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## Reports

### Karo Batak Cousin Marriage, Cosocialization, and the Westermarck Hypothesis

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Among the Karo Batak of North Sumatra, Indonesia, marriages between matrilineal cross cousins (*impal*) are the ideal, yet rarely occur. Further, ethnographic accounts reveal a stated aversion to *impal* marriage. These observations are consistent with Westermarck's "negative imprinting" hypothesis if *impal* are cosocialized. We present analyses of postmarital residence patterns from two studies of the Karo Batak. The analyses reveal that although individuals are likely to have been raised in close propinquity with some *impal*, cosocialization rates were probably not high enough for classical Westermarckian phenomena alone to account for the rarity of *impal* marriage. In accord with Westermarck's speculations on the origins of taboos, we propose a hybrid explanation combining evolved inbreeding avoidance mechanisms and their cultural by-products and generalize our findings to a model of cosocialization given cousin type and residence patterns.

Westermarck (1891) proposed that early-life association leads to sexual disinterest and sexual aversion in adulthood. Having a deep evolutionary history of kin association and given the detrimental effects of inbreeding on fitness, humans can be expected to possess an evolved kin recognition mechanism that subserves inbreeding avoidance. Multiple lines of evidence support the presence of an adaptive mechanism whereby individuals learn to treat cosocialized others as kin (Wolf and Durham 2004; also Lieberman et al. 2007), and natural experiments have provided compelling evidence in favor of the Westermarck hypothesis. The most well-studied cases are Taiwanese "minor" marriages (Wolf 1995) and Israeli kibbutzim (Shepher 1971; but see also Shor and Simchai 2009). In Taiwanese minor marriages, a bride is adopted into her future husband's family as a small child or infant. Com-

pared to major marriages, minor ones are marked by lower fertility and a higher probability of divorce and infidelity. In Israeli kibbutzim—Utopian communities in which unrelated children were raised in communal nurseries—nursery-mates rarely married one another. In both examples, nonrelatives treat each other as kin due to early-life cosocialization, as predicted by the Westermarck hypothesis. Westermarck originally developed his hypothesis in the context of cousin marriage in Morocco, and subsequent research has revealed a similar pattern in Lebanon (McCabe 1983). Marriageable cousins are averse to marriage, or they enter into relatively unsuccessful marriages, because early life association leads them to erroneously view one another as siblings.

Fessler (2007) suggested that cousin marriage among the Karo of Indonesia may also reveal Westermarckian patterns. The Karo are one of six patrilineal Batak groups from North Sumatra (Kipp 1993; Kushnick 2006; Singarimbun 1975; Steedly 1993). Marriages are clan exogamous, with a stated ideal for marriage between matrilineal cross cousins (or *impal*). The two types of "proper" *impal* relationships are diagrammed in figure 1.<sup>1</sup> In theory, among the Karo Batak (Kipp 1983) and other groups, such as the Kachin of Myanmar (Leach 1951), this arrangement, which has been called the "asymmetrical connubium," functions to bolster interlineage alliances and maintain ritual status differentials. That is, a single patrilineage acts as wife-givers (*kalimbubu* among the Karo Batak) for a second patrilineage, and wife-takers (*anakberu* among the Karo Batak) for a third. Ideally, under this arrangement, the wife-giver/wife-taker relationship is perpetual, and one's wife and mother are born from the same patrilineage. In practice, however, *impal* marriages are rare—just 4% of the marriages documented by Singarimbun (1975). Kipp (1986) has shown that *impal* have a stated aversion to intermarriage. These observations are consistent with the Westermarck hypothesis if *impal* are cosocialized (Fessler 2007).

Here, we present analyses of data on postmarital residence patterns collected in two ethnographic studies of the Karo Batak, one in the early 2000s (Kushnick 2006) and the other in the 1960s (Singarimbun 1975). We estimate the probability that *impal* grew up in the same village, a prerequisite for the sort of prolonged and persistent cosocialization observed in studies supporting Westermarck's (1891) hypothesis. The analyses suggest that although most individuals would have been raised in close propinquity with at least some *impal*, the probability of a given pair of *impal* being raised in the same village is often low. We generalize our results to a model of cosocialization given cousin type and postmarital residence patterns. We also acknowledge that although our study focuses on the classical Westermarckian mechanism (i.e., early-life

1. MBD-FZS is a marriage between a mother's brother's daughter and a father's sister's son; MFBSB-FBDS is a marriage between a mother's father's brother's son's daughter and a father's father's brother's daughter's son.

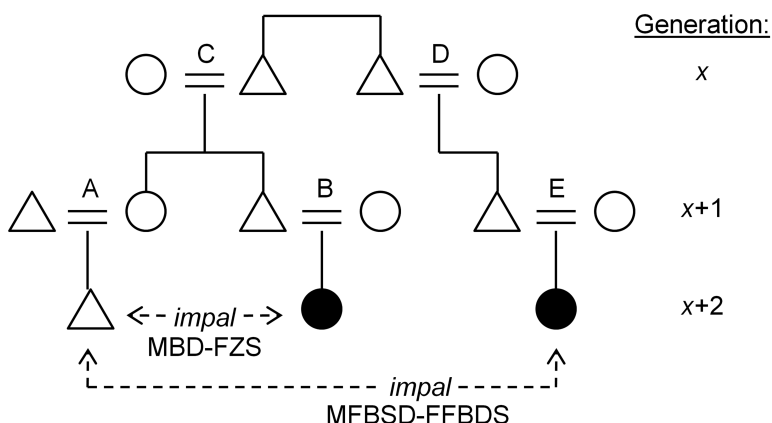


Figure 1. The two types of “proper” *impal* (matrilateral cross cousin) relationships in Karo Batak society: MBD-FZS and MFBSD-FFBDS.

cosocialization), other kin detection mechanisms (such as those discussed in Lieberman 2009; Lieberman et al. 2007; Widdig 2007) may be operating that we cannot address directly with our data.

Analyses

We estimated the probability that a given pair of *impal* were raised in the same village using observed residence patterns in generation  $x + 2$  and extrapolating back to generations  $x + 1$  and  $x$ . Then, from these estimates, we calculated the probability that a given individual was cosocialized with at least one other individual classified as *impal*. We used basic probability theory to construct our estimates (LeFebvre 2006). The residence data, presented in table 1, derive from two ethnographic studies of the Karo Batak (Kushnick 2006; Singarimbun 1975). The residence patterns can be described as multilocal. We introduce a categorical distinction as follows: intravillage means that the husband and wife are from the same village and continue to reside there after marriage.

Cosocialization of a Given Pair of Impal

For a given pair of MBD-FZS *impal* to have been cosocialized, both sets of their parents (marriages labeled A and B) need

Table 1. Residence patterns from two studies

Residence	Kushnick		Singarimbun	
	N	Frequency	N	Frequency
Intravillage	38	.27	26	.34
Virilocal	56	.40	27	.36
Uxorilocal	24	.17	20	.26
Neolocal	22	.16	3	.04
Total	140	1.00	76	1.00

Note. Data from studies by Kushnick (2006) and Singarimbun (1975). Exact test for equality of distributions in  $R \times C$  tables:  $P = .023$  (Freeman and Halton 1951).

to have resided in the same village after marriage. This will have occurred if both of the following are true with reference to the marriages in figure 1: (i) A was intravillage or uxorilocal, and (ii) B was intravillage or virilocal. We therefore estimated the probability as

$$P(i) \times P(ii),$$

where

$$P(i) = P(\text{intravillage}) + P(\text{uxorilocal}),$$

$$P(ii) = P(\text{intravillage}) + P(\text{virilocal}).$$

Using this logic, our estimates for MBD-FZS *impal* are

$$(0.27 + 0.17) \times (0.27 + 0.40) = 0.29$$

(Kushnick 2006) and

$$(0.34 + 0.26) \times (0.34 + 0.36) = 0.42$$

(Singarimbun 1975).

For a given pair of MFBSD-FFBDS *impal* to have been cosocialized, both sets of their parents and grandparents (marriages labeled A, C, D, and E) need to have taken residence in the same village after marriage. This will have occurred if both of the following are true with reference to the marriages in figure 1: (iii) marriage A was intravillage or uxorilocal, and (iv) C, D, and E were intravillage or virilocal. We therefore estimated the probability as

$$P(iii) \times P(iv),$$

where

$$P(iii) = P(\text{intravillage}) + P(\text{uxorilocal}),$$

$$P(iv) = [P(\text{intravillage}) + P(\text{virilocal})]^3.$$

Using this logic, our estimates for MFBSD-FFBDS *impal* are

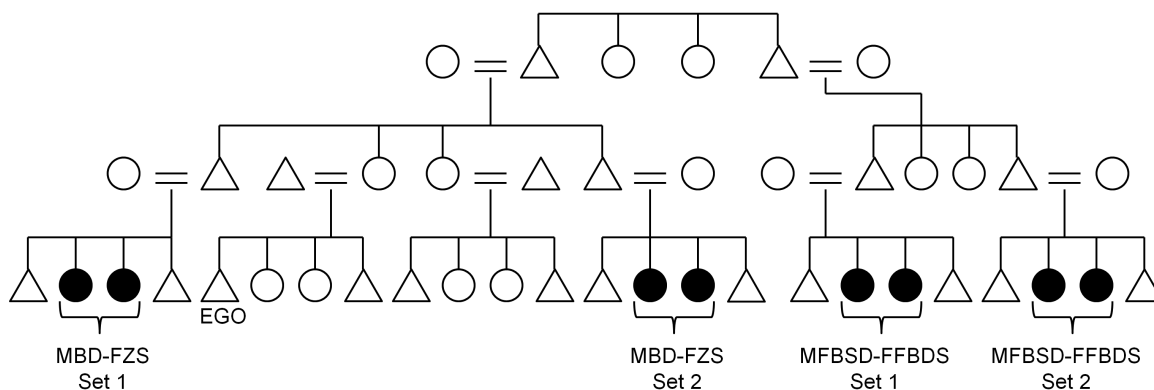


Figure 2. The *impal* relationships under the assumption that each marriage produced four offspring, with an equal number of each sex.

$$(0.27 + 0.17) \times (0.27 + 0.40)^3 = 0.13$$

(Kushnick 2006) and

$$(0.34 + 0.26) \times (0.34 + 0.36)^3 = 0.20$$

(Singarimbun 1975).

The above calculations suggest that, if Westermarck effects substantially impact Karo marriage patterns, MFBSD-FFBDS marriages should be less common than MBD-FZS marriages, as individuals standing in the latter relationship are twice as likely to have been cosocialized as individuals standing in the former relationship. Existing reports aggregate marriages across types of *impal*, hence we cannot yet determine whether the predicted asymmetry exists. We can, however, ask whether the above estimates shed light on the known overall frequency of *impal* marriage. As the two forms of *impal* relationship are equally likely to occur, we therefore ascertain the probability that, for any two individuals standing in any of the forms of *impal* relationship to one another, cosocialization occurred. We therefore combine the probabilities across types but within studies as follows:

$$0.29 + 0.13 - (0.29 \times 0.13) = 0.38$$

(Kushnick 2006), and

$$0.42 + 0.20 - (0.42 \times 0.20) = 0.54$$

(Singarimbun 1975).

These calculations suggest that, while cosocialization may well have contributed to many individuals' desire not to marry their *impal*, cosocialization alone is unlikely to fully account for the rarity of *impal* marriages despite their prescribed nature, as approximately one-half to two-thirds of all *impal* individuals would not have been cosocialized.

#### *Cosocialization with Impal Sets*

The above conclusions are based on a model in which each family produces two children, one of each sex. This is a highly

stylized model when compared with actual demographic data. Kushnick (2006) found that the total fertility rate of the women ( $n = 240$ ) studied in 2003–2004 was 3.91; the secondary, or at-birth, sex ratio was 0.95 boys to 1 girl. We can therefore make our model more realistic by assuming that each family produces four children, two of each sex, as illustrated in figure 2. Note that, when iterated over generations, this larger family size produces a larger number of possible *impal* relationships. Increasing the size of the family in the model therefore makes it less likely that the Westermarck effect can provide the sole explanation for the rarity of *impal* marriages, as larger family size generates more pairs of individuals who must be cosocialized for this explanation to apply.

How then are we to explain the ethnographic report that *impal* are averse to marriage because they view one another as siblings? One possibility is that, if cosocialization occurs with sufficient frequency, it could lead to sentiments that then become concretized in a folk model. In this view, some fraction of all possible *impal* pairs experience a Westermarck effect that shapes and maintains a folk model. These individuals apply said folk model in thinking about other *impal* with whom they were not cosocialized. What is more, the folk model is also transmitted to, and partially shared by, those individuals who are not cosocialized with any of their own *impal*. The folk model thus motivates avoidance in noncosocialized *impal* pairs, amplifying the Westermarck effect to produce a low rate of actual *impal* marriages. Finally, note that, although the above terminology equates Westermarck's name with only the biological half of this coevolutionary dynamic, this convention is an artifact of subsequent scholarship in this area, as Westermarck (1891) actually sought to explain cultural models as derived from subjective experiences produced by evolved mechanisms—our postulated folk model is thus a nascent Westermarckian taboo.

To explore the above possibility, we need to determine the

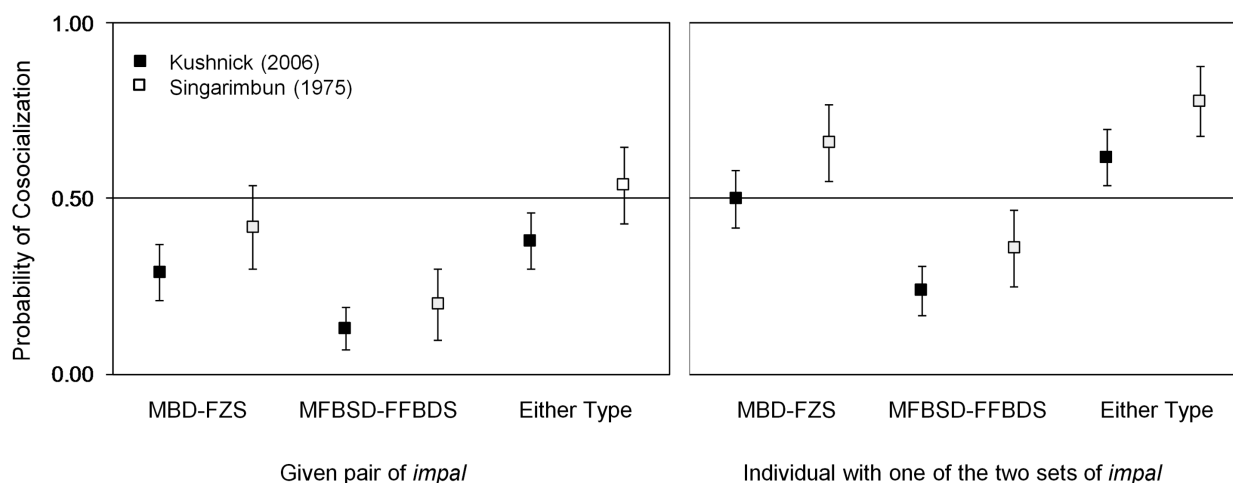


Figure 3. Estimated probabilities with 95% confidence intervals.

likelihood that an individual would have been cosocialized with any of his or her *impal*, as the goal here is not to account for the avoidance of all possible *impal* unions, but rather to determine whether cosocialization would have occurred with sufficient frequency to maintain the *impal*-as-sibling folk model in the face of the competing cultural representation of *impal*-as-future-spouse.

Because the probability that ego is cosocialized with an *impal* is the same for each of the two individuals who stand in a given genealogical relationship to ego, we treat each such sibling pair as a single set. The probability that an individual is cosocialized with a given set of MBD-FZS *impal* is identical to the estimated probabilities in the first model. Therefore, our estimates that a given individual is cosocialized with one or the other (or both) sets of MBD-FZS *impal* in our expanded model are

$$(0.29 + 0.29) - (0.29 \times 0.29) = 0.50$$

(Kushnick 2006) and

$$(0.42 + 0.42) - (0.42 \times 0.42) = 0.66$$

(Singarimbun 1975).

The probability that an individual is cosocialized with a given set MFBSD-FFBDS *impal* is identical to the estimated probabilities above. Therefore, our estimates that a given individual is cosocialized with one or the other (or both) sets of MFBSD-FFBDS *impal* in our expanded model are

$$(0.13 + 0.13) - (0.13 \times 0.13) = 0.24$$

(Kushnick 2006) and

$$(0.20 + 0.20) - (0.20 \times 0.20) = 0.36$$

(Singarimbun 1975).

Combining the MBD-FZS and MFBSD-FFBDS calculations, we estimate the probability that an individual is co-

socialized with at least one set of *impal* regardless of relationships as

$$(0.50 + 0.24) - (0.50 \times 0.24) = 0.62$$

(Kushnick 2006) and

$$(0.66 + 0.36) - (0.66 \times 0.36) = 0.78$$

(Singarimbun 1975). These calculations suggest that most individuals would indeed have been coresident with, and thus possibly cosocialized with, at least some *impal*.

## Discussion

Using residence data from two ethnographic studies, we estimated the probability that *impal* cross cousins were raised in the same village (see fig. 3; note 2 for explanation of confidence interval calculations). Our analyses indicate that the probability that a given pair of *impal* were raised in the same village is not sufficiently high to allow the Westermarck effect alone to account for the rarity of *impal* marriage despite its prescription. Nonetheless, the estimated probability that a given individual was raised in close propinquity with at least some *impal* suggests that the Westermarck effect plays a role in the rarity of this type of marriage and the sexual aversion of individuals having this relationship. Between two-thirds and three-quarters of all individuals likely resided near, and thus were potentially cosocialized with, at least one *impal*. These figures seem sufficiently high to potentially generate and maintain the counternormative folk model view that,

2. The 95% confidence intervals (Newcombe 1998) were calculated as  $P \pm z\sigma P$ , where  $P$  is the estimated probability,  $z$  depends on the level of confidence sought (in this case of 95% confidence intervals,  $z = 1.96$ ), and  $\sigma P$  is the standard error of the probability, which is calculated as  $\sigma P = [P(1 - P)/N]^{1/2}$ . We used the totals from table 1 for  $N$ . We added one correction for continuity ( $0.5/N$ ) to the upper limit and subtracted one from the lower limit. The confidence intervals assume that the error around the estimated probability is normally distributed.

rather than being ideal spouses, *impal* are subjectively akin to siblings.

Our attempts to reconstruct patterns of reproduction and residence are subject to limitations. The estimated probabilities of having been raised in the same village were calculated by extrapolating residence patterns from generation  $x + 2$  to generations  $x + 1$  and  $x$ . It is possible that these extrapolations are inaccurate. This might be the case if residence patterns among the Karo Batak have changed substantially through time. The distribution of residence patterns in table 1, representing the state of Karo Batak society in the 1960s compared to the 2000s, are significantly different. Neolocal residence is more prevalent in the Kushnick (2006) sample, pulling observations from the residence categories of interest and, in part, causing the comparatively lower cosocialization probabilities. Nonetheless, the residence data are remarkably similar in other dimensions. For instance, if we redefine observed residence in the two studies as “living in close proximity with the family of the husband” (i.e., virilocal and intravillage) and “not living in close proximity with the family of the husband” (i.e., all other residence categories), the distributions are almost the same—94 and 46 in Kushnick (2006) and 53 and 23 in Singarimbun (1975). We cannot reject the hypothesis that the distributions are equal using an exact test for a  $2 \times 2$  contingency table ( $P = .761$ ; Agresti 1996). Still, it would be helpful to have more information about residence patterns prior to the 1960s; unfortunately, pre-Singarimbun accounts of Karo Batak society (e.g., Loeb 1935) are notoriously error-prone (Kipp 1983).

Because our data are limited to village-level residence information, we are able to only draw inferences about kin recognition mechanisms that require some form of sustained proximity, a gross category that includes both coresidence and observing extensive parental care. We cannot rule out other mechanisms that do not require sustained proximity; for example, cousin-level kin recognition could conceivably operate through phenotype matching based on templates acquired through propinquity with the linking parent (see Widdig 2007). However, since prior work on cousin marriage and the Westermarck effect (e.g., McCabe 1983; Westermarck 1891) indicates that coresidence among the prospective mates appears to be the determining factor, we think it unlikely that such indirect kin-recognition mechanisms explain the low rates of *impal* marriage.

Extending our results more broadly, one conclusion that can be derived from our analysis is that cross cousins may generally be less likely to receive the same sort of prolonged and persistent cosocialization as parallel cousins, as, given gendered patterns of residence, parents of the latter are probably much more likely to live in close proximity. For example, compare the results presented here with the day-by-day closeness of FBD-FBS cousins in Lebanon who, for instance, have “constant interaction from birth including eating, sleeping, and performing other bodily functions in each other’s homes, if these are not one in the same” (McCabe 1983:59). If *impal*

Table 2. Probability that cousins are raised in close propinquity by cousin type and postmarital residence

Residence	Cousin type	
	Parallel	Cross
Unilocality	0 or 1.0	0
Multilocality	Intermediate	Intermediate
Neolocality	0	0

are, indeed, averse to marriage due to cosocialization, it must have come in a different form for a good many *impal* pairs. Cross-cousin cosocialization is never a sure thing, regardless of residence pattern. So, even though some *impal* pairs had been raised together, many cases of nonmarriage are left unexplainable by first-hand cosocialization. In addition to our postulated culturally amplified Westermarck effect, it is also possible that the explanation lies in the quality of early-life associations rather than their quantity. Certainly, even if residing in different villages, *impal* will have experienced periodic meetings from a young age, during which they would have observed their parents treating their *impal* differently than other children. Perhaps this sort of periodic but qualitatively important type of observation can provide important cues to relatedness, potentially leading to Westermarckian phenomena (see Lieberman 2009; Lieberman et al. 2007).

Our modeling approach can be generalized to explore cosocialization given cousin type and residence patterns (see table 2). Under this model, for example: *a*, parallel cousins with unilocality, as in McCabe’s (1983) Lebanese sample of patrilineal parallel cousins with virilocality, are predicted to always be raised in close propinquity (note, however, that with uxrilocal residence, the cousins in that study would never have been cosocialized); *b*, cross cousins with multilocality, as in the Karo Batak samples analyzed here, are predicted to have an intermediate probability of being raised in close propinquity; and *c*, neither parallel nor cross cousins are predicted to have been raised in close propinquity under neolocality.

In the future, we plan to employ a combination of archival and ethnographic data to more fully reconstruct personal histories of cosocialization. This will allow us to more directly test the contribution of such events to both attitudes and behavior.

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