Supplementary Figures

Figure S1: Examples of emerging social networks depending on the socializing behaviours of individuals (propensities to interact with strangers) and on the volatility of the social environment. See caption of Figure 3 for more details. Under a volatile social environment, individual lifespan is short, and the number of partnerships remains very low because individuals do not have time to build many relationships. Here, N=50.

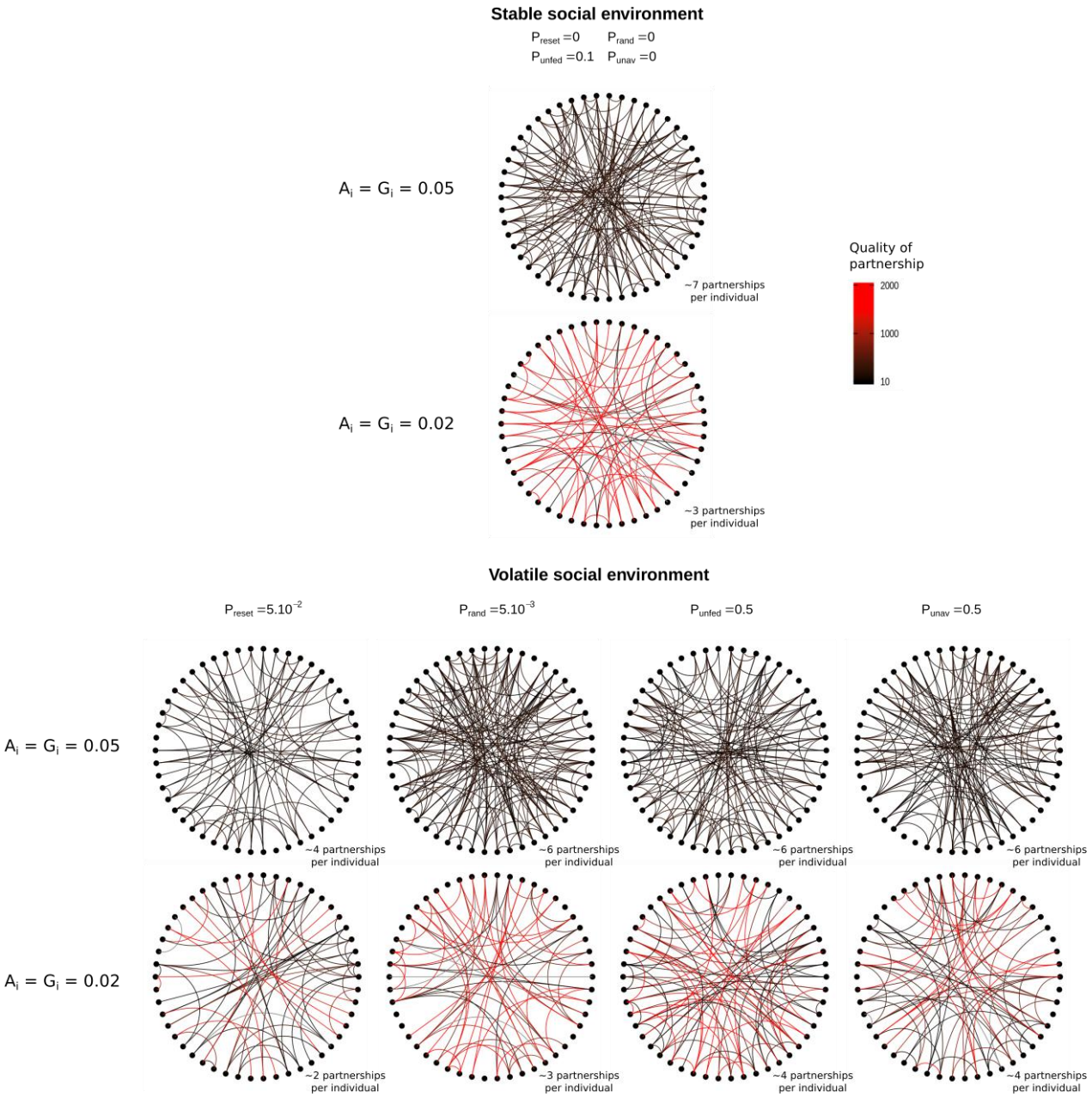

Figure S2: Trait values, A_i and G_i, at evolutionary equilibrium reached after 5 million time steps, for different group sizes. In a large group, individuals have to focus investment on few individuals to build partnerships, leading to low trait values A_i and G_i, because the risk of diluting cooperative investments is too high. For high values of P_{erase}, P_{die}, P_{unsucc} and P_{unav}, the evolutionary equilibrium is characterized by cooperative strategies focusing on the quality of each partnership rather than on the quantity of partnerships (low A_i and low G_i) as in the main analysis.

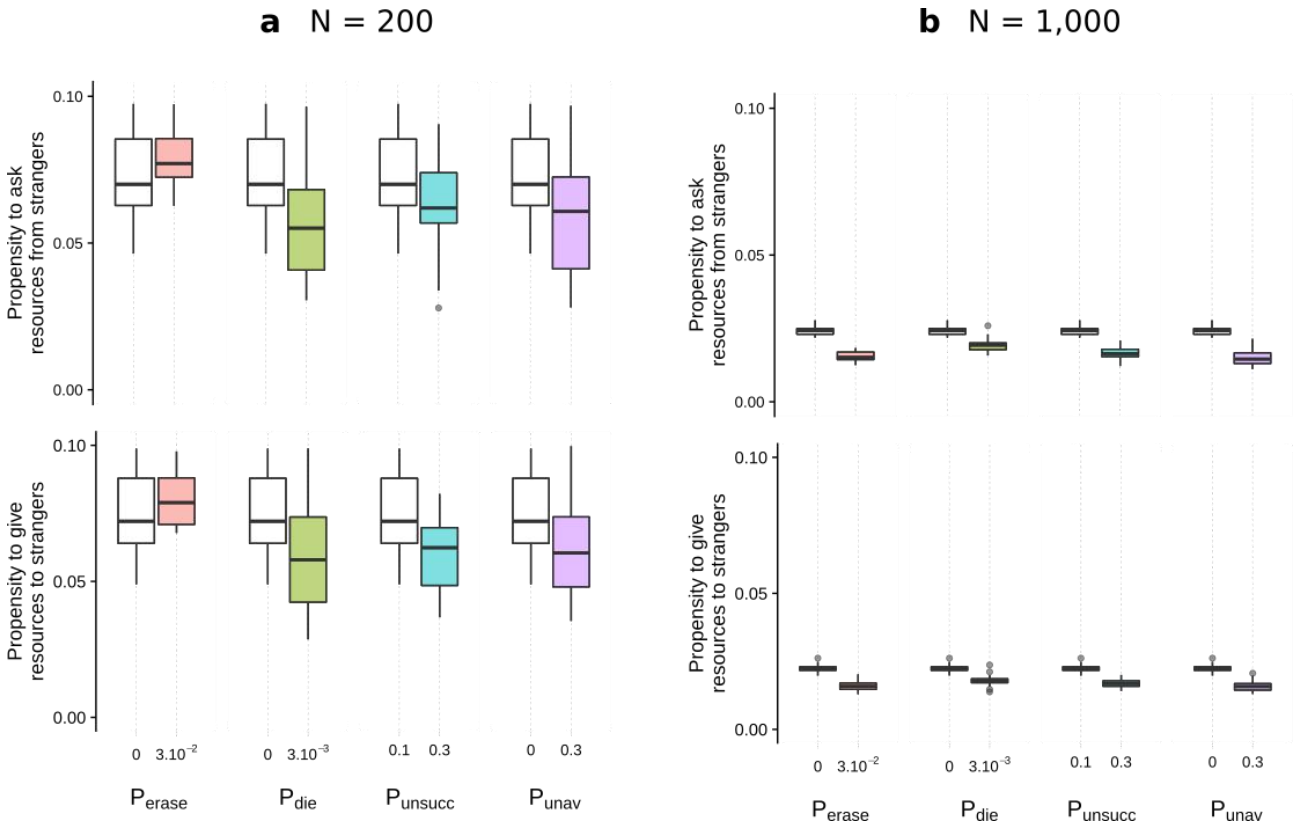

Figure S3: Trait values, A_i and G_i, at evolutionary equilibrium reached after 5 million time steps, for different strengths of the prior. For high F, updating away from prior belief is more difficult, and individuals have to focus investment on few individuals to build partnerships, leading to low trait values A_i and G_i. For high values of P_{erase}, P_{die}, P_{unsucc} and P_{unav}, the evolutionary equilibrium is characterized by cooperative strategies focusing on the quality of each partnership rather than on the quantity of partnerships (low A_i and low G_i) as in the main analysis.

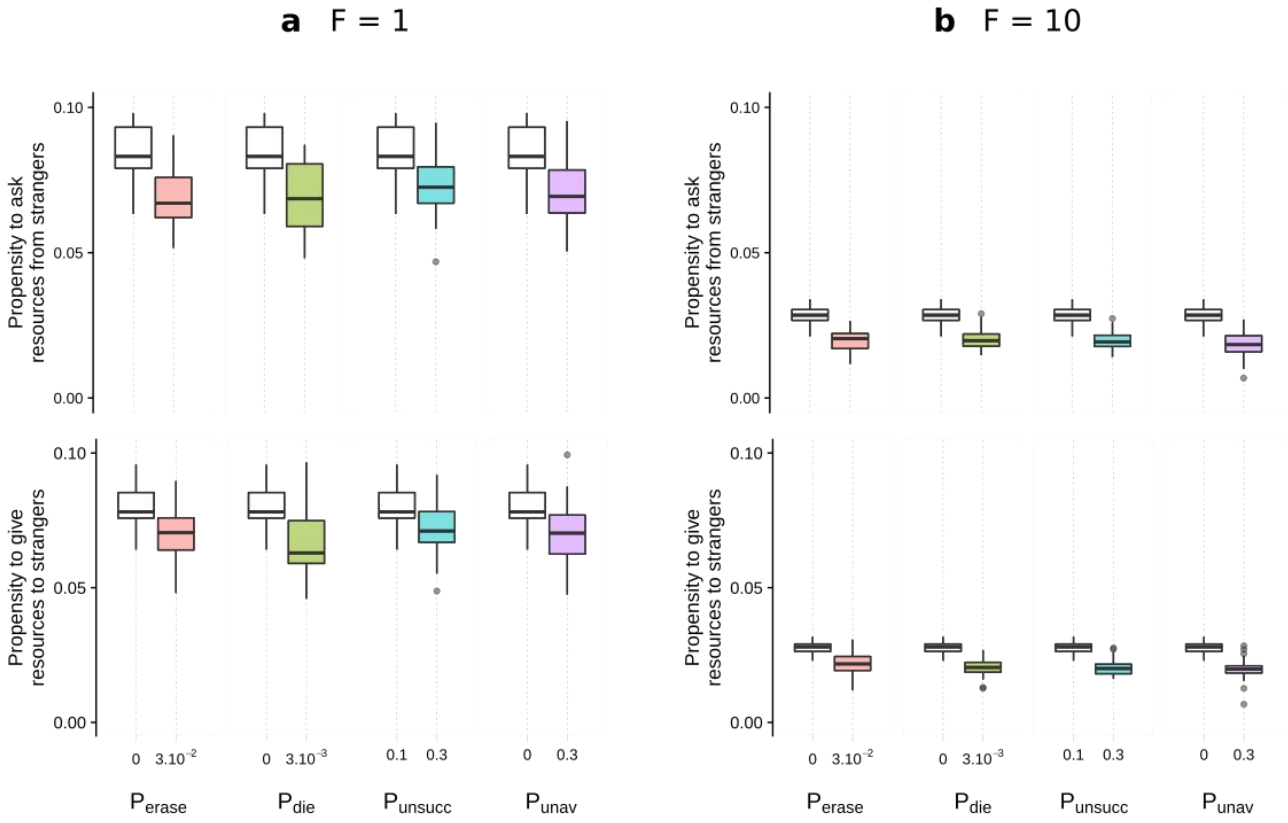

Figure S4: Trait values, A_i and G_i, at evolutionary equilibrium reached after 5 million time steps, for different number of possible interactions per time step. For low values of n_{ask} and n_{give}, individuals have less interaction opportunities, and individuals have to focus cooperative investments on few individuals to build partnerships, leading to low trait values A_i and G_i. For high values of P_{erase}, P_{die}, P_{unsucc} and P_{unav}, the evolutionary equilibrium is characterized by cooperative strategies focusing on the quality of each partnership rather than on the quantity of partnerships (low A_i and low G_i) as in the main analysis.

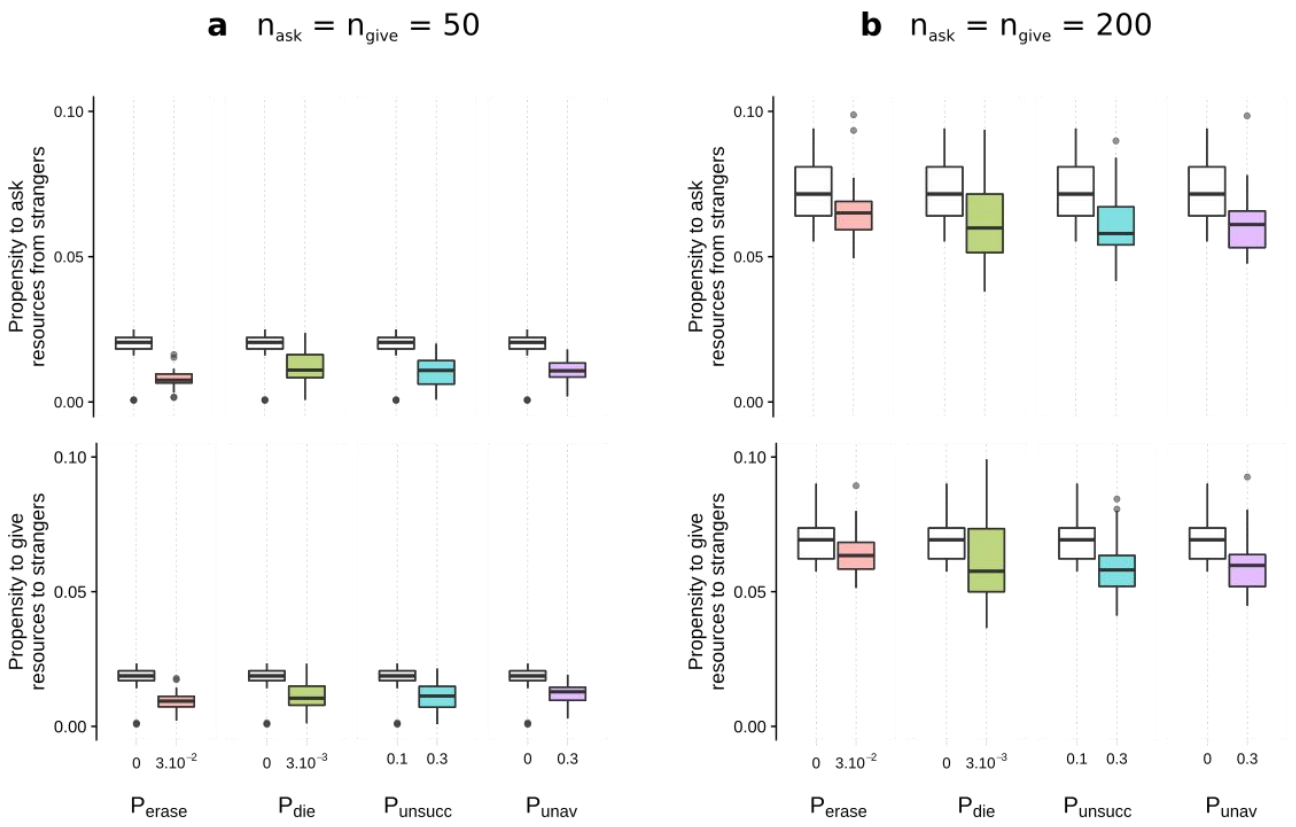

Figure S5: Trait values, A_i and G_i, at evolutionary equilibrium reached after 5 million time steps, for different resource-dependent mortality functions shown in Fig. 2. For high resource-dependent mortality, individuals have to focus investment on few individuals to build partnerships, leading to low trait values A_i and G_i. For high values of P_{erase}, P_{die}, P_{unsucc} and P_{unav}, the evolutionary equilibrium is characterized by cooperative strategies focusing on the quality of each partnership rather than on the quantity of partnerships (low A_i and low G_i) as in the main analysis.

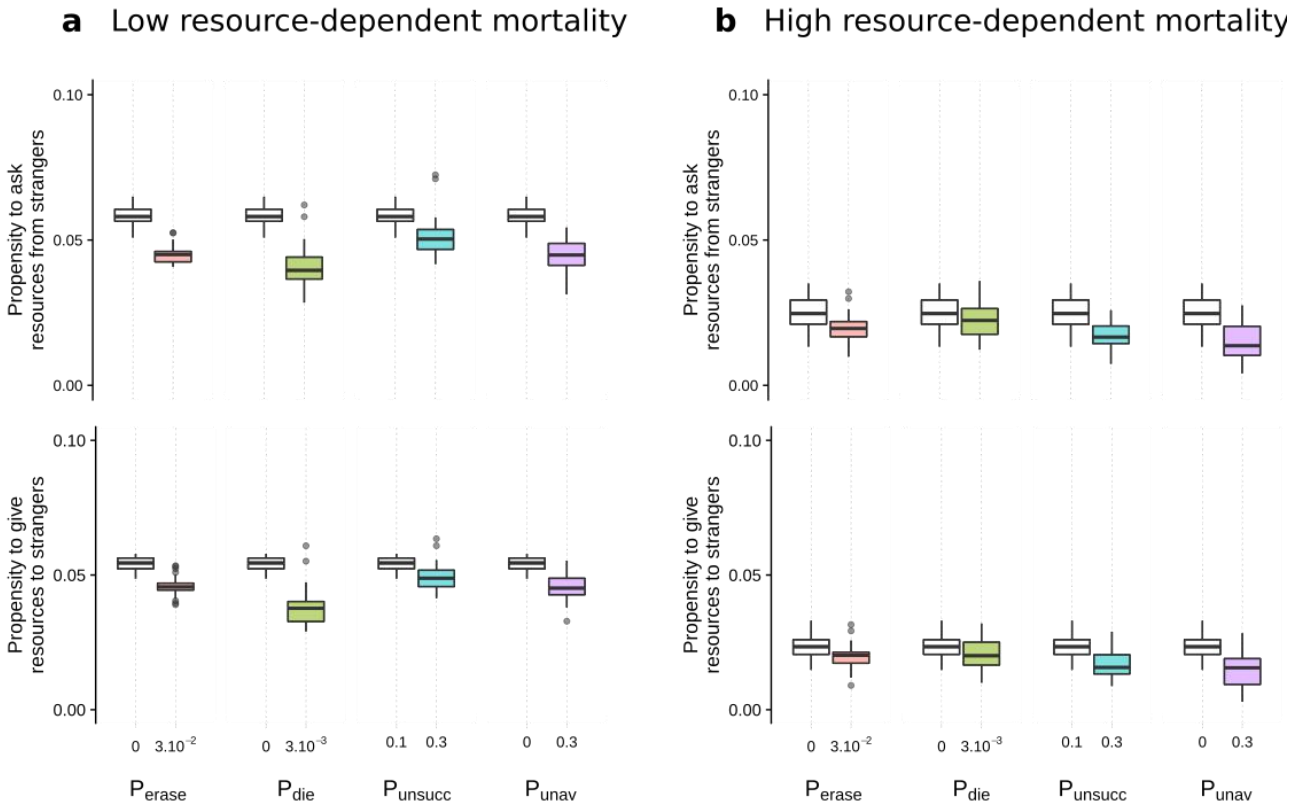

Figure S6: Probability of survival of unsuccessful individuals depending on the amount of resources received with a different resource-dependent mortality function (a), and trait values, A_i and G_i, at evolutionary equilibrium reached after 5 million time steps (b). Here, we implement the survivorship function as: $P_{starv}(r) = (1-\gamma_s)(1-exp(-(1-r)/R_s))$, with γ_s=0.9 and R_s=0.4.
For high values of P_{erase}, P_{die}, P_{unsucc} and P_{unav}, the evolutionary equilibrium is characterized by cooperative strategies focusing on the quality of each partnership rather than on the quantity of partnerships (low A_i and low G_i) as in the main analysis.

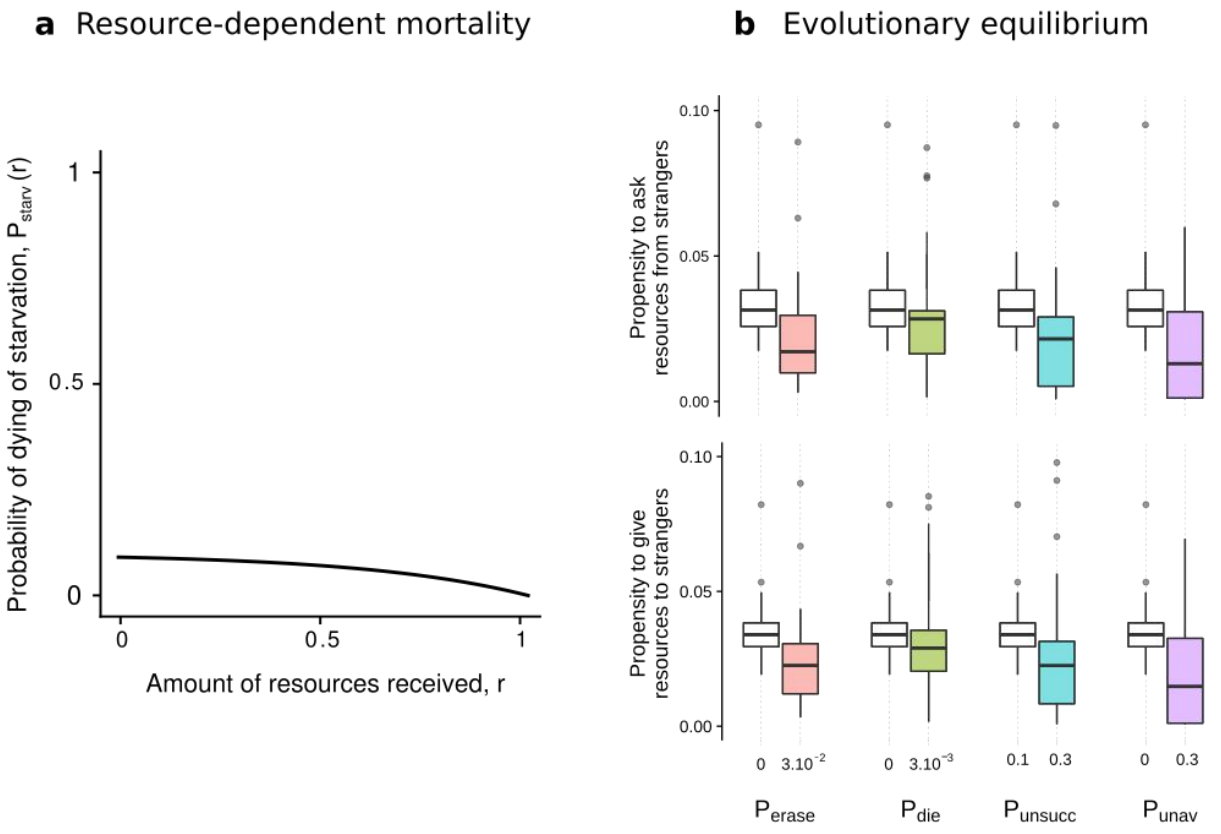

Figure S7: Comparison between different age measures. In the analysis, we measure age based on time steps at unsuccessful state. Here, we show that this age measure reflects age based on all time steps, such that 'Age based on time steps at unsuccessful state' ≈ P_{unsucc} x 'Age based on all time steps'.

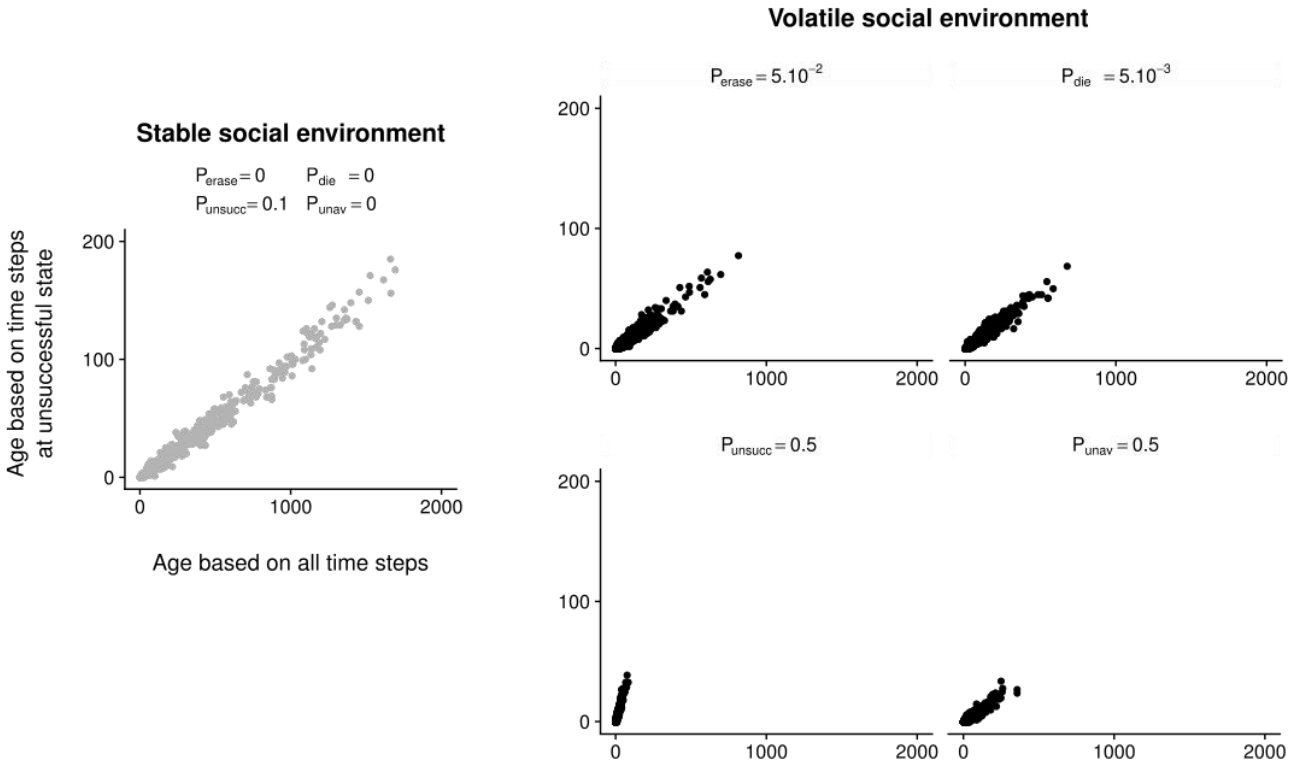

Figure S8: Characteristics of social relationships and survivorship of one individual i depending on its age and on its trait value in a population where $A_j = G_j = 0.035$ for all other individuals j either under a stable social environment or under a volatile social environment ($\mathbf{P_{erase} = 5.10^{-2}}$). See caption of Figure 5 for more details. We get qualitatively the same results as in the case with a high probability P_{die} of random death (Fig. 5) with the exception that individuals with low A_i ang G_i traits end up with a low number of relationships even late in life when $P_{erase} = 5.10^{-2}$ (for A_i=0.02 vs. for A_i=0.05). In a volatile society, speeding up the socializing process at an early age is crucial, even if this leads to a smaller network that is deleterious later in life (as in Fig. 5).

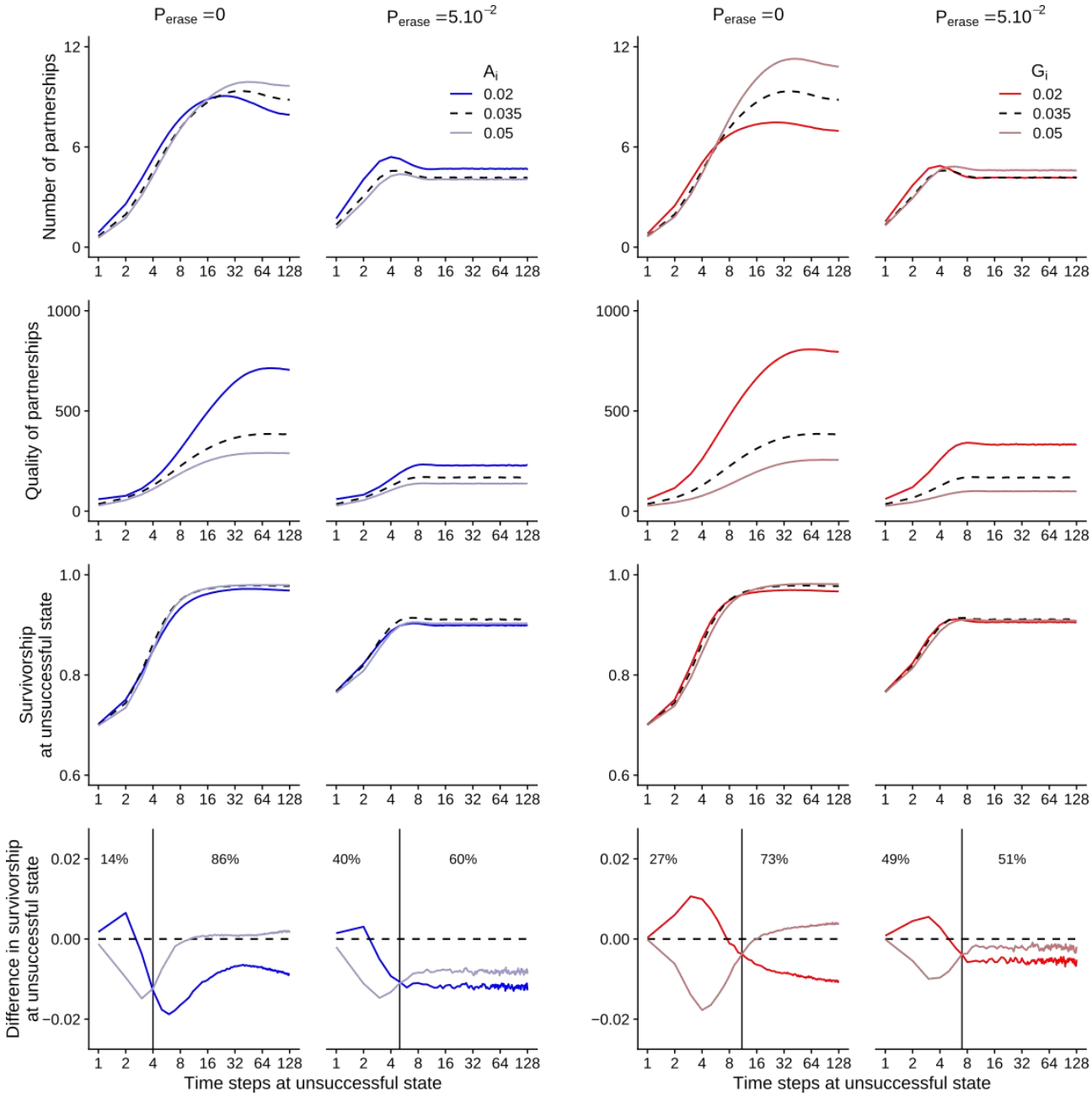

Figure S9: Characteristics of social relationships and survivorship of one individual i depending on its age and on its trait value in a population where $A_j = G_j = 0.035$ for all other individuals j either under a stable social environment or under a volatile social environment (**$P_{unsucc} = 0.5$**). See caption of Figure 5 for more details. We get qualitatively the same results as in the case with a high probability P_{die} of random death (Fig. 5). Early performance matters more than late performance (as in Fig. 5).

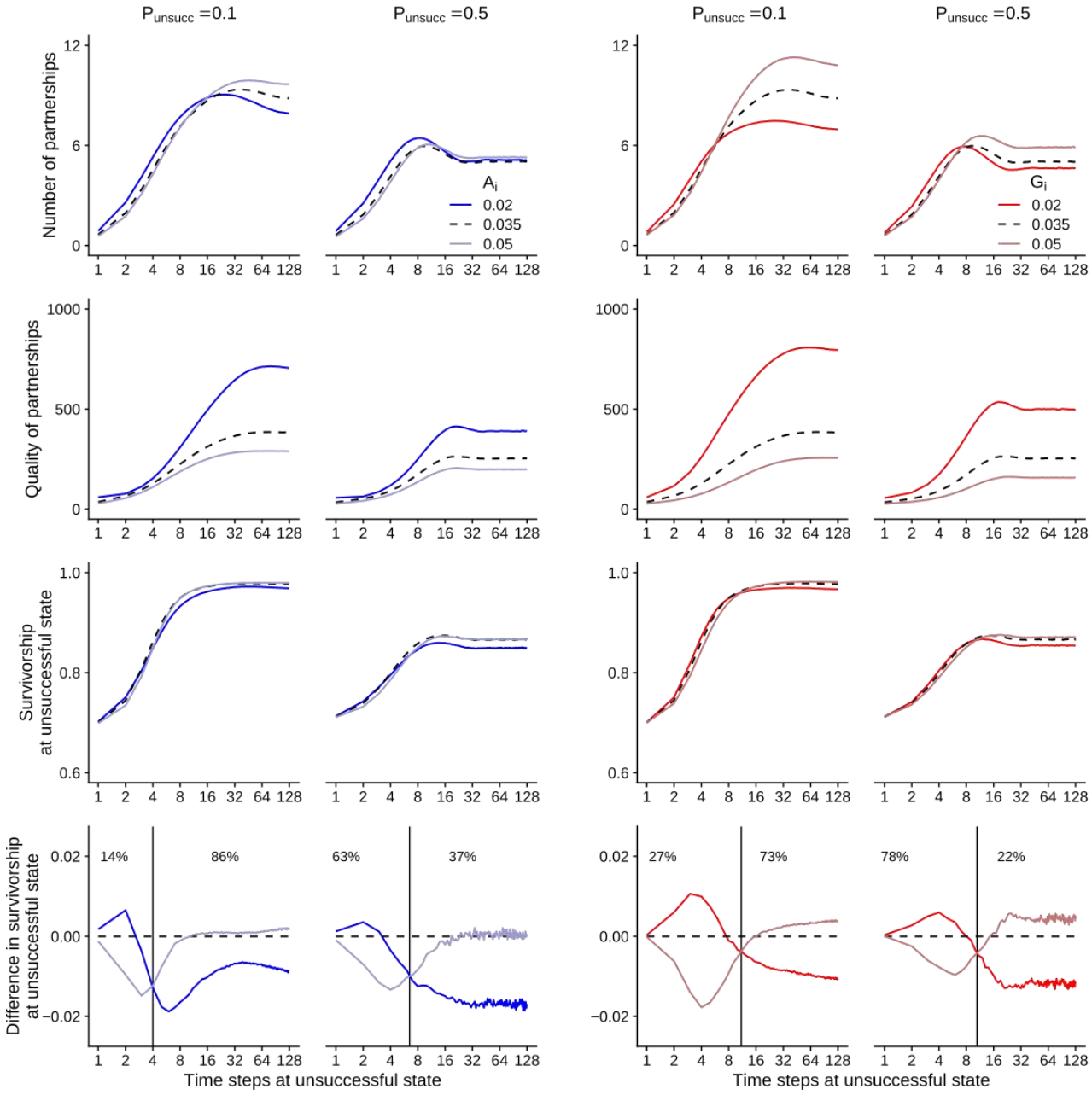

Figure S10: Characteristics of social relationships and survivorship of one individual i depending on its age and on its trait value in a population where $A_j = G_j = 0.035$ for all other individuals j either under a stable social environment or under a volatile social environment (**$P_{unav} = 0.5$**). See caption of Figure 5 for more details. We get qualitatively the same results as in the case with a high probability P_{die} of random death (Fig. 5). Early performance matters more than late performance (as in Fig. 5).

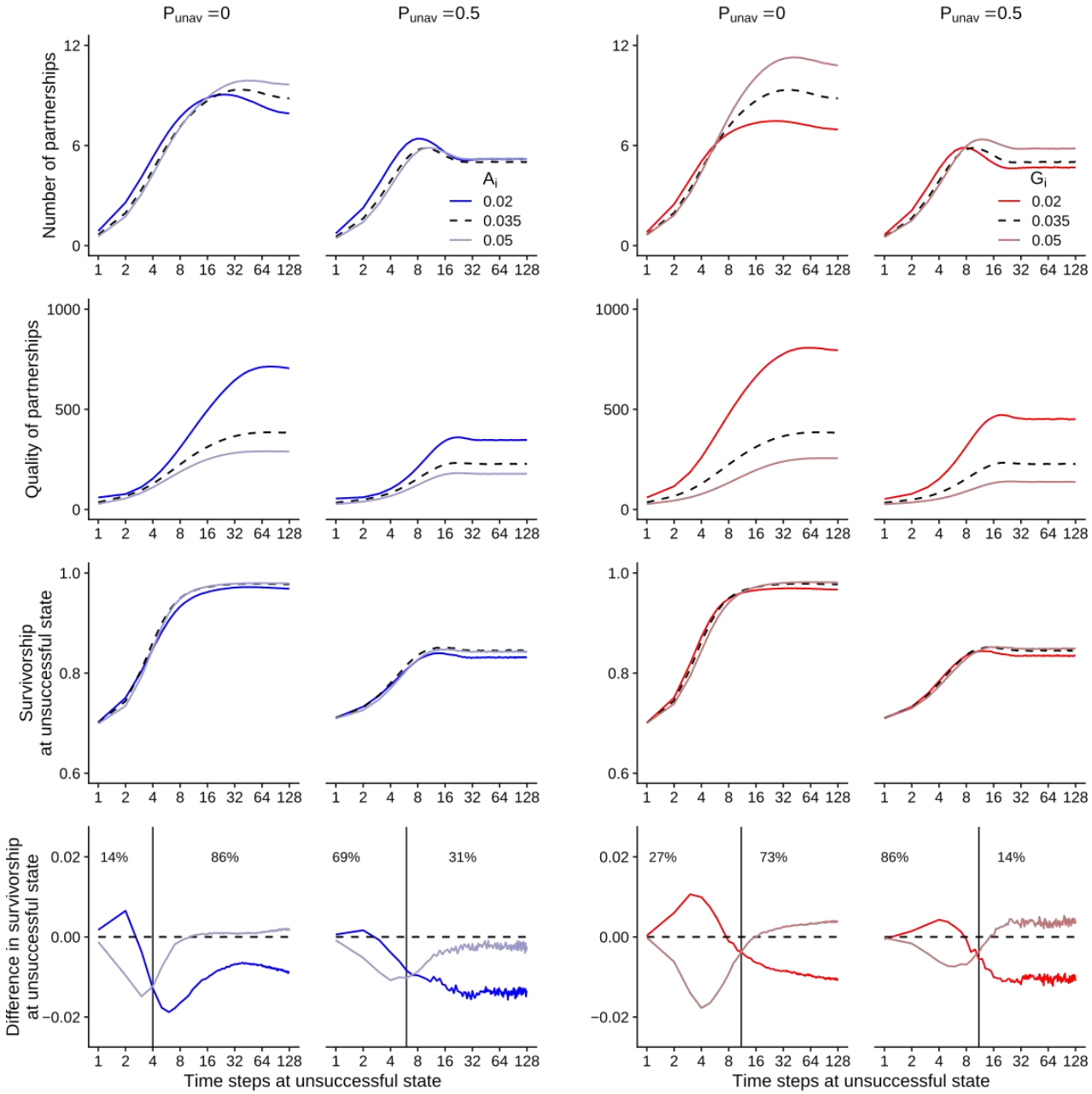

Figure S11: Age distribution under different social environments. A volatile social environment associates with high mortality, and therefore changes the age distribution.