Supporting Information
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Complementation and Epistasis in Viral Coinfection Dynamics

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FIGURE S1.—Trajectories of mean fitness changes under scenarios I and II using deterministic simulation. (b), (c), (d), and (e) show under scenarios I and II the frequency trajectories of wildtype, single mutants, double mutants, and triple mutants, respectively. Dashed lines represent the results assuming no mutation. Solid lines represent the results assuming mutation rate $\mu = 0.01$. Each color represents a co-infection fraction as labeled in the legend.
Figure S2.—(a) Trajectories of mean fitness changes under scenarios II and III using deterministic simulation. (b), (c), (d), and (e) show under scenarios II and III the frequency trajectories of wildtype, single mutants, double mutants, and triple mutants, respectively. Solid lines represent the results assuming selection coefficient $s = 0.1$. Dashed lines represent the results assuming selection coefficient $s = 0.2$. Each color represents a co-infection fraction as labeled in the legend.
FIGURE S3.—Trajectories of mean fitness changes under scenarios II, IV and V using deterministic simulation. (b), (c), (d), and (e) show under scenarios II, IV and V the frequency trajectories of wildtype, single mutants, double mutants, and triple mutants, respectively. Dashed lines represent the results assuming epistasis coefficient $\epsilon = 0.3$. Dotted lines represent the results assuming no epistasis. Solid lines represent the results assuming epistasis coefficient $\epsilon = -0.3$. Each color represents a co-infection fraction as labeled in the legend.
**FIGURE S4.**—(a) Trajectories of mean fitness changes under scenarios II, VI and VII using deterministic simulation. 
(b), (c), (d), and (e) show under scenarios II, VI and VII the frequency trajectories of wildtype, single mutants, double mutants, and triple mutants, respectively. Dashed lines represent the results assuming epistasis coefficient $\epsilon = 0.8$. Dotted lines represent the results assuming no epistasis. Solid lines represent the results assuming epistasis coefficient $\epsilon = -0.8$. Each color represents a co-infection fraction as labeled in the legend.
Figure S5.—(a) Trajectories of mean fitness changes under scenarios VIII and IX using deterministic simulation. (b), (c), (d), and (e) show under scenarios VIII and IX the frequency trajectories of wildtype, single mutants, double mutants, and triple mutants, respectively. Dashed lines represent the results assuming second order epistasis coefficient $\eta = 0.8$. Solid lines represent the results assuming second order epistasis coefficient $\eta = -0.8$. Each color represents a co-infection fraction as labeled in the legend.
Figure S6.—Trajectories of mean fitness changes under scenarios I and II using stochastic simulation. (b), (c), (d), and (e) show under scenarios I and II the frequency trajectories of wildtype, single mutants, double mutants, and triple mutants, respectively. Dashed lines represent the results assuming no mutation. Solid lines represent the results assuming mutation rate $\mu = 0.01$. Each color represents a co-infection fraction as labeled in the legend.
FIGURE S7.—(a) Trajectories of mean fitness changes under scenarios II and III using stochastic simulation. (b), (c), (d), and (e) show under scenarios II and III the frequency trajectories of wildtype, single mutants, double mutants, and triple mutants, respectively. Solid lines represent the results assuming selection coefficient $s = 0.1$. Dashed lines represent the results assuming selection coefficient $s = 0.2$. Each color represents a co-infection fraction as labeled in the legend.
Figure S8.—Trajectories of mean fitness changes under scenarios II, IV and V using stochastic simulation. (b), (c), (d), and (e) show under scenarios II, IV and V the frequency trajectories of wildtype, single mutants, double mutants, and triple mutants, respectively. Dashed lines represent the results assuming epistasis coefficient $\epsilon = 0.3$. Dotted lines represent the results assuming no epistasis. Solid lines represent the results assuming epistasis coefficient $\epsilon = -0.3$. Each color represents a co-infection fraction as labeled in the legend.
FIGURE S9.—(a) Trajectories of mean fitness changes under scenarios VIII and IX using stochastic simulation. (b), (c), (d), and (e) show under scenarios VIII and IX the frequency trajectories of wildtype, single mutants, double mutants, and triple mutants, respectively. Dashed lines represent the results assuming second order epistasis coefficient $\eta = 0.8$. Solid lines represent the results assuming second order epistasis coefficient $\eta = -0.8$. Each color represents a co-infection fraction as labeled in the legend.
FIGURE S10.—Mean fitness pattern under the three-way interaction among complementation, selection and epistasis. (a), (b), (c), (d), and (e) show the interaction patterns between selection and epistasis with the co-infection ratios, 0.1, 0.3, 0.5, 0.7, and 0.9, respectively. Colors represent values of the overall mean fitness under each combination of parameters, red for value 0.95, yellow for 0.967, green for 0.983, and blue for 1.00.
FIGURE S11.—Double mutant frequency pattern under the three-way interaction among complementation, selection and epistasis. (a), (b), (c), (d), and (e) show the interaction patterns between selection and epistasis with the co-infection ratios, 0.1, 0.3, 0.5, 0.7, and 0.9, respectively. Colors represent the values of wildtype frequency, red= 0.00, yellow= 1/3, green= 2/3, and blue= 1.00.
Figure S12.—Triple mutant frequency pattern under the three-way interaction among complementation, selection and epistasis. (a), (b), (c), (d), and (e) show the interaction patterns between selection and epistasis with the co-infection ratios, 0.1, 0.3, 0.5, 0.7, and 0.9, respectively. Colors represent the values of wildtype frequency, red = 0.00, yellow = 1/3, green = 2/3, and blue = 1.00.
FIGURE S13.—(a), (b), (c), and (d) show under various starting frequencies the frequency trajectories of wildtype, single mutants, double mutants, and triple mutants, respectively, using deterministic simulation and assuming parameters $p_c = 0.7$, $\mu = 0.01$, $s = 0.1$, $c = -0.8$, and $\eta = 0.0$. Colors represent different initial frequencies as labeled in the legend. F 0 represents the initial frequency of wildtype, F 1, F 2, and F 3 represents the initial frequencies of single mutants and F 123 represents the initial frequencies of triple mutants.