Online Resource 2.

In this technical appendix, we explain in detail why log-linear models of exchange do not need to include all three-way interactions. We also present a sensitivity analysis of our main findings based on different assumptions about the baseline pattern of educational assortative mating (EAM) that should be fit for racially exogamous couples. We begin by recapitulating the different baseline model possibilities presented in the main text.

Our simplest model for a table cross-classifying husband's race (i), wife's race (j), husband's education (k) and wife's education (l) assumes a single pattern of EAM for all couples.

$$\log(F_{ijkl}) = \lambda + \lambda_i + \lambda_j + \lambda_k + \lambda_l + \lambda_{ij} + \lambda_{ik} + \lambda_{jl} + \lambda_{kl} \quad \text{(S1)}$$

This model is analogous to the model used in Gullickson (2006) and is the most parsimonious. Status exchange and educational barrier terms can then be added to this model. The status exchange terms allow for the pattern of EAM of exogamous couples to differ systematically from the EAM patterns fit by pooling white and black endogamous couples together (as represented by the λ_{kl} term).

A potential shortcoming of this model, as noted by Rosenfeld (2005), is that it may fit poorly to the data because the EAM patterns of white endogamous couples and black endogamous couples are themselves different enough to warrant more terms than the baseline λ_{kl}. Rosenfeld's solution to this problem is to add all possible three-way interaction terms. However this approach is technically incorrect because three-way terms contain information about the status exchange parameters themselves (Gullickson and Fu [2010], Kalmijn [2010]).

The crux of this problem can be demonstrated by considering the following model:

$$\log(F_{ijkl}) = \lambda + \lambda_i + \lambda_j + \lambda_k + \lambda_l + \lambda_{ij} + \lambda_{ik} + \lambda_{jl} + \lambda_{kl} + \lambda_{ikl} + \lambda_{jkl} + \lambda_{ijkl} \quad \text{(S2)}$$

Equation S2 includes three-way interactions λ_{ikl} and λ_{jkl} advocated by Rosenfeld.[1] This model effectively fits separate saturated EAM tables to each of the four spousal types (WM/WF, BM/BF, BM/WF, and WM/BF). Using standard dummy coding in which white spouses are coded as zero and black spouses are coded as one, the λ_{kl} term measures EAM directly for white endogamous couples who serve as the reference group. The three-way term λ_{ikl} measures the difference in EAM between white endogamous couples and BM/WF couples, while the three-way term λ_{jkl} measures the difference in EAM between white endogamous couples and WM/BF couples. The difference in EAM between white endogamous couples and black endogamous couples is given by $\lambda_{ikl}+\lambda_{jkl}+\lambda_{ijkl}$. Thus, the four-way interaction term indicates how different EAM is in black endogamous couples compared to both types of exogamous unions (naturally, if the dummy coding was reversed such that white=1 and black=0, then black endogamous couples would serve as the reference group and the four-way interaction would indicate how different EAM is in white endogamous couples compared with exogamous unions).

Equation S2 saturates the EAM tables for all four union types and thus it cannot be used as a baseline for testing status exchange theory because the exchange terms are a constrained version of these terms themselves. Rosenfeld (2005) addresses this issue by leaving out the four-way interaction term, but that is the wrong term to remove. By removing the four-way interaction term, Rosenfeld has simply forced the EAM differences between black endogamous

[1] Rosenfeld also included the other two-way and three-way terms missing from equation S2 in his full model, namely λ_{il}, λ_{jk}, λ_{ijk}, and λ_{ijl}. However, these terms are identical to the market exchange terms we use in the main body of the paper. We agree with Rosenfeld that models of status exchange should include these lower-ordered terms, but instead of treating them merely as non-meaningful lower-order interaction terms, we discuss the important substantive implications of these terms in our models. For the current discussion, we have excluded these terms from equation S2 to focus on the more problematic terms that Rosenfeld included in his model.

couples and white endogamous couples to be equal to the sum of the three-way terms for BM/WF and WM/BF couples.

This assumption may not fit the data well, but even more critically, the three-way interaction terms still contain information necessary for estimating status exchange parameters. By modeling the EAM of black partners, regardless of whether they marry white or black spouses, the three-way terms also partially capture exchange because they apply to cases of both black/black and black/white marriage. This problem can be seen clearly by replicating Rosenfeld's results for black/white marriage in the United States, while leaving out the "Other" category that he used. When this is done using standard statistical software, some of the terms drop out as a result of perfect collinearity.[2]

A more appropriate way to address the issue of different patterns of EAM for white and black endogamous couples departing from a single EAM parameter captured by λ_{kl} is to fit saturated two-way tables between husband's education and wife's education for white and black endogamous couples separately, and use these terms to generate a baseline assumption about the EAM of racially exogamous couples. We start with the following model:

$$\log(F_{ijkl}) = \lambda + \lambda_i + \lambda_j + \lambda_k + \lambda_l + \lambda_{ij} + \lambda_{ik} + \lambda_{jl} + \omega_{ijkl} + \beta_{ijkl} \quad \text{(S3)}$$

Where ω_{ijkl} and β_{ijkl} represent the terms for fitting the saturated two-way education tables for white and black couples, respectively. However, equation S3 is not in and of itself sufficient, because it fits no baseline EAM pattern for racially exogamous couples from which the deviations expected by status exchange theory can be tested. There are two plausible ways to address this issue.

[2] R and Stata code used to demonstrate this collinearity is available from the authors upon request.

First, one can fit the EAM terms for racially exogamous couples as the geometric mean of the separate terms for white and black couples:

$$\log(F_{ijkl}) = \lambda + \lambda_i + \lambda_j + \lambda_k + \lambda_l + \lambda_{ij} + \lambda_{ik} + \lambda_{jl} + \omega_{ijkl} + \beta_{ijkl} + (1/2)(\omega_{ijkl} + \beta_{ijkl})(z_{ij}) \quad \text{(S4)}$$

where z_{ij} is an indicator variable that is one for racially exogamous couples and zero otherwise. This method is similar to the approach taken by Kalmijn (1993) for his hypgeramy ratio technique.

Alternatively, one could assume a baseline EAM for racially exogamous couples that is identical to either endogamous black or white couples. The baseline model for each of these cases can be created by including the general two-way interaction term for spousal education in addition to either the ω_{ijkl} and β_{ijkl} term:

$$\log(F_{ijkl}) = \lambda + \lambda_i + \lambda_j + \lambda_k + \lambda_l + \lambda_{ij} + \lambda_{ik} + \lambda_{jl} + \lambda_{kl} + \omega_{ijkl} \quad \text{(S5)}$$

$$\log(F_{ijkl}) = \lambda + \lambda_i + \lambda_j + \lambda_k + \lambda_l + \lambda_{ij} + \lambda_{ik} + \lambda_{jl} + \lambda_{kl} + \beta_{ijkl} \quad \text{(S6)}$$

Equation S5 above implicitly treats racially exogamous couples as endogamous black couples, whereas equation S6 implicitly treats racially exogamous couples as endogamous white couples.

Hou and Myles (2013) apply a technique similar to equation S6, but instead of fitting the saturated table for black endogamous couples, they fit hypergamy and hypogamy terms comparable to those for racially exogamous couples. This method allows a comparison to be made between all couple types within a single model, but might also miss potential differences picked up by the saturated model. In further tests not shown here, we have also fit this model but found that it gave us results that were extremely similar to those for equations S5 and S6.

Table S1 shows the BIC fit statistics for each of these four baseline EAM models. Model 1 pools all racially endogamous (black-black and white-white) couples together, model 2 uses

the “geometric mean” approach, model 3 uses black endogamous couples as baseline, and model 4 uses white endogamous couples as baseline. The best-fitting EAM model varied across different model and category specifications, but in all cases, a model that included market exchange parameters was preferred to a model with dyadic exchange terms alone.

The difference in parameter estimates for the dyadic exchange and market exchange terms across these different baseline EAM models is more important than goodness of fit statistics. Table S2 (in the appendix) shows these estimates for the case in which blacks and browns are collapsed into a single category and Tables S3a (white/black), S3b (white/brown), and S3c (brown/black) show these estimates for the case when blacks and browns are not collapsed. Across all four of these tables, the parameter estimates are very similar and the overall conclusions we reach above would not be changed if we were to make different assumptions about the baseline EAM of racially endogamous couples. In all cases, we find strong dyadic exchange terms except in the case of black/brown marriage, but these dyadic exchange terms largely dissipate after including market exchange terms. The market exchange terms are also very similar in size and consistent in direction across different EAM models.

Taken as a whole, the results of our sensitivity analysis demonstrate that our findings are highly robust to different assumptions about the baseline pattern of educational assortative mating among racially endogamous couples. Given this, we have used the most parsimonious pooled model as the baseline in our empirical analysis.

Table S1: BIC statistic for goodness of fit of models of status exchange applied to the Brazilian data. Models based on different assumptions about the educational assortative mating pattern among racially endogamous couples.

	Baseline Model	**+ Dyadic Exchange**	**+ Dyadic Exchange + Market Exchange**	**+ Market Exchange**
White and non-White				
Pooled	4053	1371	-233	-182
Geometric Mean	989	345	-311	-291
Same as White Endogamous	3268	1183	-226	-138
Same as Black Endogamous	1822	249	-301	-331
White, Brown, and Black				
Pooled	3069	357	-1073	-1098
Geometric Mean	48	-537	-970	-1036
Same as lighter group	2809	331	-875	-871
Same as darker group	800	-669	-960	-1078

Table S2: Parameter estimates of dyadic exchange and market exchange for white/black couples from log-linear models based on different assumptions about the baseline educational assortative mating patterns among racially endogamous couples. All blacks and browns are treated as blacks.

	Pooled		**Geometric mean**		**As White Endogamous**		**As Black Endogamous**	
Black Male/White Female								
White Hypergamy	0.292	0.115	0.226	0.102	0.301	0.128	0.259	0.081
	(0.013)	(0.021)	(0.015)	(0.021)	(0.014)	(0.022)	(0.016)	(0.024)
White Hypogamy	-0.201	0.037	-0.127	0.024	-0.153	0.071	-0.235	-0.023
	(0.012)	(0.021)	(0.014)	(0.021)	(0.013)	(0.022)	(0.013)	(0.024)
Black Ed Barrier 1		0.282		0.277		0.252		0.277
		(0.022)		(0.025)		(0.033)		(0.023)
Black Ed Barrier 2		0.117		0.126		0.156		0.103
		(0.021)		(0.027)		(0.036)		(0.022)
Black Ed Barrier 3		0.152		0.132		0.142		0.135
		(0.021)		(0.034)		(0.052)		(0.022)
Black Ed Barrier 4		0.298		0.270		0.265		0.295
		(0.036)		(0.089)		(0.167)		(0.036)
White Ed Barrier 1		-0.331		-0.281		-0.337		-0.233
		(0.024)		(0.027)		(0.024)		(0.033)
White Ed Barrier 2		0.118		0.037		0.108		0.018
		(0.020)		(0.025)		(0.02)		(0.031)
White Ed Barrier 3		-0.089		-0.074		-0.095		-0.088
		(0.019)		(0.027)		(0.02)		(0.037)
White Ed Barrier 4		-0.564		-0.539		-0.574		-0.480
		(0.027)		(0.061)		(0.028)		(0.094)
Black Female/White Male								
White Hypergamy	0.356	0.083	0.264	0.072	0.400	0.116	0.231	0.027
	(0.013)	(0.023)	(0.014)	(0.023)	(0.013)	(0.024)	(0.015)	(0.025)
White Hypogamy	-0.195	0.101	-0.12	0.086	-0.199	0.115	-0.16	0.064
	(0.015)	(0.023)	(0.016)	(0.023)	(0.016)	(0.024)	(0.017)	(0.026)
Black Ed Barrier 1		0.200		0.164		0.108		0.221
		(0.026)		(0.027)		(0.032)		(0.027)
Black Ed Barrier 2		0.071		0.132		0.183		0.069
		(0.023)		(0.025)		(0.030)		(0.023)
Black Ed Barrier 3		0.091		0.089		0.059		0.103
		(0.022)		(0.028)		(0.036)		(0.023)
Black Ed Barrier 4		0.317		0.294		0.321		0.330
		(0.036)		(0.064)		(0.107)		(0.036)
White Ed Barrier 1		-0.475		-0.465		-0.467		-0.466
		(0.024)		(0.028)		(0.024)		(0.036)
White Ed Barrier 2		-0.020		-0.035		-0.014		-0.029
		(0.022)		(0.028)		(0.022)		(0.037)
White Ed Barrier 3		-0.250		-0.230		-0.239		-0.217
		(0.022)		(0.035)		(0.022)		(0.050)
White Ed Barrier 4		-0.650		-0.606		-0.643		-0.586
		(0.032)		(0.088)		(0.033)		(0.134)

Note: Standard errors are shown in parentheses. Educational barriers: (1) primary grad vs. incomplete, (2) lower secondary vs. primary grad, (3) upper vs. lower secondary, (4) some college vs. upper secondary.

Table S3a: Parameter estimates of dyadic exchange and market exchange for white/black couples from log-linear models based on different assumptions about the baseline educational assortative mating patterns among racially endogamous couples. Blacks and browns are treated separately.

	Pooled		**Geometric Mean**		**As White Endogamous**		**As Black Endogamous**	
Black Male/White Female								
White Hypergamy	0.385	0.140	0.250	0.105	0.400	0.145	0.251	0.067
	(0.034)	(0.054)	(0.040)	(0.059)	(0.034)	(0.055)	(0.043)	(0.073)
White Hypogamy	-0.287	0.019	-0.217	0.002	-0.251	0.054	-0.343	-0.041
	(0.033)	(0.055)	(0.035)	(0.060)	(0.033)	(0.055)	(0.037)	(0.074)
Black Ed Barrier 1		0.110		0.120		0.104		0.125
		(0.066)		(0.070)		(0.09)		(0.070)
Black Ed Barrier 2		0.195		0.218		0.333		0.175
		(0.065)		(0.075)		(0.108)		(0.068)
Black Ed Barrier 3		0.322		0.266		0.119		0.313
		(0.063)		(0.089)		(0.154)		(0.070)
Black Ed Barrier 4		0.256		0.199		0.359		0.248
		(0.110)		(0.218)		(0.526)		(0.112)
White Ed Barrier 1		-0.435		-0.404		-0.442		-0.354
		(0.057)		(0.065)		(0.057)		(0.081)
White Ed Barrier 2		0.128		0.039		0.114		0.007
		(0.049)		(0.056)		(0.049)		(0.062)
White Ed Barrier 3		-0.264		-0.195		-0.274		-0.192
		(0.050)		(0.061)		(0.05)		(0.072)
White Ed Barrier 4		-0.740		-0.733		-0.752		-0.691
		(0.078)		(0.143)		(0.078)		(0.187)
Black Female/White Male								
White Hypergamy	0.503	0.035	0.324	0.034	0.557	0.068	0.267	0.002
	(0.036)	(0.063)	(0.041)	(0.067)	(0.036)	(0.063)	(0.044)	(0.080)
White Hypogamy	-0.264	0.202	-0.180	0.160	-0.286	0.209	-0.238	0.116
	(0.044)	(0.063)	(0.046)	(0.067)	(0.044)	(0.063)	(0.049)	(0.080)
Black Ed Barrier 1		0.295		0.260		0.260		0.297
		(0.078)		(0.080)		(0.090)		(0.084)
Black Ed Barrier 2		0.141		0.201		0.245		0.121
		(0.07)		(0.076)		(0.092)		(0.072)
Black Ed Barrier 3		0.066		0.00		-0.080		0.055
		(0.066)		(0.078)		(0.107)		(0.071)
Black Ed Barrier 4		0.315		0.302		0.308		0.304
		(0.11)		(0.163)		(0.304)		(0.113)
White Ed Barrier 1		-0.634		-0.619		-0.624		-0.602
		(0.059)		(0.068)		(0.059)		(0.085)
White Ed Barrier 2		-0.079		-0.104		-0.071		-0.086
		(0.057)		(0.067)		(0.057)		(0.076)
White Ed Barrier 3		-0.592		-0.524		-0.579		-0.530
		(0.061)		(0.084)		(0.061)		(0.101)
White Ed Barrier 4		-0.791		-0.701		-0.781		-0.616
		(0.100)		(0.214)		(0.101)		(0.272)

Note: Standard errors are shown in parentheses. Educational barriers: (1) primary grad vs. incomplete, (2) lower secondary vs. primary grad, (3) upper vs. lower secondary, (4) some college vs. upper secondary.

Table S3b: Parameter estimates of dyadic exchange and market exchange for white/brown couples from log-linear models based on different assumptions about the baseline educational assortative mating patterns among racially endogamous couples. Blacks and browns are treated separately.

	Pooled		**Geometric Mean**		**As White Endogamous**		**As Brown Endogamous**	
Brown Male/White Female								
White Hypergamy	0.282	0.117	0.223	0.108	0.287	0.124	0.258	0.096
	(0.014)	(0.022)	(0.016)	(0.022)	(0.015)	(0.023)	(0.017)	(0.026)
White Hypogamy	-0.187	0.039	-0.119	0.025	-0.140	0.073	-0.222	-0.026
	(0.013)	(0.022)	(0.014)	(0.023)	(0.014)	(0.023)	(0.014)	(0.026)
Brown Ed Barrier 1		0.303		0.299		0.283		0.293
		(0.024)		(0.027)		(0.035)		(0.024)
Brown Ed Barrier 2		0.120		0.124		0.148		0.102
		(0.023)		(0.029)		(0.038)		(0.023)
Brown Ed Barrier 3		0.131		0.113		0.131		0.109
		(0.023)		(0.036)		(0.054)		(0.024)
Brown Ed Barrier 4		0.307		0.267		0.23		0.297
		(0.039)		(0.094)		(0.172)		(0.039)
White Ed Barrier 1		-0.313		-0.260		-0.321		-0.209
		(0.025)		(0.028)		(0.025)		(0.035)
White Ed Barrier 2		0.118		0.037		0.106		0.021
		(0.021)		(0.026)		(0.022)		(0.032)
White Ed Barrier 3		-0.063		-0.058		-0.071		-0.076
		(0.020)		(0.028)		(0.021)		(0.038)
White Ed Barrier 4		-0.54		-0.513		-0.552		-0.455
		(0.029)		(0.064)		(0.029)		(0.098)
Brown Female/White Male								
White Hypergamy	0.339	0.090	0.253	0.076	0.380	0.122	0.221	0.028
	(0.014)	(0.024)	(0.015)	(0.025)	(0.014)	(0.025)	(0.016)	(0.027)
White Hypogamy	-0.183	0.094	-0.111	0.084	-0.188	0.102	-0.144	0.071
	(0.016)	(0.024)	(0.017)	(0.025)	(0.017)	(0.025)	(0.018)	(0.028)
Brown Ed Barrier 1		0.183		0.148		0.087		0.210
		(0.028)		(0.029)		(0.033)		(0.029)
Brown Ed Barrier 2		0.062		0.126		0.178		0.065
		(0.025)		(0.027)		(0.032)		(0.025)
Brown Ed Barrier 3		0.098		0.109		0.081		0.117
		(0.023)		(0.029)		(0.038)		(0.024)
Brown Ed Barrier 4		0.299		0.276		0.299		0.318
		(0.038)		(0.068)		(0.112)		(0.039)
White Ed Barrier 1		-0.453		-0.449		-0.444		-0.458
		(0.025)		(0.029)		(0.025)		(0.038)
White Ed Barrier 2		-0.014		-0.025		-0.006		-0.021
		(0.023)		(0.030)		(0.023)		(0.039)
White Ed Barrier 3		-0.211		-0.197		-0.199		-0.183
		(0.023)		(0.036)		(0.024)		(0.052)
White Ed Barrier 4		-0.636		-0.586		-0.627		-0.578
		(0.034)		(0.093)		(0.034)		(0.141)

Note: Standard errors are shown in parentheses. Educational barriers: (1) primary grad vs. incomplete, (2) lower secondary vs. primary grad, (3) upper vs. lower secondary, (4) some college vs. upper secondary.

Table S3c: Parameter estimates of dyadic exchange and market exchange for brown/black couples from log-linear models based on different assumptions about the baseline educational assortative mating patterns among racially endogamous couples. Blacks and browns are treated separately.

	Pooled		**Geometric Mean**		**As Brown Endogamous**		**As Black Endogamous**	
Black Male/Brown Female								
Brown Hypergamy	0.137	0.189	0.036	0.142	0.132	0.171	0.010	0.113
	(0.037)	(0.057)	(0.042)	(0.062)	(0.038)	(0.058)	(0.044)	(0.075)
Brown Hypogamy	-0.063	-0.093	-0.149	-0.148	-0.130	-0.157	-0.152	-0.136
	(0.034)	(0.059)	(0.036)	(0.063)	(0.034)	(0.060)	(0.037)	(0.077)
Black Ed Barrier 1		-0.059		-0.050		-0.051		-0.039
		(0.067)		(0.072)		(0.092)		(0.071)
Black Ed Barrier 2		0.094		0.102		0.183		0.086
		(0.066)		(0.077)		(0.11)		(0.069)
Black Ed Barrier 3		0.113		0.059		-0.119		0.116
		(0.067)		(0.092)		(0.158)		(0.073)
Black Ed Barrier 4		-0.011		-0.035		0.161		-0.014
		(0.121)		(0.232)		(0.545)		(0.123)
Brown Ed Barrier 1		-0.027		-0.025		0.002		-0.026
		(0.059)		(0.066)		(0.060)		(0.081)
Brown Ed Barrier 2		0.067		0.058		0.071		0.041
		(0.053)		(0.058)		(0.053)		(0.062)
Brown Ed Barrier 3		0.066		0.144		0.090		0.157
		(0.053)		(0.063)		(0.053)		(0.070)
Brown Ed Barrier 4		-0.126		-0.131		-0.106		-0.154
		(0.097)		(0.156)		(0.097)		(0.193)
Black Female/Brown Male								
Brown Hypergamy	0.262	0.170	0.093	0.132	0.221	0.113	0.084	0.144
	(0.041)	(0.073)	(0.046)	(0.077)	(0.042)	(0.074)	(0.047)	(0.088)
Brown Hypogamy	-0.037	0.088	-0.064	0.04	-0.070	0.070	-0.069	0.010
	(0.051)	(0.074)	(0.053)	(0.078)	(0.051)	(0.075)	(0.054)	(0.089)
Black Ed Barrier 1		-0.041		-0.018		0.047		-0.042
		(0.086)		(0.088)		(0.097)		(0.091)
Black Ed Barrier 2		-0.006		0.000		-0.006		-0.018
		(0.076)		(0.082)		(0.097)		(0.078)
Black Ed Barrier 3		0.090		0.023		-0.028		0.076
		(0.074)		(0.086)		(0.113)		(0.078)
Black Ed Barrier 4		-0.198		-0.181		-0.193		-0.220
		(0.139)		(0.186)		(0.324)		(0.141)
Brown Ed Barrier 1		-0.082		-0.083		-0.094		-0.053
		(0.068)		(0.076)		(0.069)		(0.091)
Brown Ed Barrier 2		0.161		0.138		0.149		0.146
		(0.067)		(0.075)		(0.067)		(0.081)
Brown Ed Barrier 3		-0.208		-0.167		-0.227		-0.192
		(0.073)		(0.093)		(0.074)		(0.106)
Brown Ed Barrier 4		-0.209		-0.182		-0.213		-0.116
		(0.150)		(0.247)		(0.150)		(0.298)

Note: Standard errors are shown in parentheses. Educational barriers: (1) primary grad vs. incomplete, (2) lower secondary vs. primary grad, (3) upper vs. lower secondary, (4) some college vs. upper secondary.