Sex-biased Dispersal in the Contemporary United States

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Females in the contemporary United States disperse farther and are less philopatric than males, a pattern rare among mammals. This difference occurs primarily during the period of first independence following graduation from high school. I examine the patterns and possible causes of sex bias in internal migration using data derived from high school reunion booklets and a survey conducted on a sample of individuals selected from reunion booklets. The bias, which is small but significant, is largely eliminated when locality and socioeconomic factors are controlled. This suggests that these factors affect the sexes differentially. In general, females who move away to college or obtain jobs that are important to their residence are more likely to disperse relatively long distances, while males appear to be more constrained in their dispersal patterns. Female-biased dispersal (virilocal residence) in many nonindustrialized human societies is apparently a consequence of differences between the sexes in patterns of resource accumulation, exemplified by patrilinial inheritance. Similar differences still characterize, to a lesser extent, modern industrialized societies, and may be responsible, at least in part, for the pattern of sex-biased dispersal found in this study.

KEY WORDS: Dispersal; Migration; Philopatry; Sex Bias; Sex-biased Dispersal.

INTRODUCTION

Dispersal, defined as movement by an animal from its home area in order to establish or potentially establish a new home (Lidicker 1975), is often sex biased in birds and mammals (Gaines and McClenaghan 1980; Greenwood 1980; 1983; Waser and Jones 1983). Such sex differences can have important implications for the evolution of genetic differentiation (Powell et al. 1976) and life history traits (Bekoff 1977; Baker 1978; Endler 1979; Greenwood 1980; Dobson 1982).

Of particular interest is the striking difference in the direction of sex

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Ethology and Sociobiology 10: 263–278 (1989)
© Elsevier Science Publishing Co., Inc., 1989
655 Avenue of the Americas, New York, NY 10010
0162-3095/89/$3.50

bias observed in the dispersal patterns of birds and mammals: In the vast majority of birds, females disperse farther and more frequently than males, whereas the reverse holds for most mammals (Greenwood 1980; Dobson 1982). As of Greenwood's review (1980) only five species of mammals were known to exhibit female-biased natal dispersal (defined as the distance from birth site to first breeding), and only two species were known to exhibit female-biased breeding dispersal (defined as movement of individuals between successive breeding sites). Apparently overlooked by Greenwood and other authors examining dispersal in animals sociobiologically is that a majority of human populations exhibit female bias in dispersal (or migration, as it is often called in the sociological and anthropological literature). Indeed, this pattern, known as virilocal residence, is prevalent enough to have been identified as a "law" of migration by Ravenstein (1885) over a century ago. More recently, Murdock's compendium (1967) lists virilocal residence as the rule in 68.6% of 857 human societies, whereas uxorilocal, or male-biased dispersal, occurs regularly in only 13.0% of societies (van den Berghe 1979; see also Divale 1984). Specifically, female-biased dispersal usually characterizes *internal* migration in human societies, i.e., dispersal within a large, relatively homogenous political unit such as a country. In contrast, immigration and emigration outside of national boundaries is typically male-biased (e.g., Katz and Hill 1962; Brettell 1986).

Numerous studies since Ravenstein's landmark paper have confirmed the pattern of female-biased internal migration in nonindustrialized, generally agricultural, human populations (Cavalli-Sforza and Bodmer 1971, p. 433). Examples of populations exhibiting female-biased dispersal include Australian aborigines (Tindale 1953), Kalahari bushmen (Murdock 1959), residents of the Parma Valley in Italy (Cavalli-Sforza 1962) and the Gainj and Kalam of Papua New Guinea (Wood et al. 1985). In these and other nonindustrialized societies, wealth is typically passed on through the male lineage (patrilineal descent) while mates are exchanged among lineages (van den Berghe 1979), thereby resulting in relatively greater movement by females.

There is less support for this trend among modern, industrialized societies. For example, Hollingsworth (1970) found virtually no sex bias in dispersal in mid-twentieth-century Scotland, Freire-Maia and Freire-Maia (1962) found male-biased dispersal in twentieth-century Brazil, and both Spuhler and Clark (1961) and Shryock (1964) reported a male dispersal bias in the twentieth-century United States. However, consistent with the trends seen in many of the nonindustrialized societies, preliminary analyses (Koenig 1988) suggest that there is a significant female bias in dispersal in the contemporary United States following graduation from high school, when individuals typically attain independence. The purpose of this paper is to examine internal migration in the contemporary United States with an emphasis on the extent and the causes of sex-biased dispersal.

MATERIALS AND METHODS

Reunion Booklets

Dispersal data on cohorts of individuals during the period in which they first attained independence was acquired from high school reunion booklets. Booklets were solicited from a variety of sources—primarily friends, relatives, and through professional newsletters. In all, 19 booklets were obtained from 17 different localities throughout the United States. Thirteen of the booklets were from 10-year reunions; the others ranged from 15- to 40-year reunion booklets. Only reunion booklets that attempted to list the current residences of all graduates, whether they had physically attended the reunion or not, were used. In order to exclude immigrants and to restrict the analyses to a geographically contiguous area, I included only individuals residing within the continental United States and adjacent Canada (excluding Alaska and Hawaii); individuals whose address was listed as being "in care of" another individual were excluded.

In all, these booklets listed the current residences of 6,381 individuals. Evidence from ten of the booklets that included the names of individuals *not* located indicates that on average, 73% of graduates (range 39–90%) were represented in reunion booklets. Based on these same ten booklets, there was also usually no sex bias in response: eight of ten booklets showed no significant difference in the proportions of males located compared to females (χ^2 tests, all $p > 0.05$). Only two of the ten booklets indicated a significant sex bias, with females located more successfully than males (χ^2 tests, both $p < 0.01$).

This sex difference in locatability could, however, be sufficient to influence the results. For example, there was no significant difference in the incidence of philopatry (individuals dispersing <20 km, see below) or mean dispersal distance (log-transformed, see below) between males and females listed in the two booklets for which a sex bias in locatability existed (philopatry: $\chi^2 = 0.1$, df = 1, $p > 0.50$; mean dispersal distance [tested by ANOVA]: $F_{1,626} = 0.02$, $p > 0.50$). However, there was highly significant sex bias in the incidence of philopatry among individuals listed in booklets for which no sex bias in locatability was indicated (philopatry: $\chi^2 = 19.2$, df = 1, $p < 0.001$; mean dispersal distance: $F_{1,2857} = 16.8$, $p < 0.001$). This suggests that the relatively higher representation of females in the former sample tends to favor those that are more philopatric, thereby leading to increased similarity between the sexes. Thus, using data from all booklets is likely to underestimate the sex bias in dispersal and philopatry. Consequently, using the reunion booklet data, I report results from both the complete sample (referred to as "complete booklet" data) and from only those eight booklets for which no sex bias in locatability was indicated (referred to as "unbiased booklet" data).

A list of the localities and sample sizes from which reunion booklets were obtained is presented in Table 1.

Table 1. High School Reunion Data Used for Analysis of Sex Bias in Dispersal

Locality	Year of Graduation	Years after Graduation	Sample Size (Booklet) ♂♂	♀♀	Total	Sample Size (Survey) ♂♂	♀♀	Total
Eastern								
Doylestown, PA	1969	10	177	171	348[1]	—	—	—
Southern								
Tuscaloosa, AL	1954	30	82	115	197[1]	42	57	99
Winter Garden, FL	1972	10	56	50	106[1]	13	12	25
Midwestern								
Berkley, MI	1970	10	139	160	299[1]	—	—	—
Cleveland Hts, OH	1972	10	351	353	704	49	37	86
Davenport, IA	1936	40	179	226	405	—	—	—
East Lansing, MI	1966	10	102	132	234	—	—	—
Elmhurst, IL	1965	20	253	293	546[1]	—	—	—
Elmhurst, IL	1968	10	279	254	533	—	—	—
Lima, OH	1964	10	222	247	469[1]	—	—	—
Madison, WI	1966	20	317	261	585[1]	—	—	—
Madison, WI	1968	15	31	45	76	14	25	39
Milwaukee, WI	1967	10	130	201	331	—	—	—
Oshkosh, WI	1973	10	168	257	425[2]	52	58	110
Western								
Berkeley, CA	1963	20	92	112	204	25	27	52
Brea, CA	1971	10	70	99	169	—	—	—
El Cerrito, CA	1969	10	75	128	203[2]	—	—	—
Pasadena, CA	1963	20	89	136	225	31	40	71
San Jose, CA	1961–63	19–21	181	148	329[1]	59	57	118
Total			2,993	3,388	6,381	285	313	598

[1] Booklets for which there was no sex difference between the proportion of individuals listed and those not located.

[2] Booklets showing a significant sex difference between individuals listed and those not located (see text).

Reunion Survey

I acquired more detailed information on both dispersal and the possible causes of any observed sex bias by sending a questionnaire to 1,095 individuals arbitrarily selected from eight of the reunion localities in November 1984. I received 607 (55%) replies (Table 1). In the questionnaires, I asked respondents their sex, current occupation, whether or not they had moved away to college within 2 years of high school graduation, and of how many children they were the biological parent. For dispersal, I asked 1) place of birth, 2) place of high school graduation, 3) current residence, 4) birthplace of first child, 5) place of marriage, 6) birthplace of (first) spouse, and 7) place where their (first) spouse graduated from high school. I also asked respondents to list how or where they had met their (first) spouse and to rank, in order of importance, the following reasons for why they live where they do: a) because of their job, b) because of their spouse's job, c) because of school, d) to be near relatives. Answers to this last question were divided on the basis of whether they were ranked first or second in importance, or lower. For example, if category (a) was rated either 1 or 2, the job of that individual was considered as being important to where he or she lived. If it was rated 3 or 4, it was not.

Dispersal Distance

I determined the latitude and longitude for all localities within the continental United States or adjacent Canada. From these data, I calculated the great circle distance between each available pair of events in the lives of the individuals involved. Mean distances and root-mean-square distances (see Rockwell and Barrowclough 1987) were calculated. For statistical analyses, distances were logarithmically transformed (after adding 1 to the dispersal distance) in order to reduce the correlation between the mean and variance (Spuhler and Clark 1961; Sokal and Rohlf 1981). I also measured "philopatry," defined arbitrarily as the percent of the individuals in a particular category whose dispersal distance was less than 20 km.

Total migration distance, defined as the distance between birth and current residence, was divided into six nonmutually exclusive periods: 1) the period of dependence between birth and graduation from high school (usually at age 18), 2) birth to marriage, 3) birth to current residence (total migration distance), 4) graduation from high school to marriage, 5) graduation from high school to current residence, and 6) birth to birthplace of first child (parent–offspring distance). Here I extend my earlier analyses comparing dispersal during different mutally exclusive life-history stages (Koenig 1988) and attempt to understand the observed sex-biased dispersal from an evolutionary perspective.

Potential Biases in the Data

There are at least four potential sources of bias in the data (Koenig 1988). First, the geographic distribution of sampled individuals is not random: There is a clear bias toward Northern–Midwestern localities, with no samples from the Pacific Northwest or Southern–Midwest states. Additionally, no Eastern localities were represented in the survey. Second, even within the sampled localities, only individuals graduating or nearly graduating from high school are likely to be represented in the reunion booklets. Third, although booklets included all individuals whose current residences could be located whether they attended the reunion or not, there is still a possible bias among locatable individuals. Fourth, there is the inevitable bias in the response to the survey.

The probable effects that these biases have on the absolute dispersal distances are discussed elsewhere (Koenig 1988). For the analyses performed here, only biases that might affect the sexes differentially are critical. It is likely that the most serious of these is in relative locatability. As discussed above, the female-bias in locatability shown by at least some of the reunion booklets may tend to underestimate the degree of sex bias in dispersal. I have no objective way of estimating the importance of any sex bias due to the other three potential sources of error. However, there is no a priori reason to expect them to significantly influence the results.

Table 2. Mean Dispersal Distances

	Mean (± SE)		RMS[1]		*N*	
	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀
Reunion booklets						
All data	375.8 ± 14.5	403.1 ± 13.8	620.6	633.0	2981	3377
Unbiased only	381.8 ± 21.0	441.1 ± 21.8	620.5	662.6	1420	1439
Surveys[2]						
1. Birth → HS	510.3 ± 60.5	593.7 ± 64.9	806.5	913.4	285	313
2. Birth → marriage	608.7 ± 67.5	655.4 ± 66.6	844.6	917.7	233	284
3. Birth → CR	700.4 ± 63.9	793.8 ± 65.3	906.2	984.4	283	308
4. HS → marriage	196.4 ± 37.9	164.1 ± 32.6	432.5	409.1	234	290
5. HS → CR	360.0 ± 48.1	424.7 ± 47.4	626.0	665.0	284	314
6. Parent → offspring	678.2 ± 78.1	849.8 ± 80.9	896.6	1060.2	189	234

[1] Root-mean-square dispersal distance, RMS = $\sqrt{((1/2N)\sum_{i=1}^{N} x_i^2)}$, where x_i equals the dispersal distances (Rockwell and Barrowclough 1987).

[2] HS = high school graduation; CR = current residence.

RESULTS

Sex Bias in Dispersal: Univariate Tests

Differences between the sexes in several measures of dispersal, determined using 1) mean values, 2) root-mean-square values, 3) log-transformed values, and 4) percent philopatry, are given in Tables 2 and 3. Statistical tests are performed only on the latter two of these measures (Table 3).

In general, dispersal is female-biased, except for stages ending at marriage (periods 2 and 4). This female bias is significant using either all data or only the unbiased data from the reunion booklets. The cumulative frequency distributions of these latter data are shown in Fig. 1. There is also

Table 3. Sex Bias in Dispersal and Philopatry

	Mean Distance[1]		*p* Value[2]	Percent Philopatric		*p* Value[3]	N	
	♂♂	♀♀		♂♂	♀♀		♂♂	♀♀
Reunion booklets								
All data	21.5	28.8	***	54.0	48.0	***	2981	3377
Unbiased	21.6	33.5	***	52.5	44.2	***	1420	1439
Married only	23.6	30.2	*	52.3	47.0	**	1240	2556
Unmarried only	31.0	25.4	ns	49.9	49.5	ns	399	416
Surveys[4]								
1. Birth → HS	22.7	20.7	ns	58.9	58.8	ns	285	313
2. Birth → marriage	55.5	35.4	ns	38.2	46.1	ns	233	284
3. Birth → CR	80.0	104.0	ns	32.5	30.8	ns	283	308
4. HS → marriage	11.6	4.9	***	61.5	76.2	***	234	290
5. HS → CR	22.7	29.1	ns	49.6	46.2	ns	284	314
6. Parent → offspring	65.0	76.4	ns	37.0	35.5	ns	189	234

[1] Mean values (in kms) are back-transformed from log-transformed values.

[2] Tests are by ANOVA; * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$, ns = $p > 0.05$.

[3] Tests are by χ^2 contingency tests; symbols as in footnote 2.

[4] HS = high school; CR = current residence.

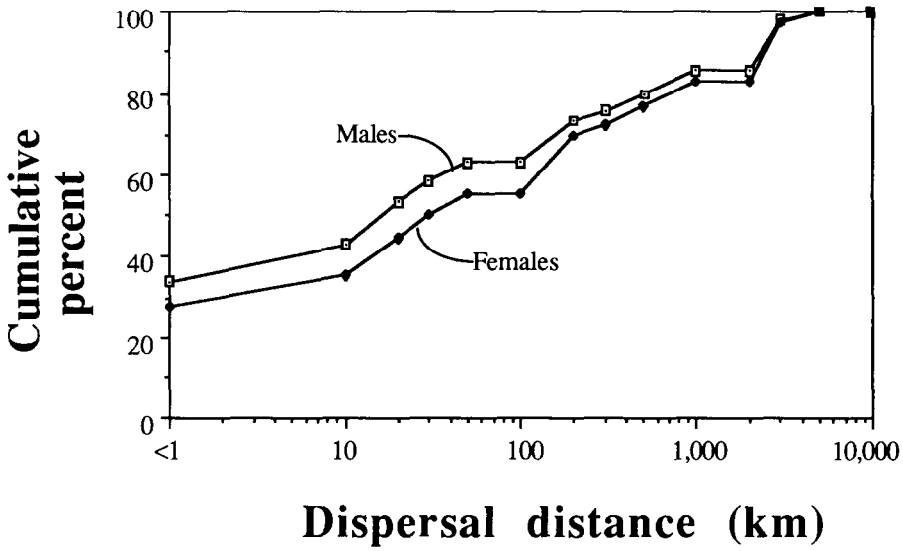

FIGURE 1. The cumulative frequency distribution of dispersal distance for males and females in the contemporary United States. Distance is based on the great-circle distance between where individuals graduated from high school and their current residence, as determined from the unbiased sample of high school reunion booklets (see text). N = 1,420 (males) and 1,439 (females).

a significant difference between the sexes using only married individuals, but not using only unmarried individuals.

The only significant sex bias emerging from the survey data is the male bias in the distance between graduation from high school and marriage (period 4, Table 3). Dispersal and philopatry between birth and graduation from high school (period 1) is not significantly different between the sexes, as would be expected given that movement during this phase is generally dependent on dispersal by parents. Dispersal including the period of independence following high school graduation is always slightly greater among females, again except for those periods ending at marriage. Thus, these data suggest that there is female-biased dispersal and relatively greater male philopatry following the independence usually attained with graduation from high school, although the differences are only significant using the large sample available from the reunion booklets.

Sex Bias in Dispersal: Multivariate Tests

A variety of other variables influence dispersal in the contemporary United States, including whether individuals moved away to attend college, their occupation, and several factors related to the location of the high schools sampled (Koenig 1988). To control for these variables, I performed analyses of variance using sex, locality (which high school individuals graduated

from), whether individuals moved away to attend college or not, and their occupation (professional, managerial or teacher, blue collar or secretarial, part-time or housewife). The results of these analyses are given in Table 4.

If one uses the booklets, there is still a significant female bias in dispersal controlling for the other factors in the analysis. The difference is no longer significant using the unbiased booklet data, even though the absolute difference between the sexes is larger, suggesting that the lack of significance is in part due to the reduced sample size. General patterns using the survey data are identical to those derived from the univariate analyses: a) there is virtually no difference between the sexes up to graduation from high school (period 1); b) females marry closer to their birthplaces (period 2) and to where they graduated from high school (period 4), significantly so for the latter; and c) otherwise females tend to disperse farther than males (periods 3, 5, and 6), but these differences are not significant.

In summary, there is no sex bias in dispersal during the stage of dependency between birth and graduation from high school. Marriages take place closer to the home of females than males. Females tend to disperse slightly farther than do males following independence, but the difference is only significant using the large reunion booklet sample. Controlling for location and several socioeconomic variables influencing dispersal, there is still a tendency for female-biased dispersal following independence, but the difference is small. Overall, slightly more than one-third of all first children are born within 20 km of the birthplaces of their parents.

College, Marriage, and Sex-biased Dispersal

Respondents were asked 1) whether they moved away from home to attend college within 2 years of high school graduation, 2) how they met their first spouse, and 3) the most important reasons for living in their current location.

Table 4. Tests for Sex Bias in Dispersal: Multiway ANOVAs[1]

	Adjusted Distance[2]		Significance of F-value					
	♂♂	♀♀	Sex	Locality	College	Occupation	Total	N
Reunion booklets								
All data	20.6	27.9	*	***	***	***	***	2253
Unbiased	34.7	45.2	ns	ns	***	***	***	835
Married only	20.3	26.4	ns	***	***	***	***	1787
Unmarried only	23.9	30.1	ns	***	***	***	***	457
Survey data[3]								
1. Birth → HS	23.1	24.9	ns	***	***	ns	***	441
2. Birth → marriage	71.5	40.4	ns	***	***	ns	***	381
3. Birth → CR	102.8	141.9	ns	***	***	ns	***	435
4. HS → marriage	16.8	5.5	***	ns	**	ns	**	386
5. HS → CR	35.0	49.6	ns	**	***	ns	***	440
6. Parent → offspring	73.0	118.6	ns	***	***	ns	***	311

[1] * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$, ns = $p > 0.05$.

[2] Mean dispersal distance (kms), adjusted for all other factors.

[3] HS = high school; CR = current residence.

The results, divided by sex, for the first two of these questions are presented in Table 5. Individuals that moved away to attend college invariably dispersed farther than those that did not attend college or lived at home while doing so. Also, individuals meeting their spouses in college dispersed farther than those meeting their spouses prior to attending college or while working. There was no difference in the proportion of males and females that moved away to attend college ($\chi^2 = 0.8$, df = 1, ns).

However, even though this pattern holds for all data, there is an interesting difference between the sexes. There are only small differences between the parent–offspring dispersal distance (period 6) of males and females that did not move away to attend college, or that met their first spouse prior to college. In contrast, females that moved away to attend college had parent–offspring dispersal distances averaging 260.6 km, significantly farther than either 1) females that did not move away to attend college ($p < 0.001$; Table 5) or 2) males that moved away to attend college (1-way ANOVA, $F_{1,156} = 4.3$, $p < 0.05$). This significant sex bias in parent–offspring dispersal distance is maintained in a three-way ANOVA including locality and occupation (adjusted mean dispersal distance = 93.9 km for males and 287.0 km for females controlling for locality and occupation; $F_{1,155} = 5.5$, $p = 0.02$). A similar tendency for females who go away to attend college to move farther than those that do not, relative to the same comparison for males, is also exhibited during period 5 (graduation from high school to current residence).

This differential response by females is also shown when the data are divided according to how respondents met their first spouse. Parent–offspring dispersal distance (period 6) for females meeting their husbands in college averaged 271.8 km, again considerably, although not significantly, farther than males who met their wives in college (one-way ANOVA, $F_{1,112} = 2.1$, $p = 0.15$). However, parent–offspring dispersal distance of females meeting their husbands in college was significantly more than that of females who met their husbands prior to college (Student-Neulman-Keuls multiple

Table 5. Dispersal According to Residence during College and How Spouse was Met[2]

	College Residence			How Spouse Was Met			
	Away from Home	At Home or Did Not Attend	*p* Value	Work	College	Pre-college	*p* Value
Males							
1. Birth → HS	33.5 (120)	15.9 (92)	0.08	16.9 (47)	28.5 (70)	16.2 (57)	ns
5. HS → CR	63.3 (120)	19.6 (92)	**	28.0 (48)	77.2 (70)	9.2 (57)	***
6. Parent → offspring	109.1 (73)	55.9 (72)	ns	41.5 (33)	133.3 (55)	43.7 (52)	0.09
Females[2]							
1. Birth → HS	46.4 (123)	11.7 (114)	***	16.2 (41)	23.2 (85)	12.1 (75)	ns
5. HS → CR	82.1 (123)	23.0 (114)	***	40.1 (41)	77.4 (85)	19.1 (75)	*
6. Parent → offspring	260.6 (84)	49.2 (85)	***	96.0 (31)	271.8 (75)	30.8 (61)	***

[1] Tests are by ANOVA. Values listed are back-transformed from means of log-transformed values; sample size in parentheses. * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.00$, ns = $p > 0.10$; p values > 0.05 but <0.10 are listed.

[2] HS = high school graduation; CR = current residence.

Table 6. Dispersal According to the Importance of Jobs[1]

	Importance of					
	Own Job			Spouse's Job		
	I	NI	p Value	I	NI	p Value
Males[2]						
1. Birth → HS	21.4 (244)	22.1 (26)	ns	14.3 (61)	21.6 (137)	ns
5. HS → CR	24.7 (244)	31.0 (26)	ns	48.4 (61)	13.9 (137)	**
6. Parent → offspring	68.7 (163)	60.8 (20)	ns	47.3 (43)	67.5 (114)	ns
Females[2]						
1. Birth → HS	23.4 (150)	12.4 (123)	ns	16.9 (211)	23.6 (51)	ns
5. HS → CR	35.2 (150)	19.3 (123)	0.08	42.1 (209)	18.2 (54)	0.06
6. Parent → offspring	111.7 (93)	49.7 (103)	0.08	73.1 (175)	74.6 (40)	ns

[1] I = Important; NI = Not important; p value from ANOVA. Values listed are back-transformed from means of log-transformed values; sample size in parentheses. Only married individuals are included in those ranking the importance of their spouse's job. * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$, ns = $p > 0.10$; p values > 0.05 but <0.10 are listed.

[2] HS = high school graduation; CR = current residence.

range test, $p < 0.05$), whereas there was no significant difference in the parent–offspring dispersal distance of males in these categories (Table 5).

Thus, both data sets point to a significant tendency for female dispersal to be differentially influenced by college and by who they meet while attending college. Note, however, that there is the possibility that part of this difference, at least for females, is "inherited," in a sense, from their parents: Females that move away to college also dispersed significantly farther between birth and graduation from high school (period 1), during the stage of dependency on their parents, than those that did not. A similar trend appears in the data for males, but the difference is not quite significant (Table 5).

Dispersal during periods 1, 5, and 6, divided according to sex and the respondent's rating of the importance of their own and their spouse's job, is summarized in Table 6. There are no differences in any of these three stages between males rating their jobs are important or not important to where they lived. Differences for females in these two categories were more prevalent, suggesting that women holding jobs important to themselves are willing to move significantly farther than those that do not, relative to the same comparison for males. This trend is weak, but also discernable, in the answers given to the importance of the spouse's job: Males listing their wife's job as being important to where they live dispersed significantly farther following graduation from high school (stage 5) than those who did not.

DISCUSSION

Dispersal following attainment of independence is female-biased in the contemporary United States (Table 2 and 3). However, the difference is not striking, and is significant only when using the large samples available from the reunion booklets. Using the unbiased reunion booklet data, females disperse an average of 11.9 km farther than males (all means are calculated

from log-transformed data and then back-transformed). On average, 52.5% of males listed in the reunion booklets still lived within 20 km of where they graduated from high school compared to 44.2% of females. Thus, dispersal following graduation from high school in the modern United States follows the same pattern of sex bias found in many nonindustrialized societies and is opposite the male bias found in the majority of mammals (Greenwood 1980).

This sex bias is considerably reduced, but not eliminated completely, when controlling for locality and socioeconomic factors. The most important of these factors is whether individuals moved away to attend college or not (Table 4). A sex-bias still emerges using the complete and the unbiased reunion booklet data, but only the former is significant. There are no significant sex differences that relate to whether individuals have been married or not. The survey data revealed no significant sex differences in dispersal at any period (Tables 3 and 4) except for the highly significant tendency, documented in prior studies (Spuhler and Clark 1961; Geary and Hughes 1970; Calderon 1983), for females to marry closer to their prior residence than males.

Thus, all other things being equal, there is only a slight tendency for sex-biased dispersal in the contemporary United States. This suggests that the observed sex bias in the univariate analyses (Table 3) is largely, if not entirely, the result of differences in socioeconomic conditions between the sexes. That is, all things are *not* equal between the sexes, and these differences are a primary cause of the biased dispersal pattern seen in the reunion booklet data.

There are probably numerous socioeconomic variables contributing to the dispersal distance between males and females. The most important measured in this study appear to be whether individuals moved away to attend college after high school (Table 5) and the effect of the respondent's job on place of residence (Table 6).

1. *Importance of moving away to attend college*—There is virtually no difference in either the high school to current residence or parent–offspring dispersal distances between males and females that did not move away to attend college following high school (Table 5). However, females that moved away from home to attend college dispersed relatively farther than males that did so; this difference was significant for the parent–offspring distance. A similar difference, with females who meet their spouses in college dispersing farther than males that do so, also shows up in the parent–offspring dispersal distances (Table 5). Thus, dispersal differences for males, separated according to whether they moved away to college or not, are less than the same difference for females. This suggests that males are relatively more constrained than females in their dispersal patterns.

2. *Importance of job*—Dispersal distance of males shows virtually no difference that can be attributed to whether their job is important to where they live (Table 6). Females, however, show nearly significant differences

in both high school to current residence and parent–offspring distances. Again, males exhibit a more constrained pattern than do females; males whose jobs are important to where they live disperse no farther than males whose jobs are not, while females whose jobs are important to where they live disperse considerably farther than other females.

There are numerous hypotheses for the evolution of sex-biased dispersal. These include behavioral dominance (Gauthreaux 1978), inbreeding avoidance (Packer 1979), and competition for mates or for environmental resources (Greenwood 1980; Dobson 1982). Although both virilocal residence and male dominance (in the form of patrilineal descent) co-occur in many nonindustrialized human societies (van den Berghe 1979), behavioral dominance does not explain the general trends of sex-biased dispersal of birds or mammals (Greenwood 1980), and at best can provide only a proximate reason for an observed sex bias in dispersal (Koenig et al. 1983). Inbreeding avoidance may be one cause of sex-biased dispersal in humans, as in some other species (Dobson 1982), but does not predict the direction of a bias (Greenwood 1980).

Competition for resources and mates, however, is consistent with the pattern of female-biased dispersal shown by many nonindustrialized human societies. These societies are generally patrilocal, with males inheriting land or job opportunities from their parents, while females, unhampered by the necessity to earn a living on their own following marriage, are more likely to disperse and take up residence in their husband's village (Cavalli-Sforza and Bodmer 1971. p. 433).

Species in which dispersal is male biased, as in most mammals, are associated with social systems in which males defend mates directly (Greenwood 1980, 1983). In such systems, which are often polygynous, females tend to invest relatively more in each reproductive attempt than do males. Philopatry may benefit females by allowing them to maintain social bonds with female relatives while dispersal may benefit males by allowing them greater access to mates (Dobson 1982).

In contrast, species in which dispersal is female biased are associated with social systems in which males are better able to accrue resources critical for reproduction by remaining in familiar areas (Greenwood 1980, 1983). In most birds, this is presumably because males are more likely to be successful at establishing and maintaining a territory near their natal area. Analogously, in nonindustrialized human societies with virilocal residence, males may be more likely to obtain the resources necessary to attract a wife by settling in or near their natal village. Females, on the other hand, are able to gain access to resources necessary for reproduction without the constraint of philopatry and may even benefit by greater mobility allowing them access to an increased number of potential mates.

Can the male resource defence hypothesis explain the female-biased dispersal in the contemporary United States? The evidence presented here indicates that a significant bias occurs only following graduation from high

school (Table 3) and is largely eliminated when controlling for several socioeconomic variables in a multiway ANOVA (Table 4). Analyses of dispersal indicate that two variables that influence sex-specific dispersal are moving away to attend college and the importance of the respondent's job to their residence. In both cases, these variables influence female dispersal to a greater extent than male dispersal.

These data are insufficient to reject alternative hypotheses for sex-biased dispersal in the U.S. population. However, they are consistent with the hypothesis that the differential pattern by which the sexes accrue resources is important in determining female-biased dispersal in the contemporary United States, although the bias is considerably less than that found in some nonindustrialized societies (e.g., Wood et al. 1985). There are two additional lines of evidence supporting this hypothesis.

First, males are far more likely to indicate that their jobs are important to where they live than are females (90.4% of males [$N = 271$] vs. 54.9% of females [$N = 277$] so indicated; $\chi^2 = 86.6$, df $= 1, p < 0.001$). Conversely, married males are far less likely to indicate that their spouse's job is important to where they live (30.7% of married males [$N = 199$] vs. 79.9% of married females [$N = 268$] so indicated; $\chi^2 = 112.0$, df $= 1$, $p < 0.001$). Thus, unsurprisingly, the critical resource represented by a husband's occupation is considerably more important to where a family lives than is the wife's occupation in contemporary U.S. society.

Second, males are generally more conservative in their dispersal pattern than females and are affected less by moving away to attend college or their jobs. In particular, differences among subgroups of females according to whether they moved away to attend college, how they met their spouse, and the importance of their own job to where they live, are generally greater and more often significantly different than similar comparisons for males.

Although there are alternative interpretations of these trends, they are consistent with the hypothesis that males are more constrained in their dispersal, possibly because they are more likely to be successful by settling near an area—their birthplace or former residence—with which they are familiar. Females, especially those gaining greater independence as indicated by moving away to college or obtaining a job that is important to them, are considerably more mobile than males in similar circumstances. Thus, the patterns of resource accrual may be one important factor influencing the sex-bias in dispersal seen in modern U.S. society.

In the highly mobile and highly heterogeneous society of the contemporary United States, it is not surprising that a sex bias in dispersal is difficult to detect. The evidence presented here suggests only the likelihood that such a bias exists following the attainment of independence; additional data are needed. However, care must be taken that appropriate measures are used in determining sex-biases in dispersal. For example, matrimonial distances determined from marriage records, frequently used in studies of human dispersal, should not be used unless the place of marriage is likely to be the

place of residence following marriage. Otherwise, considerable bias may be introduced. For example, in the data analyzed here as in several prior studies, marriages clearly tended to be performed nearer the prior residence (as measured by where partners graduated from high school) of females than males (see also Spuhler and Clark 1961; Geary and Hughes 1970; Calderon 1983). This may be a consequence of the custom in the United States for the marriage ceremony to be paid for by the bride's parents, an unusual pattern found in only 2.6% of 860 societies surveyed by Murdock (1967; data compiled by van den Berghe 1979). However, this strong sex bias does not follow the trend shown by more genetically relevant dispersal measures such as the parent–offspring dispersal distance (e.g., Table 4).

The variable results of several prior studies of dispersal in industrialized societies may be in part explained by this and similar problems. For example, the male-biased dispersal reported for twentieth-century Brazil by Freire-Maia and Freire-Maia (1962) and that for mid-twentieth-century Ann Arbor, Michigan by Spuhler and Clark (1961) were based on distances between the birthplaces and place of marriage of males and females, and therefore included the bias just discussed. Other studies, such as those of Shryock (1964), who reported male-biased internal migration in the United States, and Hollingsworth (1970), who found no sex bias in internal migration within twentieth-century Scotland, were based on census data and are difficult to interpret at the individual level of primary interest here. Clearly additional studies, preferably following the forward dispersal patterns of large numbers of individuals, are needed to understand the evolution of this important behavior in modern societies.

I thank those who responded to the survey, and especially Carolyn Crockett, Gary Ellis, Todd Engstrom, David Ewert, Tom Gavin, Anne Jacobberger, Dobie Jenkins, Bill and Linda Koenig, Stephen Lewis, Peter Lowther, Nancy Mann, James Otto, Cindy Paszkowski, Peg Smith, Bill Tonn, and Jim Wilson for offering their high school reunion booklets. Katy Heck helped computerize the survey data, and the residents of Hastings Reservation helped stuff envelopes. Vince Sarich suggested the explanation for why marriages usually take place at the bride's home, and Janis Dickinson provided helpful comments on the manuscript. I also thank the faculty of the Department of Zoology, Arizona State University, for providing space during the preparation of this paper.

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