**Supporting Information**

**S1 Appendix.** Derivation of Equation (3).

Manipulating algebraically it is easy to show that

$$V\left(p\_{1},\cdots ,p\_{k}\right)=\sum\_{i=1}^{i=k}\sum\_{j=1}^{j=k}p\_{i}p\_{j}I\left(i,j\right)=\frac{\sum\_{i=1}^{k}\sum\_{j\ne i}^{}N\_{i}N\_{j}}{N^{2}}=\frac{\sum\_{i=1}^{k}\sum\_{j\ne i}^{}(N\_{i}^{f}+N\_{i}^{m})(N\_{j}^{f}+N\_{j}^{m})}{N^{2}}$$

$$=\frac{\sum\_{i=1}^{k}\sum\_{j\ne i}^{}N\_{i}^{f}N\_{j}^{f}+\sum\_{i=1}^{k}\sum\_{j\ne i}^{}N\_{i}^{m}N\_{j}^{m}+\sum\_{i=1}^{k}\sum\_{j\ne i}^{}N\_{i}^{f}N\_{j}^{m}+\sum\_{i=1}^{k}\sum\_{j\ne i}^{}N\_{i}^{m}N\_{j}^{f}}{N^{2}}$$

$$=\left(\frac{N^{f}}{N}\right)^{2}\frac{\sum\_{i=1}^{k}\sum\_{j\ne i}^{}N\_{i}^{f}N\_{j}^{f}}{\left(N^{f}\right)^{2}}+\left(\frac{N^{m}}{N}\right)^{2}\frac{\sum\_{i=1}^{k}\sum\_{j\ne i}^{}N\_{i}^{m}N\_{j}^{m}}{\left(N^{m}\right)^{2}}+$$

$$+\left(2\frac{N^{f}N^{m}}{N^{2}}\right)\frac{\sum\_{i=1}^{k}\sum\_{j\ne i}^{}N\_{i}^{f}N\_{j}^{m}}{N^{f}N^{m}}$$

$$=s\_{f}V\_{f}+s\_{m}V\_{m}+\frac{s\_{b}}{N^{f}N^{m}}\left(\sum\_{i=2}^{i=k}\sum\_{j<i}^{}N\_{i}^{f}N\_{j}^{m}+\sum\_{i=2}^{i=k}\sum\_{j<i}^{}N\_{i}^{m}N\_{j}^{f}\right)=s\_{f}V\_{f}+s\_{m}V\_{m}+s\_{b}\left(\sum\_{i=2}^{i=k}\sum\_{j<i}^{}p\_{i}^{f}p\_{j}^{m}+\sum\_{i=2}^{i=k}\sum\_{j<i}^{}p\_{i}^{m}p\_{j}^{f}\right)=s\_{f}V\_{f}+s\_{m}V\_{m}+s\_{b}\left(A\_{f}+A\_{m}\right).$$

This is the decomposition we were looking for.