed four code sheets, one for each sub-scale. The content and ranking of the phrases found on the code sheets were developed after reading ethnographic reports of premarital and extramarital sex in 60 societies. During the development of our scales, we took into consideration that a double standard exists in many societies. When a double standard is in place, females as a group are less likely to engage in premarital and extramarital sex than are males, and the application of premarital and extra-marital restrictions is generally more forcefully applied to females than to males (see also Frayser 1985:218, 324). We also developed criteria that were based on reports of behavior rather than on reports of social norms and rules. See Appendix 1 for the criteria that were used to rank the frequency and level of deterrence of premarital and extramarital sex.

The first and second authors independently filled out the four paternal certainty code sheets for the 60 societies of the Probability Sample. We searched the eHRAF under OCM subject codes: #836-Premarital Sex Relations, #837-Extramarital Sex, #684-Sex and Marital Offenses, and #848-Illegitimacy. A full text search was also undertaken using variations of the following words: adultery, chastity, courtship, defloration, extramarital, fidelity, illegitimate, premarital, prenuptial, promiscuity, sex, and virginity. Coders were instructed to check off those phrases on the code sheets that were most similar in meaning to those found in the eHRAF. The summary rating score is the highest number in the scale for which a corresponding phrase is checked.

4. INTER-CODER RELIABILITY

Both coders independently rated all 60 societies of the Probability Sample on four indicators of paternal certainty: 1) Frequency and 2) Level of Deterrence of Premarital Sex, and 3) Frequency and 4) Deterrence Level of Extramarital Sex. The percentage of agreement and coefficient of association methods were used to assess the consistency of the measurements or inter-rater reliability. Table 1 reports the results of these methods. The results indicate that inter-rater error for all four indicators is within acceptable limits.

Table 1. Inter-rater reliability

	Percentage of Agreement	Coefficients of Association
Frequency of Premarital Sex	75.0%	Gamma = .882 Pearson's R = .853
Level of Deterrence of Premarital Sex	68.3%	Gamma = .863 Pearson's R = .725
Frequency of Extramarital Sex	66.7%	Gamma = .780 Pearson's R = .706
Level of Deterrence of Premarital Sex	71.7%	Gamma = .943 Pearson's R = .758

Approximate Significance (2-tail) = 0.000 for all coefficients.

We dealt with rater discrepancies through discussion and resolution (Ember and Ember 2001: 133). Discrepancies generally came about as a result of a coder overlooking a relevant passage. Moreover, the coding errors were generally small, e.g. one coder assigning a “3”

and the other assigning a “4”. In the case of a discrepancy, each coder pointed out to the other the original ethnographic reports upon which a score was based. All of the discrepancies were resolved. The final ratings for the four paternal certainty sub-scales are presented in Appendix 2.

5. FACTOR ANALYSIS

The next step was to determine whether a composite measure of paternal certainty that combined the four sub-scales could be justified on statistical grounds. First, we ran a principal components analysis on the four indicators to see if one factor accounted for most of the variability in the four sub-scales. If so, this would be regarded as a justification for simply adding up the four scale scores to form a composite index. Second, we ran Cronbach's alpha on the four items to see if this statistic justified an index.

The results of the factor analysis presented in Table 2 showed that one factor accounted for 51.25% of the variance. This slightly exceeds the 50% cutoff point. Many researchers would comfortably interpret this finding as support for adding up the four scale scores to form a composite index for paternal certainty (cf. Bernard 2002:644). We'll call this measure of paternal certainty the “PC4” option.

Table 2. Principal Components Analysis with Eigenvalues, Loadings, and Correlation Matrix

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% Variance	Cumulative %	Total	% Variance	Cumulative %
1	2.050	51.251	51.251	2.050	51.251	51.251
2	0.989	24.715	75.966			
3	0.543	13.583	89.549			
4	0.418	10.451	100.000			

	PRESEX	PRSEXDET	EXTRASEX	EXSEXDET
Correlation:				
PRESEX	1.000	0.573	0.406	0.183
PRSEXDET	0.573	1.000	0.335	0.152
EXTRASEX	0.406	0.335	1.000	0.405
EXSEXDET	0.183	0.152	0.405	1.000
Sig. (one tail):				
PRESEX		0.000	0.001	0.087
PRSEXDET	0.000		0.005	0.130
EXTRASEX	0.001	0.005		0.001
EXSEXDET	0.087	0.005	0.001	

Justifying a composite measure that adds up the component scores rests also on each of the component variables being strongly correlated with the others. Table 2 shows that the premarital sex frequency variable correlates with the premarital sex deterrence and the extramarital sex frequency variables at about 0.575 and 0.400 respectively, but the other correlations are lower, e.g. the premarital and extramarital sex deterrence levels correlate at

0.150. Moreover, Cronbach’s alpha coefficient was 0.6729. By convention, a good set of items should scale at 0.80 or above. As a result, we feel using the **PC4** variable as a measure of paternal certainty is not our very best option.

In order to identify a more valid measure of paternal certainty, we conducted a factor analysis with two rotated factors. As can be seen in Table 3, the first component had large loadings for the two premarital sex items, while the second component had relatively large loadings on the two extramarital sex items. These two distinct components (the two premarital variables and the two extra-marital variables) account for about 76% of the variance. Given our a priori conceptual belief that level of paternal certainty depends primarily upon extra-marital sexual relationships engaged in by married members of a society, we chose to operationalize our measure of paternal certainty as the sum of the two-extramarital variables (**PC2Extra**). Additional support for selecting this option is provided in Table 4. Table 4 shows that this measure of paternal certainty is more highly correlated with those developed by Gaulin and Schlegel (1980) and Flinn (1981) than is a measure based upon the two premarital sex sub-scales.

Table 3: Loadings for Two Rotated Components, with Initial Eigenvalues and Explained Variance.

Variable	Component 1	Component 2
Premarital Sex Frequency ¹	0.859	0.176
Extra-marital Sex Frequency	0.415	0.704
Level of Deterrence of Premarital Sex	0.873	0.085
Level of Deterrence of Extramarital Sex	-0.010	0.913
Initial Eigenvalue ²	2.050	0.989
Percent of Variance	51.251	24.715

The values for the Frequency of Premarital and Extramarital Sex variables were reversed so that they represent the appropriate value for paternal certainty. For example, “1-Very Low Frequency” is “5-Very High Paternal Certainty”.

An eigenvalue is the amount of variance of the variables accounted for by a factor. An eigenvalue for a factor should be greater than or equal to zero and may not exceed the total variance (in this case, 4).

Table 5: Correlations, Gaulin and Schlegel's (1980), Flinn's (1981), and Three Measures of Paternal Certainty Developed by Huber et al.

	Paternal Certainty, Gaulin and Schlegel (1980)	Paternal Certainty, Flinn (1981)
Paternal Certainty, Sum of Two Extra-Marital Sex Variables – PC2Ex	Pearson's R = .626 Sig.(2-tailed) = .000 N = 32	Pearson's R = .378 Sig.(2-tailed) = .010 N = 45
Paternal Certainty, Sum Of Four Sub-Scales – PC4	Pearson's R = .622 Sig.(2-tailed) = .000 N = 32	Pearson's R = .456 Sig.(2-tailed) = .002 N = 44
Paternal Certainty, Sum of Two Premarital Sex Variables ¹ - PC2Pre	Pearson's R = .429 Sig.(2-tailed) = .014 N = 32	Pearson's R = .335 Sig.(2-tailed) = .026 N = 44
Paternal Certainty, Flinn (1981)	Pearson's R = .533 Sig.(2-tailed) = .004 N = 27	Pearson's R = 1.000

1. Justifying a composite measure by adding up the component scores rests, essentially, on each of the component variables being strongly correlated with the others. The premarital sex frequency variable correlates with the premarital sex deterrence and the extramarital sex frequency variables at about 0.575 and 0.400 respectively, but the other correlations are lower, e.g. the premarital and extramarital sex deterrence levels correlate at 0.150.

2. There is an error in one of Flinn's codes for paternal certainty (Hartung 1985, Note 2). The statistics in this table were computed after this error was corrected.

6. DISCUSSION

In the past, scholars engaged in cross-cultural research have examined the relationship of paternal certainty to a number of variables including inheritance of property, succession to political office, post-marital residence, descent, source of altruism (agnatic vs. matrilineal), conjugal dissolution, and marriage preferences (Flinn 1981; Gaulin and Schlegel 1980; Hartung 1985). In the future, cross-cultural researchers should consider examining paternal certainty as both an independent and dependent variable. For example, we soon hope to test cross-cultural hypotheses that relate paternal certainty to the amount of assistance father's and mother's patrilateral relatives provide during the prenatal, birth and post-natal periods. We also hope to examine paternal certainty and the couvade, naming ceremonies, rites of initiation, weddings, funerals, and a number of variables that are related to social, economic, political and religious complexity (cf. Frayser 1985).

7. NOTES

1. Paper presented at the 15th annual meeting of The Human Behavior and Evolution Society, University of Nebraska-Lincoln, June 4-8, 2003. The authors thank Mike Lacy (Department of Sociology, Colorado State University) for his assistance with statistical analyses, especially the factor analysis.

2. Other researchers have referred to this variable with similar terms such as paternal confidence, confidence of paternity, and paternal uncertainty.
3. This sample is also known as the HRAF Quality Control Sample.
4. We developed a cross-cultural measure of paternal certainty in order to examine its relationship to a number of childbirth-related variables. For some cultures, the most recent information on childbirth is somewhat older than the most recent information on premarital and extramarital sex. Since we strove for consistency in our time frames, we set our time focus in some cultures five to ten years earlier than the “most recent time period” for which we had data on premarital and extramarital sex. As Ember and Ember (2001: 64) note “... [It] is important to measure your hypothetically related variables for the same time and place in a given sample case. Otherwise, you may be introducing random error that will wash out the real relationship”.

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9. APPENDIX 1: PREMARITAL AND EXTRAMARITAL SEX SCALES

Frequency of Premarital Sex Scale:

- | | | |
|---|----|---|
| . | 3 | Missing data |
| 1 | 6 | Very Low Frequency: Premarital sex is uncommon, rare, occurs on a small scale, or to no great extent. It is noted that no instances of premarital sex came to the ethnographer's attention while conducting field work. Unmarried girls are as a rule chaste. Morality of women is famous, high, beyond question, or reproach. |
| 2 | 7 | Low Frequency: Cases of premarital sex for girls are mentioned, but there is no mention of their being rare or uncommon, or of their being common. Premarital Sex sometimes occurs or is known to occur. |
| 3 | 10 | Moderate Frequency: Unmarried girls having sex often occurs, is common, frequent, not unusual, not uncommon, or not infrequent. Many girls have premarital sex. |
| 4 | 20 | High Frequency: Unmarried girls having sex is very common or very frequent. Unmarried girls or people of both sexes have considerable freedom to have sex or experiment freely. Some unmarried boys or girls have sex with multiple unmarried partners during the same time period. Unmarried men and women have multiple sex partners during the same time period under specific circumstances or at specific times. Most or the majority of girls have premarital sex. |
| 5 | 14 | Very High Frequency: Premarital Sex is universal, extremely common, or extremely frequent for women or for both women and men. Unmarried women or unmarried men and women who have sex are very numerous. There is a very high incidence, a very great deal of, or very much premarital sex, unfaithfulness, or infidelity among unmarried girls or people of both sexes. Unmarried men and women having multiple sex partners during the same time period is common, or a custom; unmarried people have as many lovers during the same time period as they like. |

Level of Deterrence of Premarital Sex Scale:

- . 3 Missing data
- 1 6 Very Weak Deterrence: Premarital Sex is generally overlooked or gives rise to mild gossiping, jealousy, or minor quarreling. Premarital Sex is usually not a cause of couples separating. Premarital Sex is usually not regarded with serious concern.
- 2 7 Weak Deterrence: Premarital Sex leads to strong quarreling or people scolding, bickering, or cursing. Premarital Sex may lead to couples separating. Premarital Sex is brought to public attention or leads to public shaming. Unmarried people who have sex pay a small fine or are made to suffer minor physical discomfort when discovered. Premarital Sex is thought to be punished supernaturally. Unmarried men may marry when they have sex with a girlfriend or when their girlfriends become pregnant. Fetuses of premarital unions may be aborted or infanticide practiced.
- 3 37 Intermediate Deterrence: Premarital Sex often or generally leads to couples separating. Premarital sex is moderately to heavily fined; pre-nuptial gifts or payments are returned; the engagement is canceled. Unmarried men generally marry when they have sex with a girlfriend or when their girlfriends become pregnant. Unmarried people who have sex are apprehended, detained, or made to appear at a trial, ordeal, or public meeting. Unmarried people who have sex may be beaten, wounded, maimed, killed, flee their community, sent away from it, or they may have difficulty getting married in the future, their worth as marriage partners may be diminished, or they may be imprisoned or forced to labor; these things are rare, not frequent, not common. There is a virginity test or defloration custom. Whether a girl was a virgin upon marriage may be publicly broadcast. Fetuses of premarital unions are generally aborted or infanticide may be a common way to deal with premarital pregnancies.
- 4 6 Strong Deterrence: Unmarried people may be killed, imprisoned, or forced to labor; these things are rare, not frequent, not common. Unmarried people who have sex are generally beaten, wounded, maimed, flee their community, sent away from it, or they generally have difficulty getting married in the future, or their worth as marriage partners is significantly diminished. These things are common or frequent.
- 5 1 Very Strong Deterrence: People who have premarital sex are frequently, commonly, or generally killed, imprisoned, or forced to labor for a substantial period.

Frequency of Extramarital Sex Scale:

- | | | |
|---|----|--|
| . | 2 | Missing data |
| 1 | 4 | Very Low Frequency: Adultery is uncommon, rare. Spouses are as a rule faithful. Morality of women is famous. |
| 2 | 18 | Low Frequency: Cases of Adultery are mentioned, but there is no mention of their being rare or uncommon, or of their being common. Adultery sometimes occurs; infidelity is known to occur. |
| 3 | 9 | Moderate Frequency: Adultery or unfaithfulness or infidelity is common or frequent, or not unusual; not uncommon; not infrequent. Adultery is a rather common pleasure. |
| 4 | 21 | High Frequency: Adultery is very common or very frequent. There is a great deal or high incidence of adultery or marital infidelity or there is much marital infidelity. Spouses have considerable freedom to have sex outside of marriage. People do not resist adultery. People are not or never satisfied [sexually] by their spouses only. Adultery is extremely common or very frequent for men but this is not the case for women. Wives are exchanged under specific circumstances or at specific times or by a specific group. |
| 5 | 6 | Very High Frequency: Adultery is extremely common or extremely frequent for women or for both sexes. Women adulterers or adulterers of both sexes are very numerous. There is a very high incidence of adultery or infidelity. Wife exchange is practiced, common, or a custom. |

Level of Deterrence of Extramarital Sex Scale:

- | | | |
|---|----|---|
| . | 3 | Missing data |
| 1 | 1 | Very Weak Deterrence: Adultery may be overlooked. Adultery gives rise to gossiping or jealousy. Adultery is not a cause of divorce or separation. Adultery is not regarded with serious concern. |
| 2 | 6 | Weak Deterrence: Adultery leads to domestic quarreling or people scolding or cursing. Adultery may lead to separation or divorce. Adultery is brought to public attention or leads to public shaming. Adulterers pay a small fine or are made to suffer minor physical discomfort. Adultery is thought to be punished supernaturally. Adultery is generally overlooked when permission is given by spouses but adulterers may be beaten, wounded, maimed, fined, or deprived of material goods when adultery is engaged in without their spouses' permission. Children of adulterous unions may be aborted. |
| 3 | 33 | Intermediate Deterrence: Adultery often or generally leads to separation or divorce. Adulterers are moderately to heavily fined; bride price or wedding expenses are returned. Adulterers are apprehended or made to appear at a trial, ordeal, or public meeting. There are reports of adulterers being beaten, wounded, maimed, or killed but no mention is made of how frequent these |

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things happen.

- 4 15 Strong Deterrence: Adulterers are sent away from or made to flee their community. Remarriage is restricted. Adulterers may be imprisoned or forced to labor for a period of time. Adulterers are generally, often, or frequently beaten, wounded, maimed or killed.
- 5 2 Very Strong Deterrence: Adulterers are very frequently, very commonly, or generally killed or imprisoned.

10. APPENDIX 2: Summary of Codes for the Four Paternal Certainty Sub Scales

Culture	OWC Code	Time	Premarital Sex Frequency	Premarital Sex Deterrence	Extramarital Sex Frequency	Extramarital Sex Deterrence
Akan	FE12	1900-1950	4	3	4	3
Ahmara	MP05	1950-1970	1	4	2	3
Andamans	AZ02	1880-1910	5	3	4	2
Aranda	OI08	1880-1930	5	1	5	3
Aymara	SF05	1937-1953	5	2	3	3
Azande	FO07	1909-1930	3	3	4	4
Bahia Brazil	SO11	1870-1945	4	4	3	3
Bemba	FQ05	1930-1990	2	3	2	3
Blackfoot	NF06	1830-1910	4	3	4	3
Bororo	SP08	1930-1960	4	1	4	3
Central Thai	AO07	1930-1980	3	3	4	3
Chukchee	RY02	1900-1921	4	1	5	2
Chuuk	OR19	1945-1956	4	3	5	3
Copper Inuit	ND08	1958-1983	5	1	5	2
Dogon	FA16	1931-1960	4	3	4	2
Eastern Toraja	OG11	1892-1932	4	3	4	2
Ganda	FK07	1910-1932	3	3	2	3
Garo	AR05	1953-1968	4	3	2	3
Guarani	SM04	1946-1954
Hausa	MS12	1900-1972	4	3	4	4
Highland Scots	ES10	1953-1971	3	3	1	4
Hopi	NT09	1890-1945	5	3	4	3
Iban	OC06	1890-1960	4	3	1	4
Ifugao	OA19	1908-1940	5	3	2	3
Iroquois	NM09	1953-1960	4	1	2	3
Kanuri	MS14	1955-1966	1	4	4	3
Kapauku	OJ29	1948-1975	4	3	4	4
Khasi	ARO7	1900-1960	4	1	2	4
Klamath	NR10	1860-1900	3	3	2	5
Kogi	SC07	1914-1950	3	2	3	3
Korea	AA01	1945-1991	3	3	2	4
Kuna	SB05	1940-1980	3	3	3	3
Kurds	MA11	1880-1950	1	5	1	5
Lau Fijians	OQ06	1920-1934	4	3	4	1
Libyan Bedouin	MT09	1948-1980	1	4	2	3
Lozi	FQ09	1940-1965	2	3	4	3
Maasai	FL12	1894-1975	5	3	5	3

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Mataco	SI07	1939-1985	5	3	3	4
Mbuti	FO04	1948-1958	4	3	4	3
Ojibwa	NG06	1932-1966	4	3	3	3
Ona	SH04	1910-1923	1	3	2	4
Pawnee	NQ18	1900-1920	2	4	2	4
Saami	EP04	1913-1959	5	2	1	3
Santal	AW42	1931-1942	5	3	2	3
Saramaka	SR15	1928-1980	3	3	4	3
Serbs	EF06	1920-1955	.	.	3	2
Shluh	MW11	Missing
Sinhalese	AX04	1954-1956	2	3	4	3
Somali	MO04	1919-1955	1	4	2	3
Taiwan Hokkien	AD05	1945-1973	2	3	3	3
Tarahumara	NU33	1930-1959	5	2	4	4
Tikopia	OT11	1928-1952	4	3	2	4
Tiv	FF57	1929-1953	4	2	3	4
Tlingit	NA12	1931-1954	2	3	2	3
Trobriands	OL06	1914-1981	5	2	4	4
Tukano	SQ19	1939-1973	4	3	4	3
Tzeltal	NV09	1950-1960	3	3	2	3
Wolof	MS30	1939-1975	2	3	2	4
Yakut	RV02	1876-1930	5	3	4	3
Yanoama	SQ18	1950-1987	5	2	5	.