Supplemental information

(3 Schemes, 4 figures with multiple panels, 10 tables)

Miscibility of Sphingomyelins and Phosphatidylcholines in Unsaturated Phosphatidylcholine Bilayers

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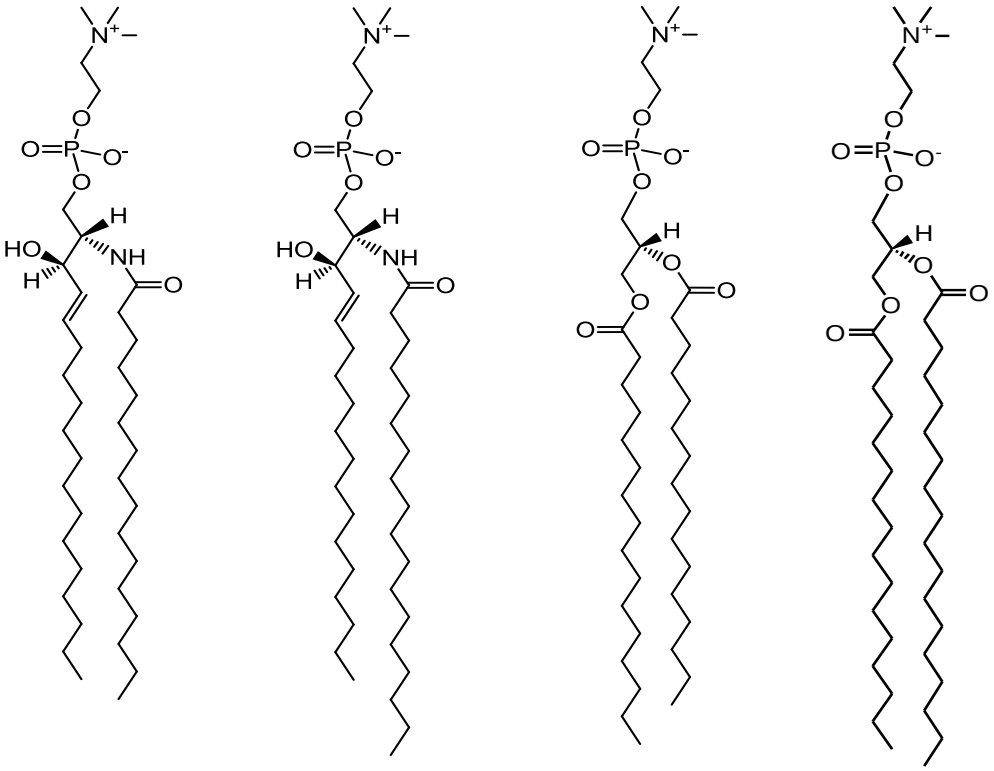
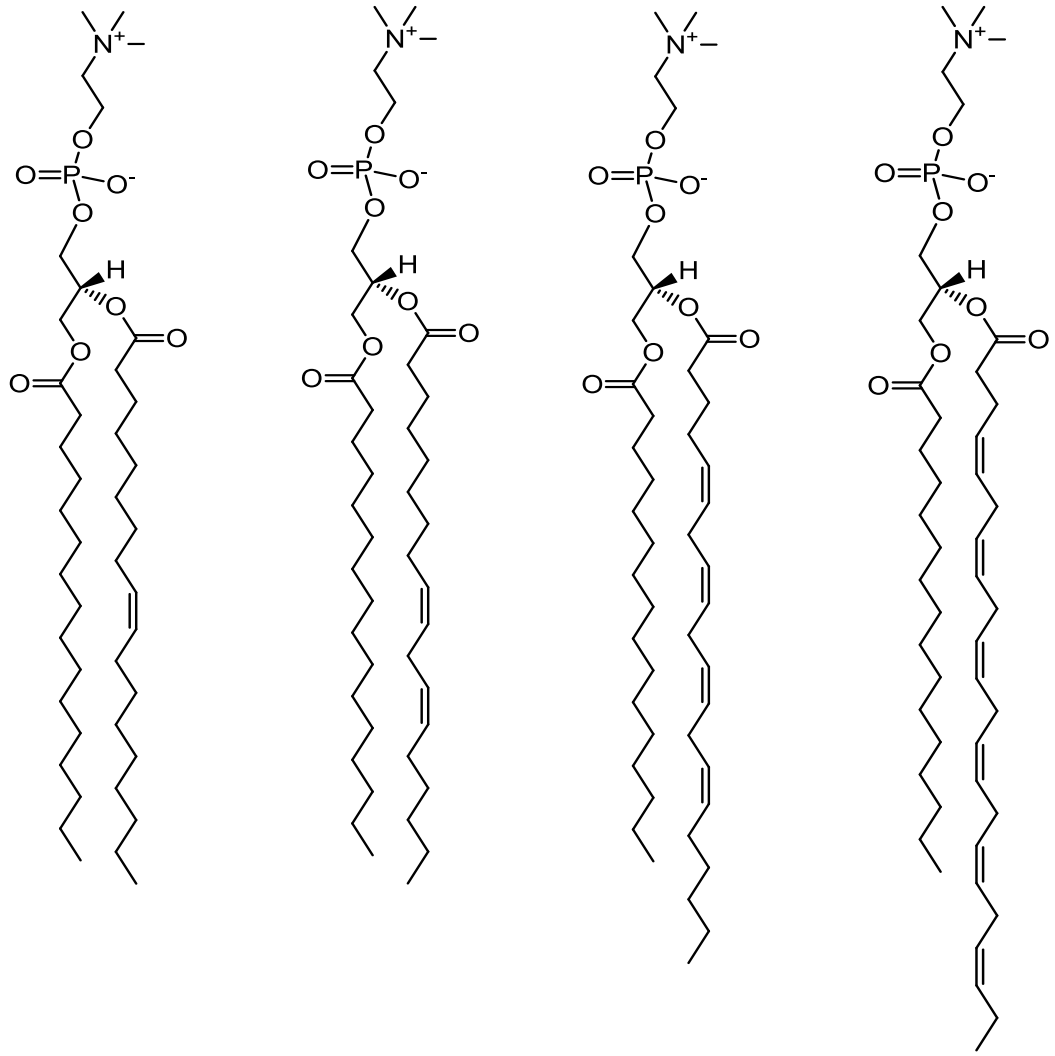
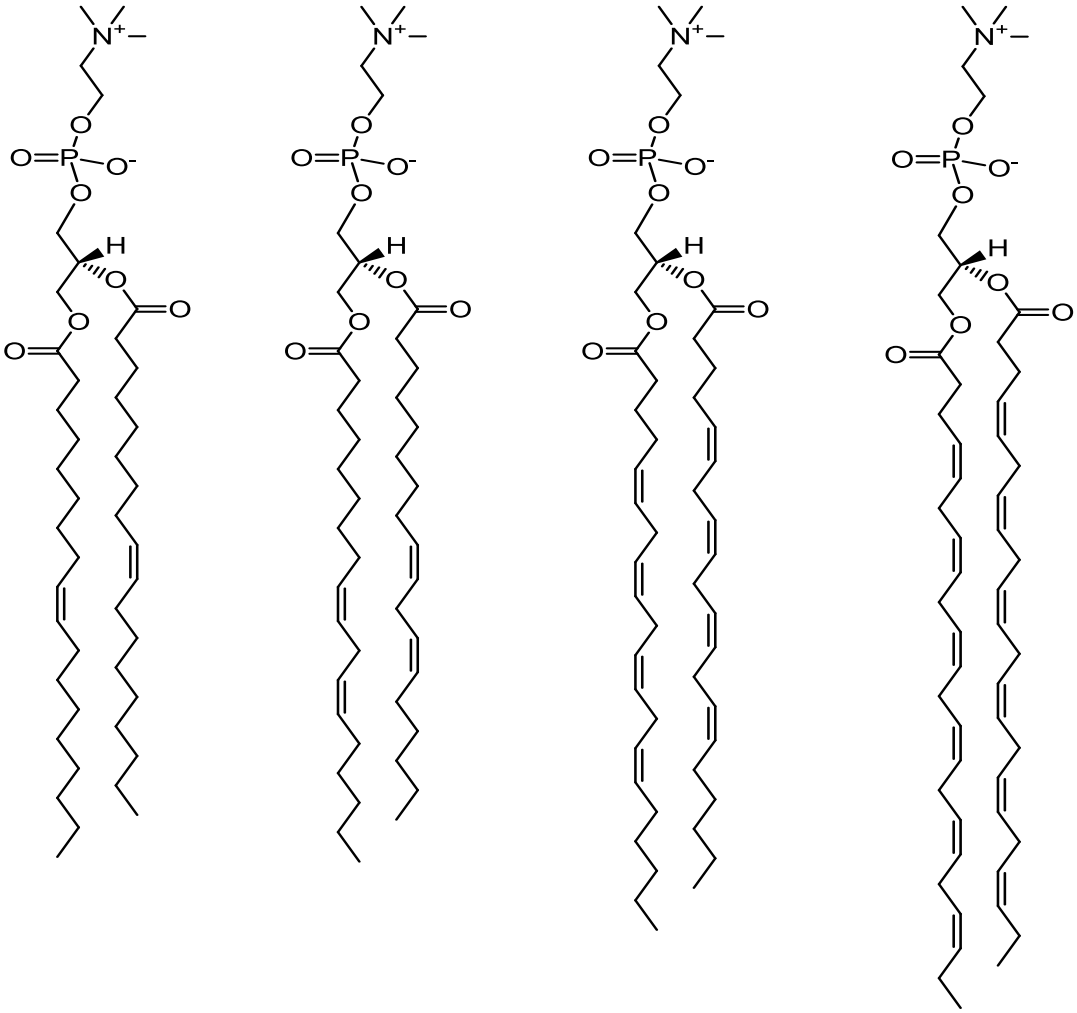


Scheme S1. Molecular structures of (from left to right) PSM, SSM, DPPC, and PSPC

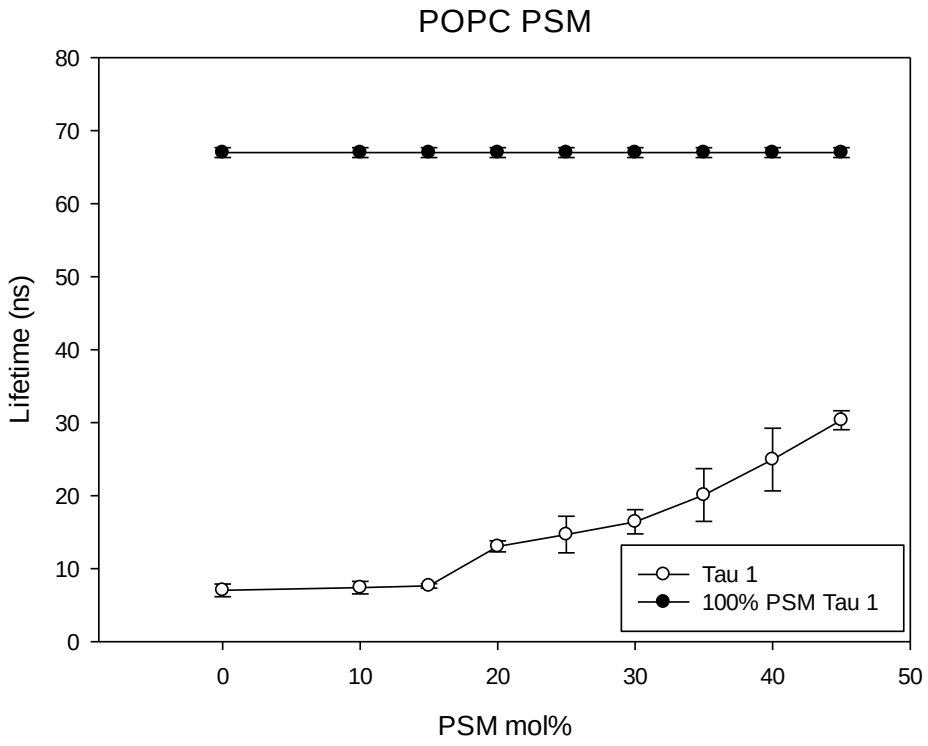


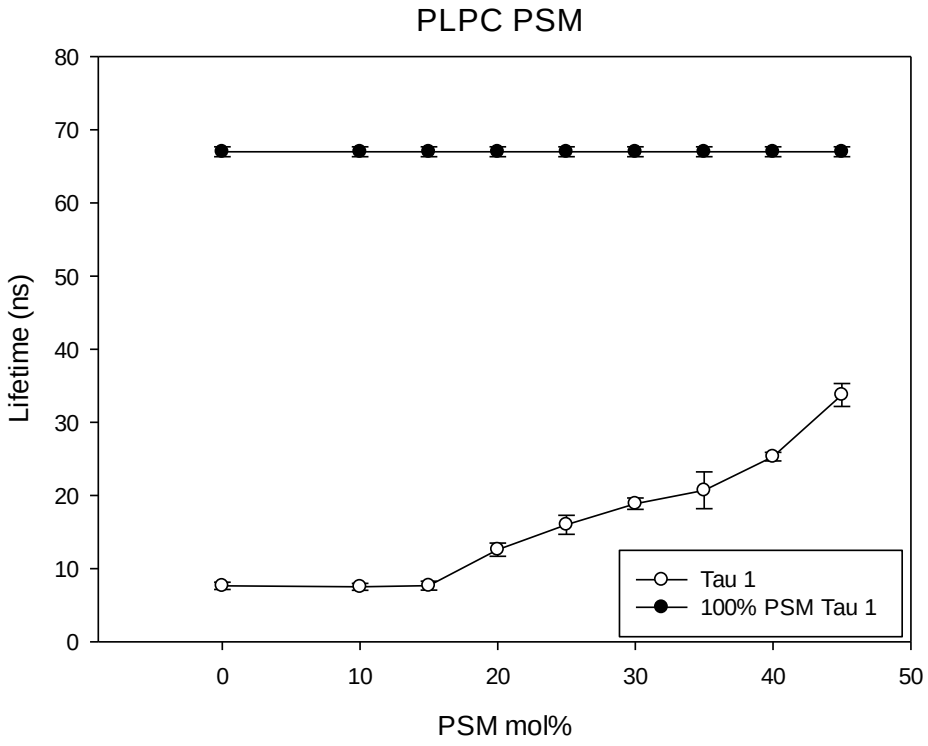
Scheme S2. Molecular structures of (from left to right) POPC, PLPC, PAPC and PDPC

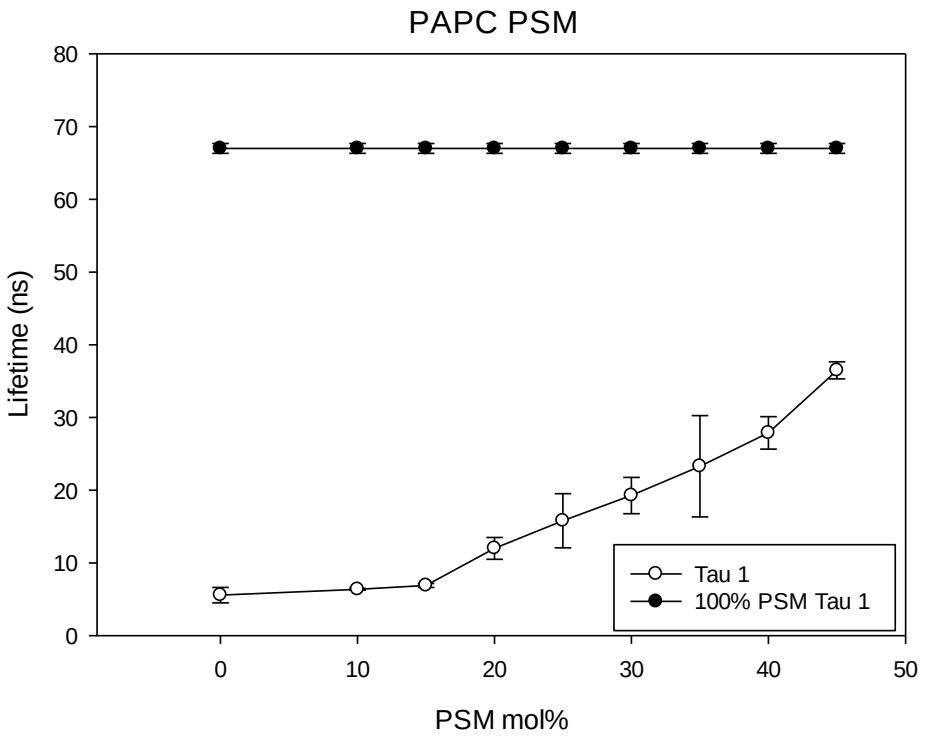


Scheme S3. Molecular structures of (from left to right) DOPC, DLPC, DAPC and DDPC

Figure S1. The longest lifetime component (τ_1) of tPA is given for pure PSM (filled symbols, and for PSM in unsaturated phosphatidylcholine bilayers (open symbols).






PAPC PSM
Lifetime (ns)
PSM mol%
Tau 1
100% PSM Tau 1
0
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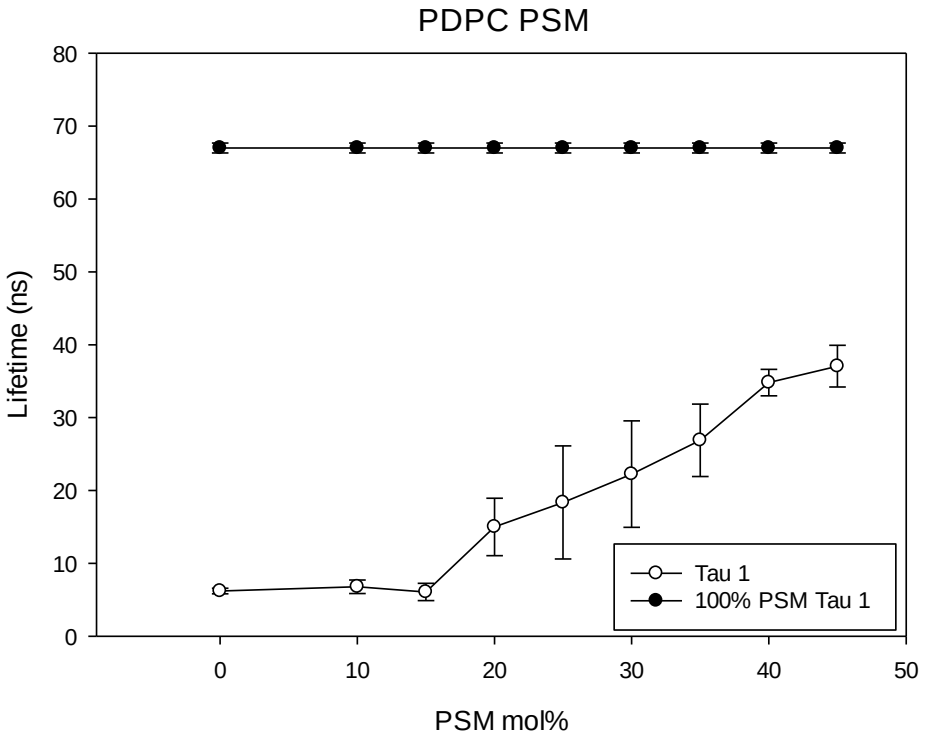
PDPC PSM
Lifetime (ns)
PSM mol%
Tau 1
100% PSM Tau 1
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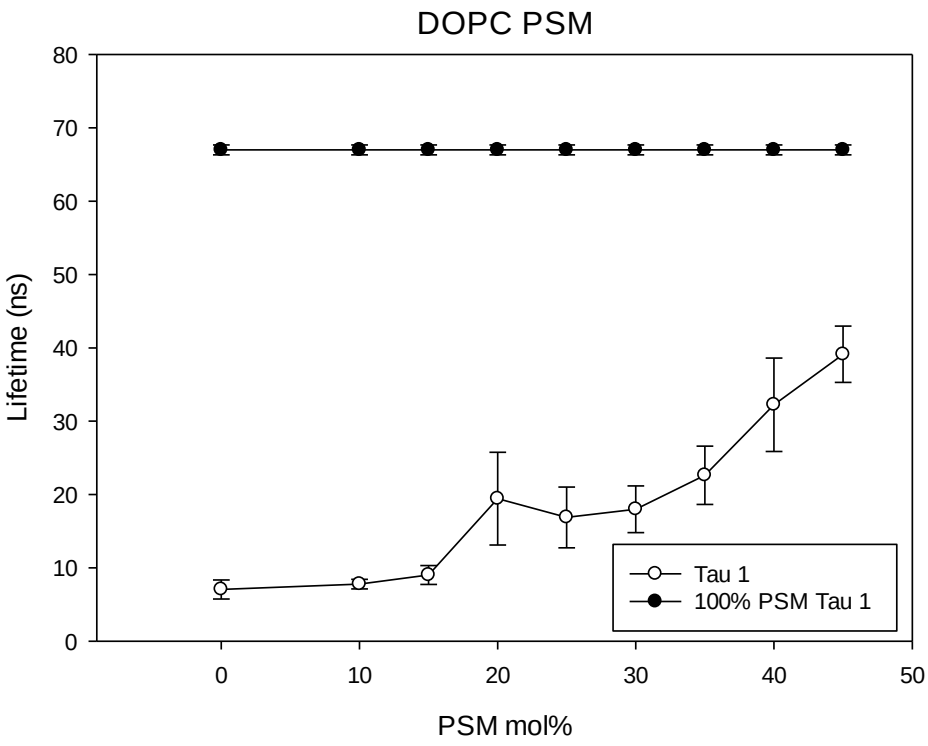
DOPC PSM
Lifetime (ns)
PSM mol%
Tau 1
100% PSM Tau 1
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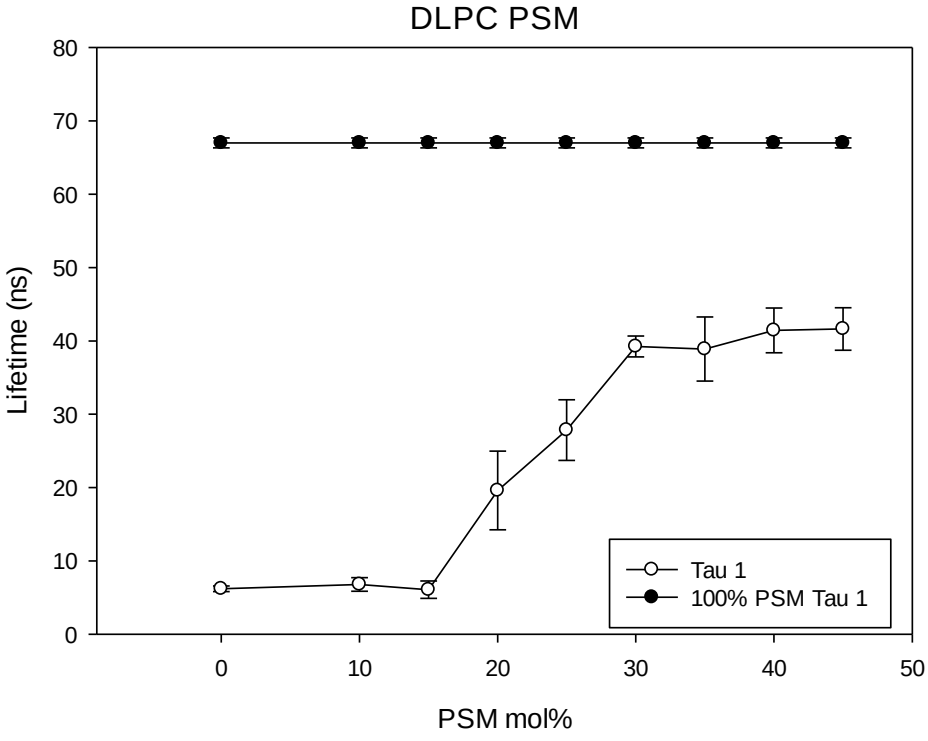
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Lifetime (ns)
PSM mol%
Tau 1
100% PSM Tau 1
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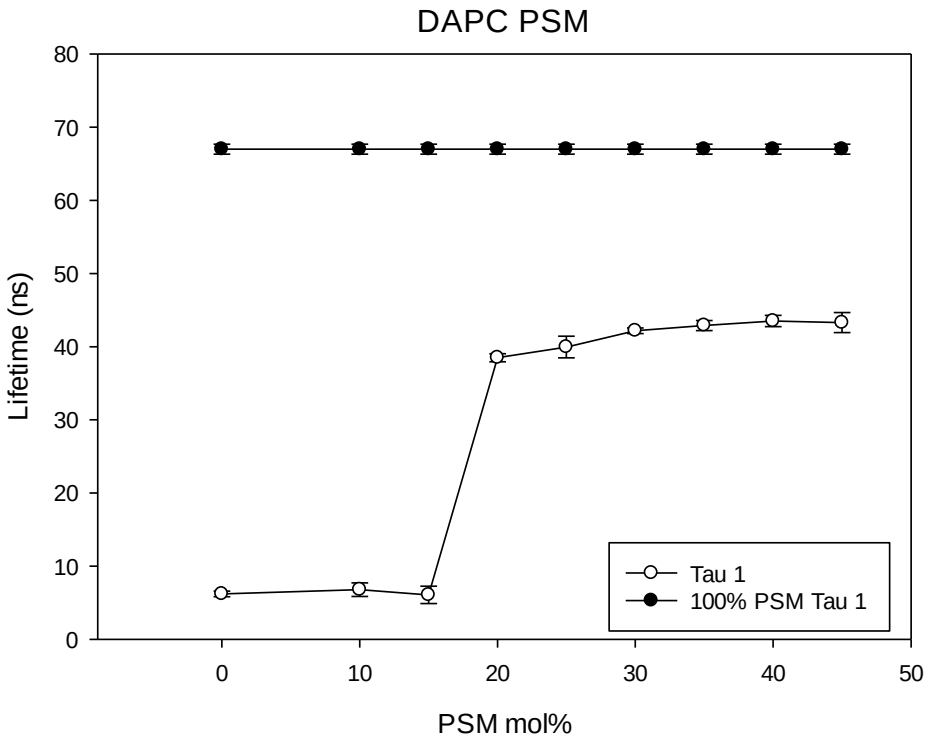
DAPC PSM
Lifetime (ns)
PSM mol%
Tau 1
100% PSM Tau 1
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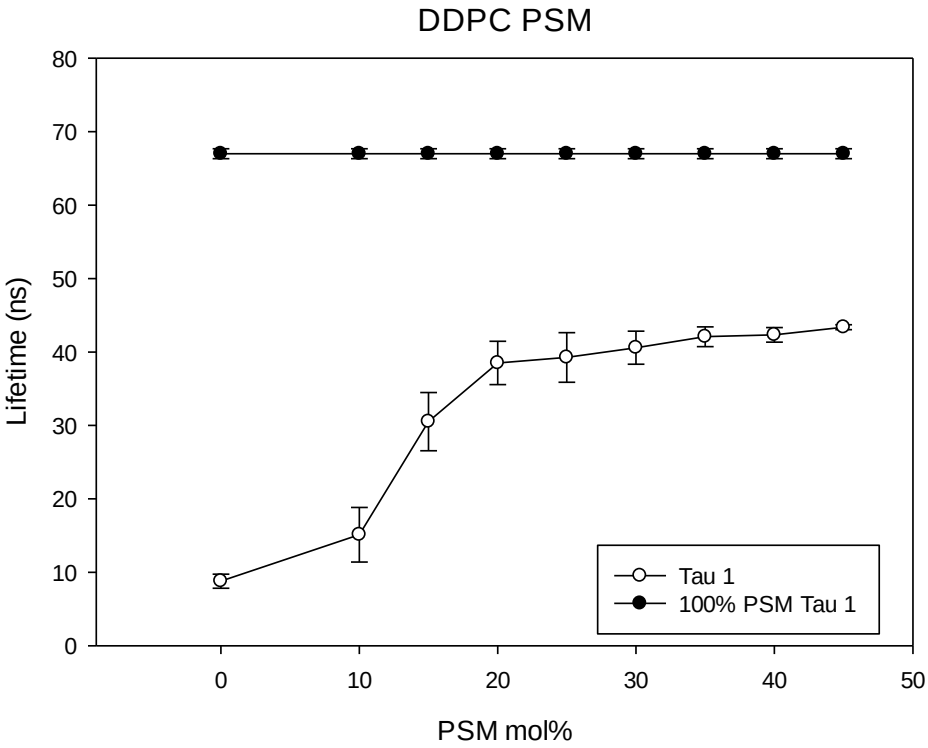
DDPC PSM
Lifetime (ns)
PSM mol%
Tau 1
100% PSM Tau 1
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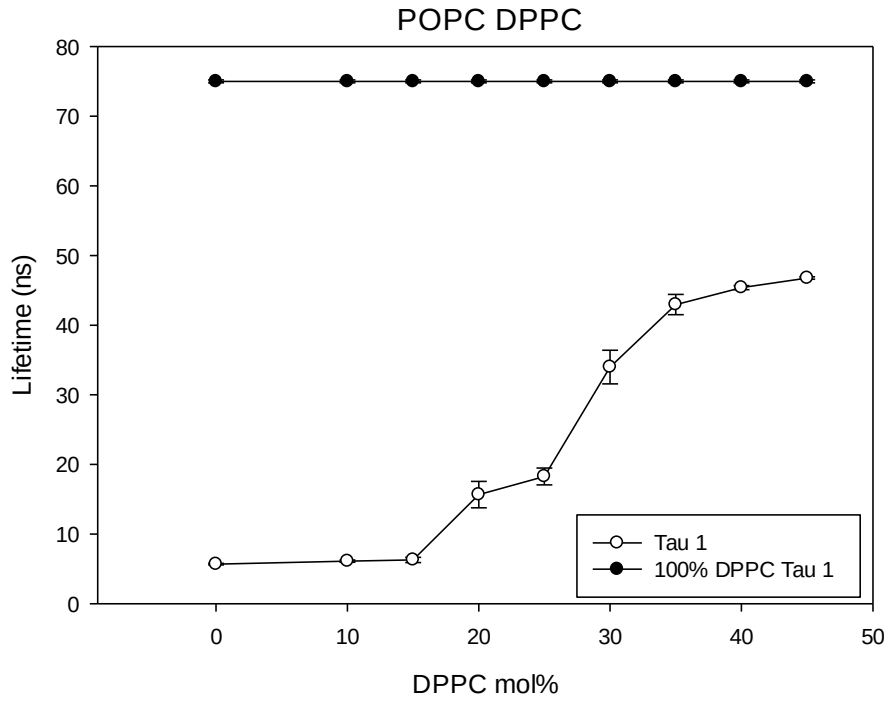
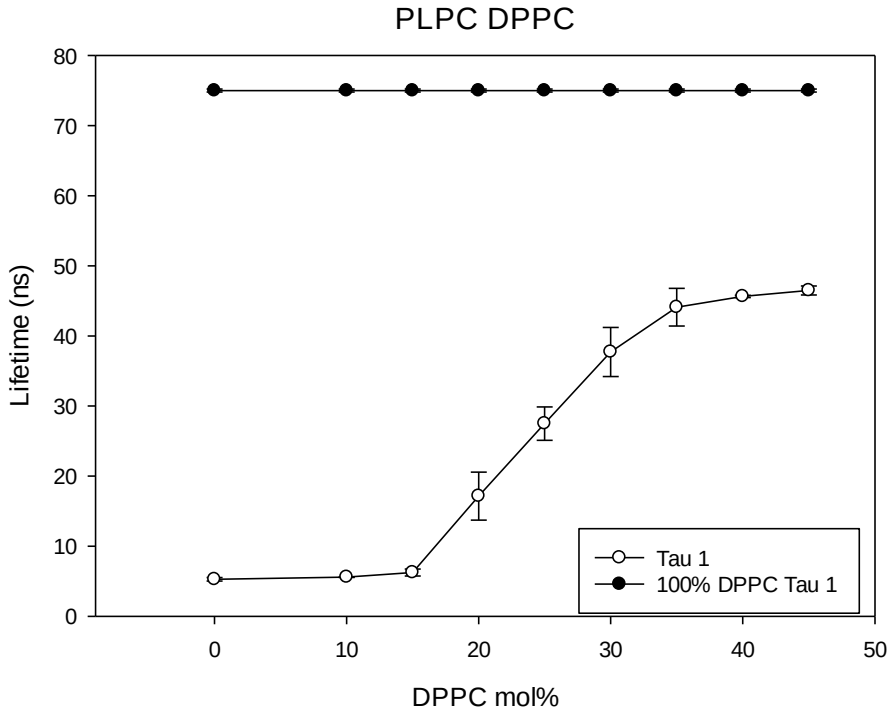
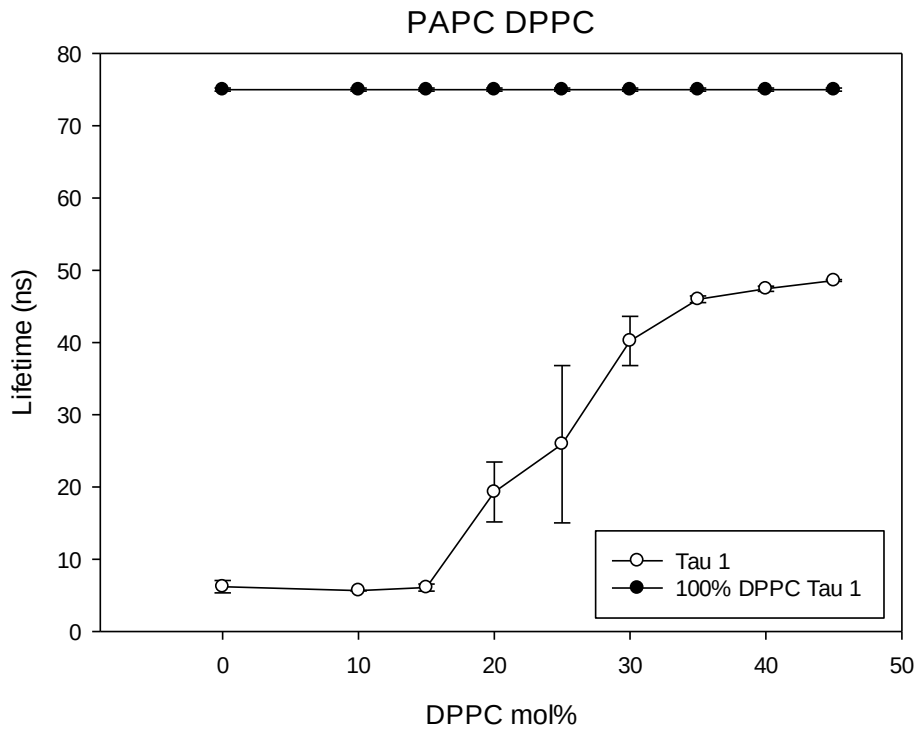
Figure S2. The longest lifetime component (τ_1) of tPA is given for pure DPPC (filled symbols), and for DPPC in unsaturated phosphatidylcholine bilayers (open symbols).






PAPC DPPC
Lifetime (ns)
DPPC mol%
Tau 1
100% DPPC Tau 1
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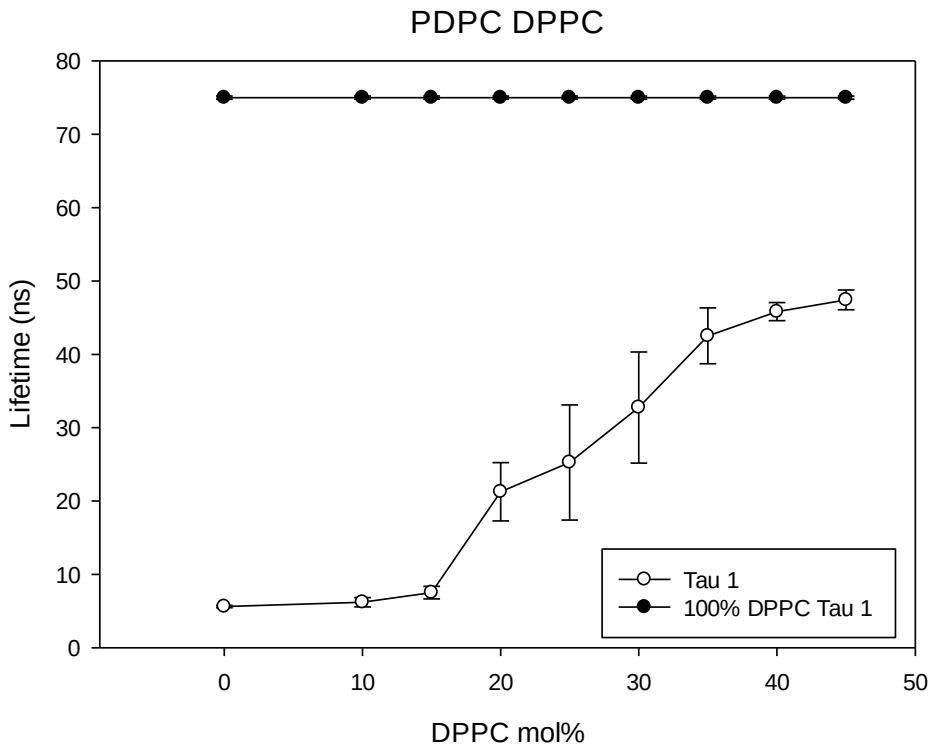
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Lifetime (ns)
DPPC mol%
Tau 1
100% DPPC Tau 1
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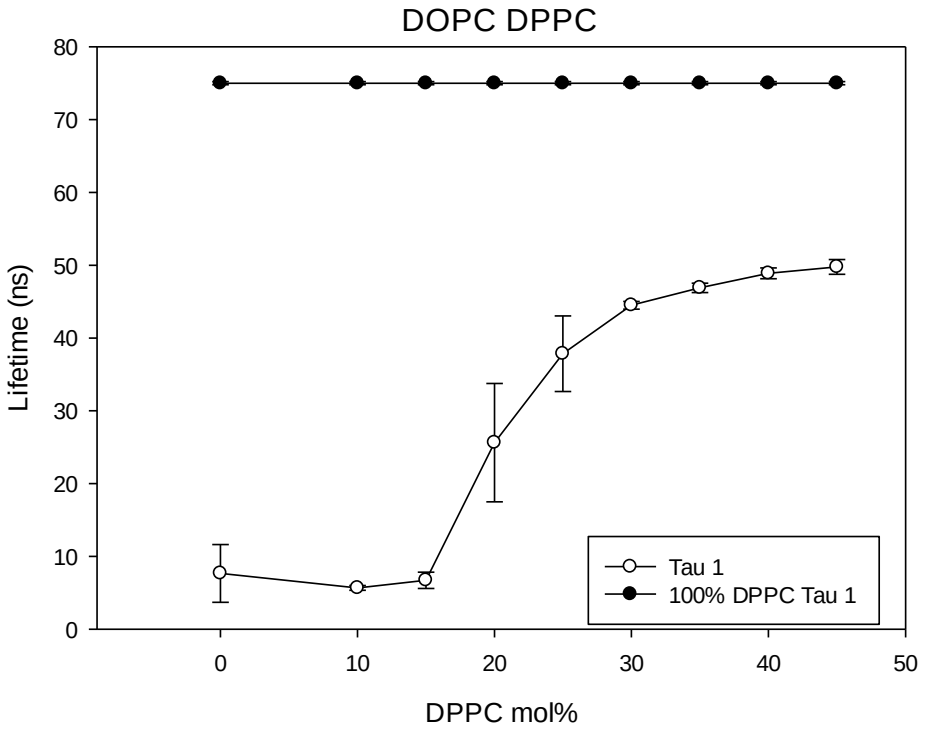
DOPC DPPC
Lifetime (ns)
DPPC mol%
Tau 1
100% DPPC Tau 1
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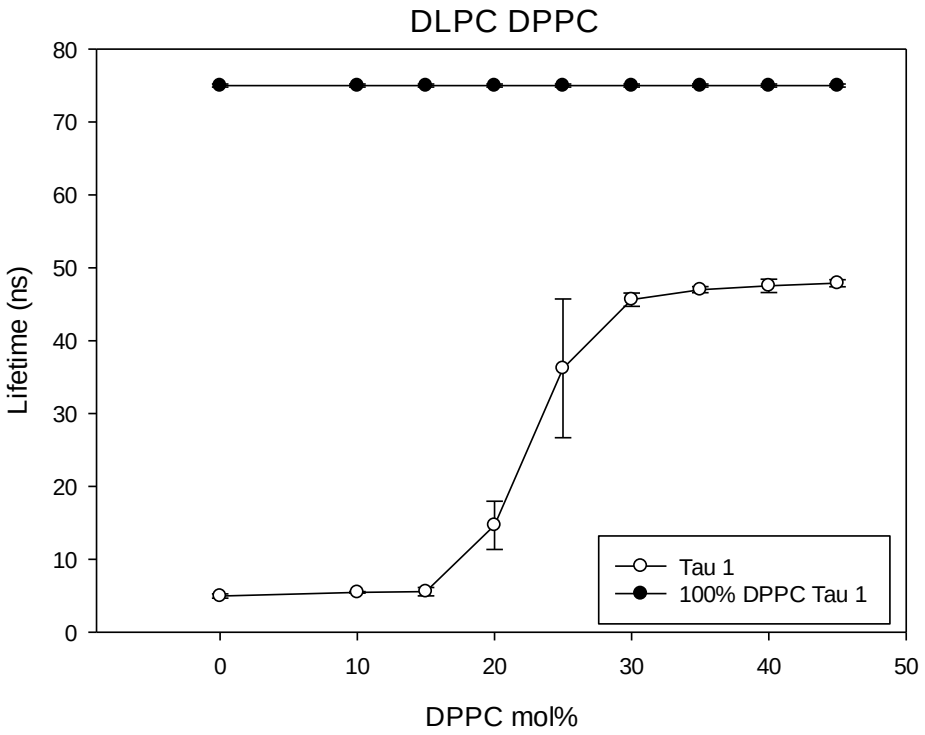
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Lifetime (ns)
DPPC mol%
Tau 1
100% DPPC Tau 1
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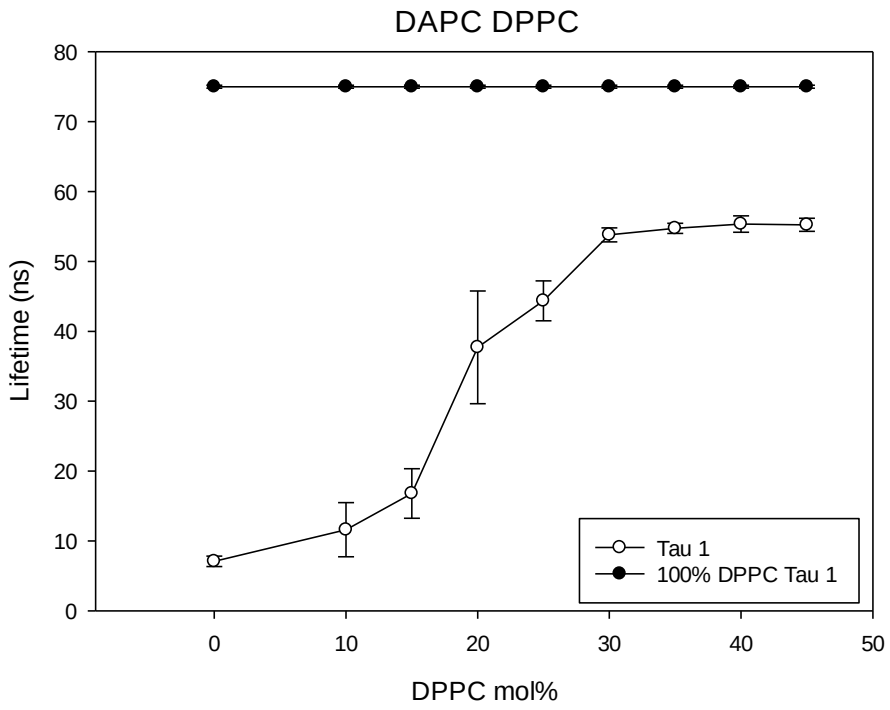
DAPC DPPC
Lifetime (ns)
DPPC mol%
Tau 1
100% DPPC Tau 1
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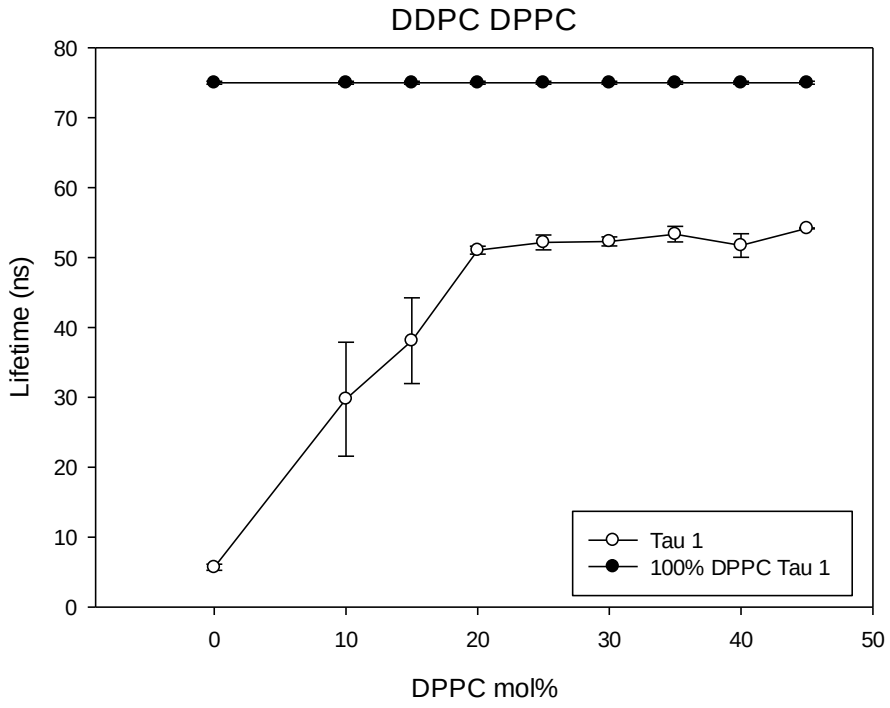
DDPC DPPC
Lifetime (ns)
DPPC mol%
Tau 1
100% DPPC Tau 1
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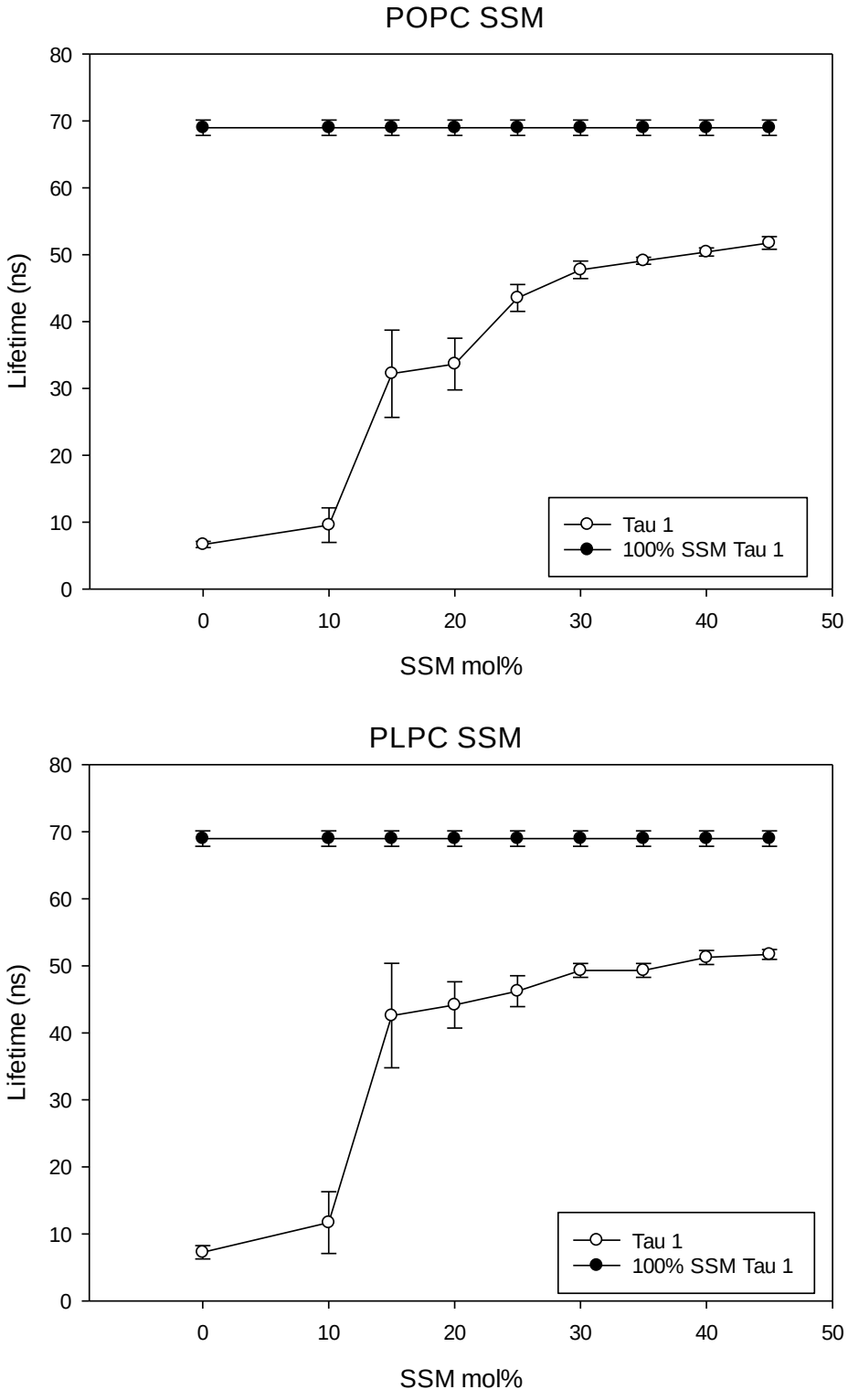
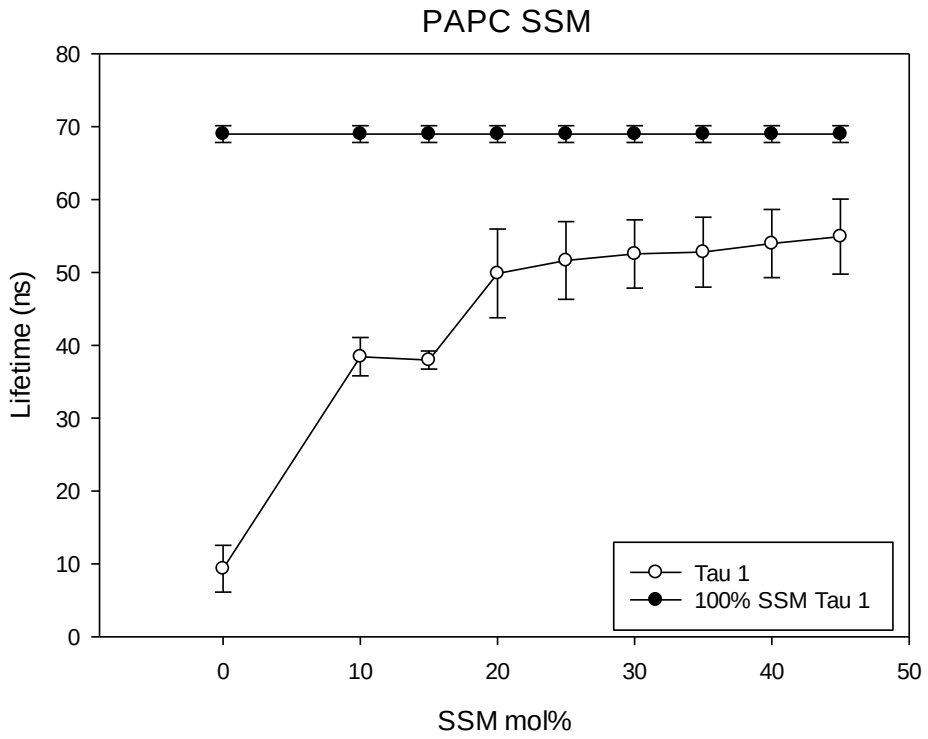
Figure S3. The longest lifetime component (τ_1) of tPA is given for pure SSM (filled symbols), and for SSM in unsaturated phosphatidylcholine bilayers (open symbols).




PAPC SSM
Lifetime (ns)
SSM mol%
Tau 1
100% SSM Tau 1
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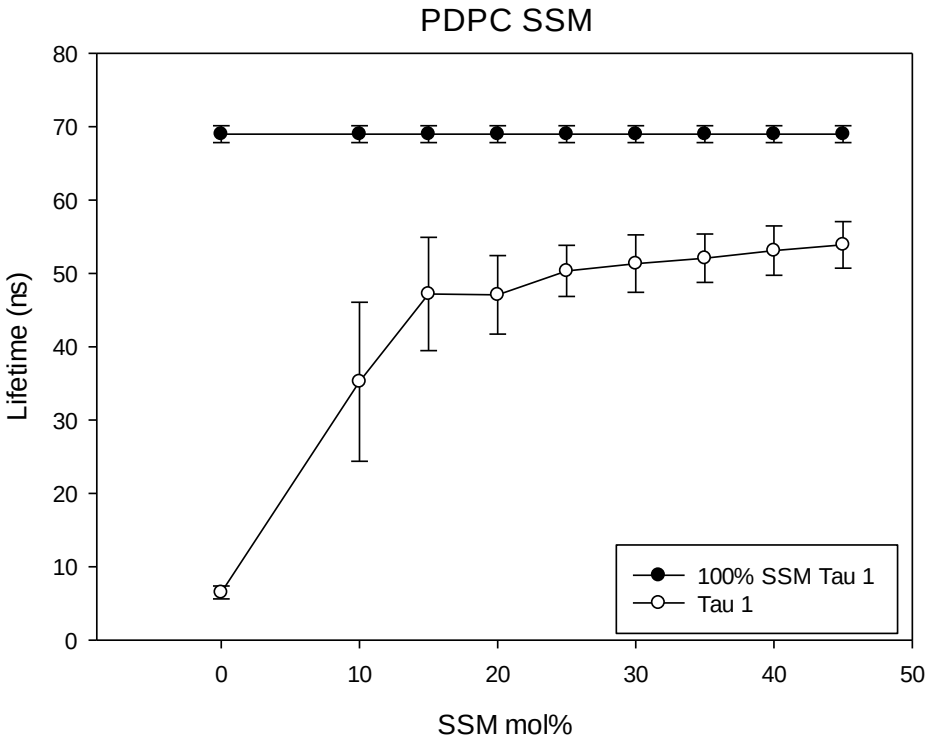
PDPC SSM
Lifetime (ns)
SSM mol%
100% SSM Tau 1
Tau 1
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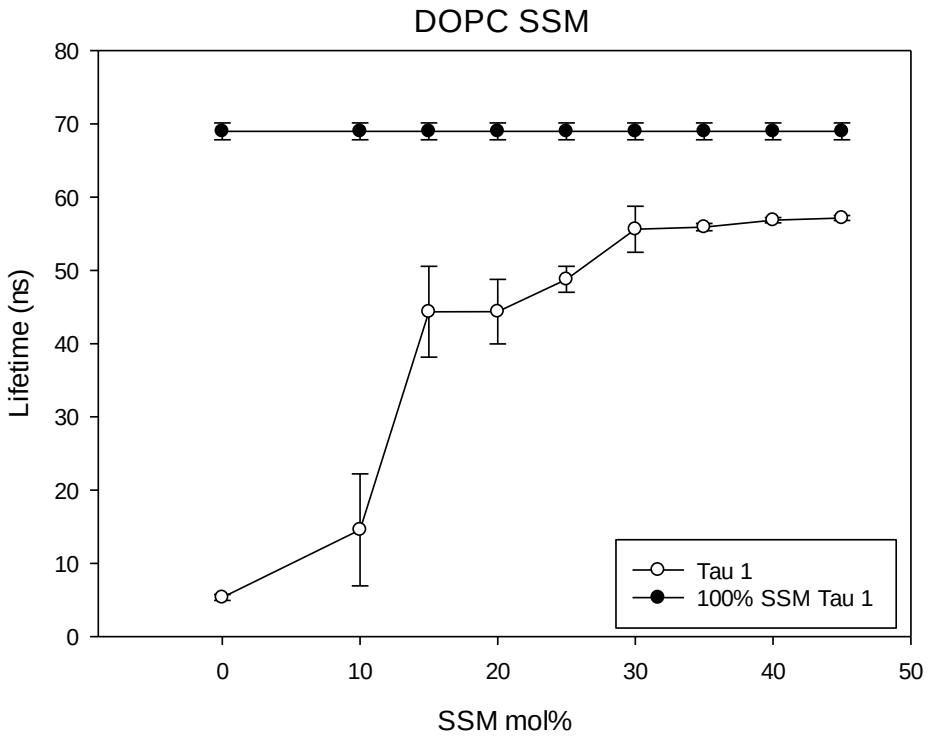
DOPC SSM
Lifetime (ns)
SSM mol%
Tau 1
100% SSM Tau 1
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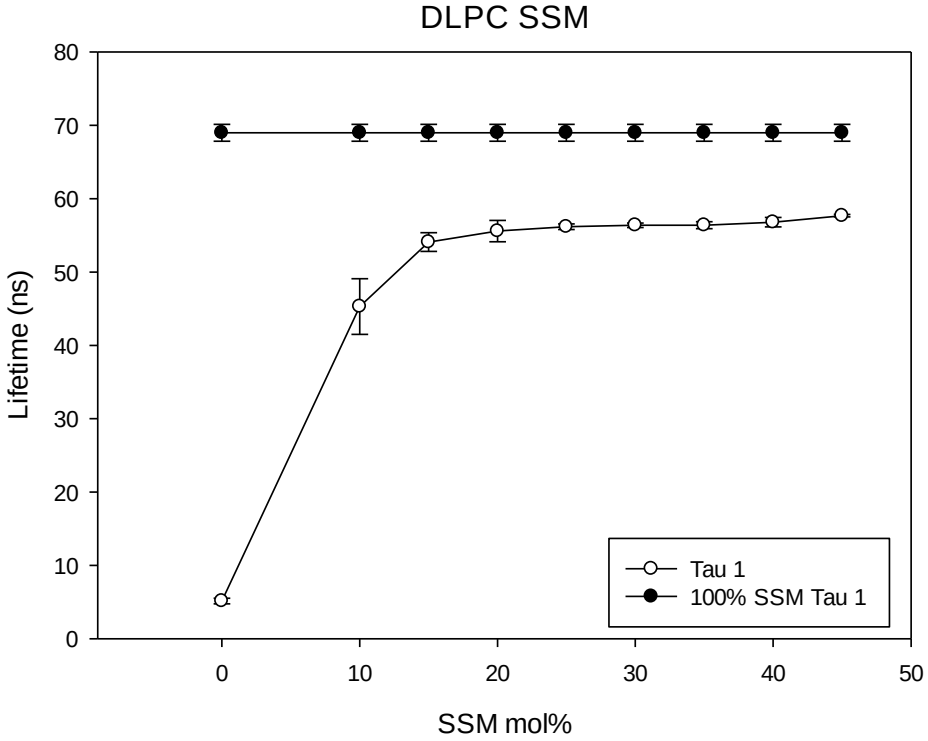
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Lifetime (ns)
SSM mol%
Tau 1
100% SSM Tau 1
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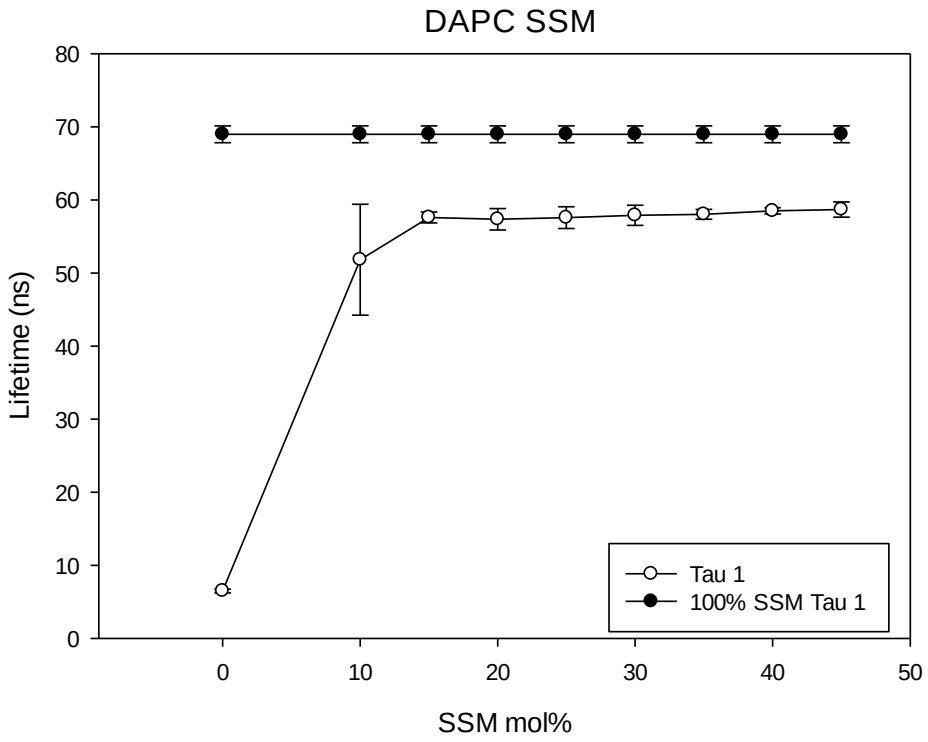
DAPC SSM
Lifetime (ns)
SSM mol%
Tau 1
100% SSM Tau 1
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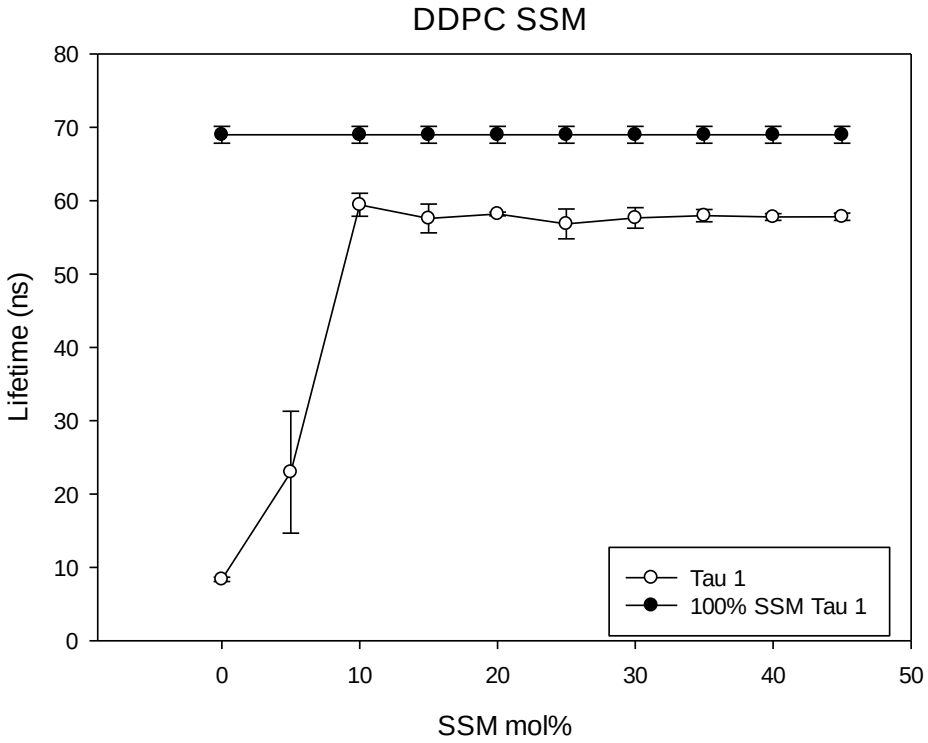
DDPC SSM
Lifetime (ns)
SSM mol%
Tau 1
100% SSM Tau 1
0
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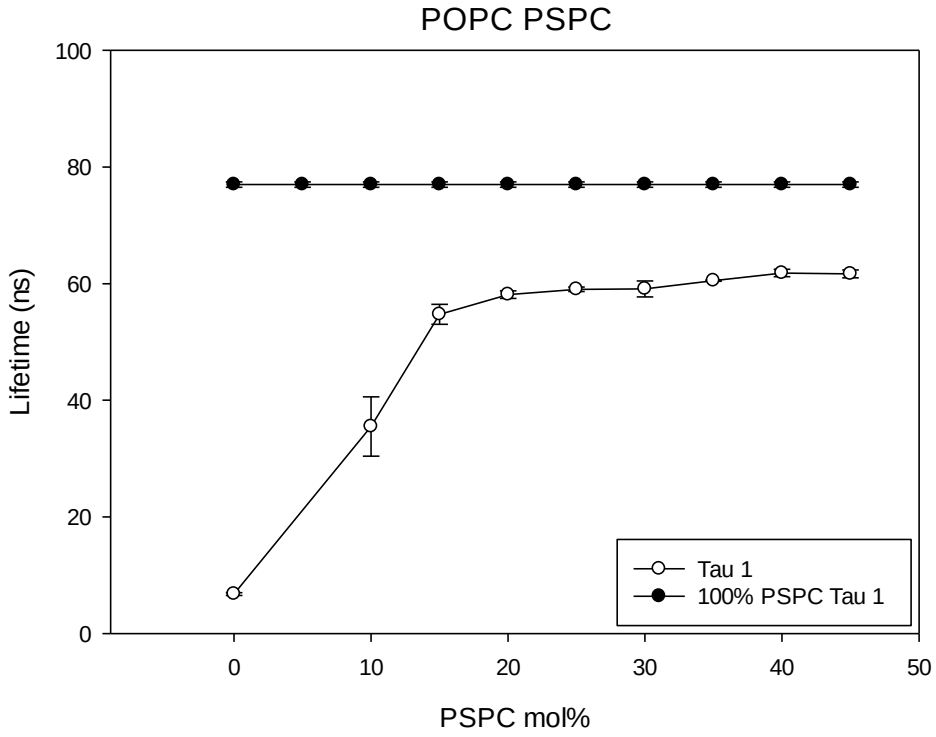
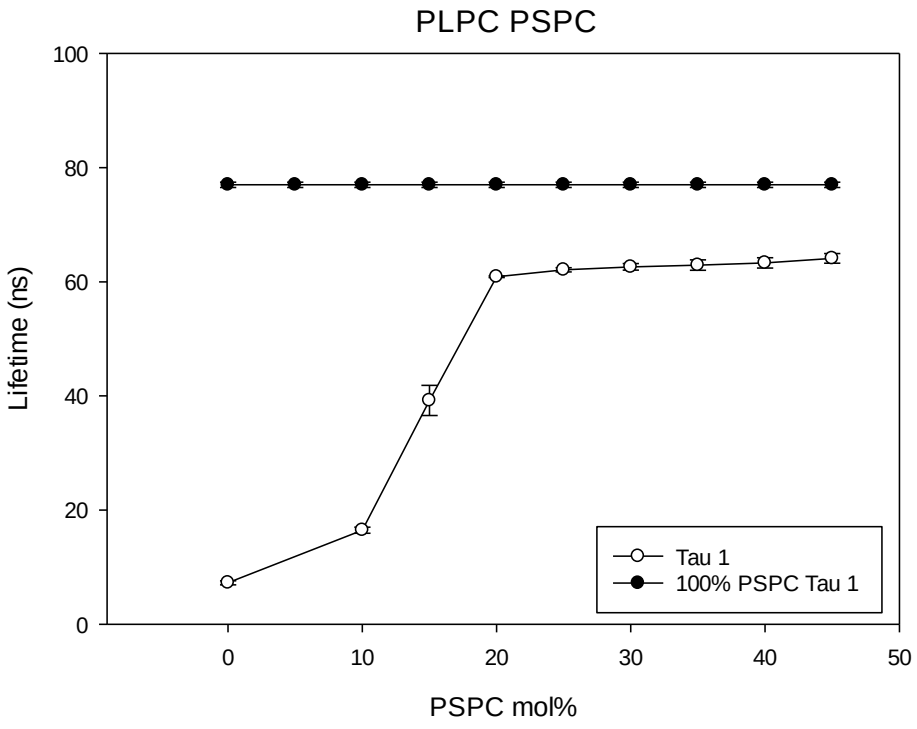
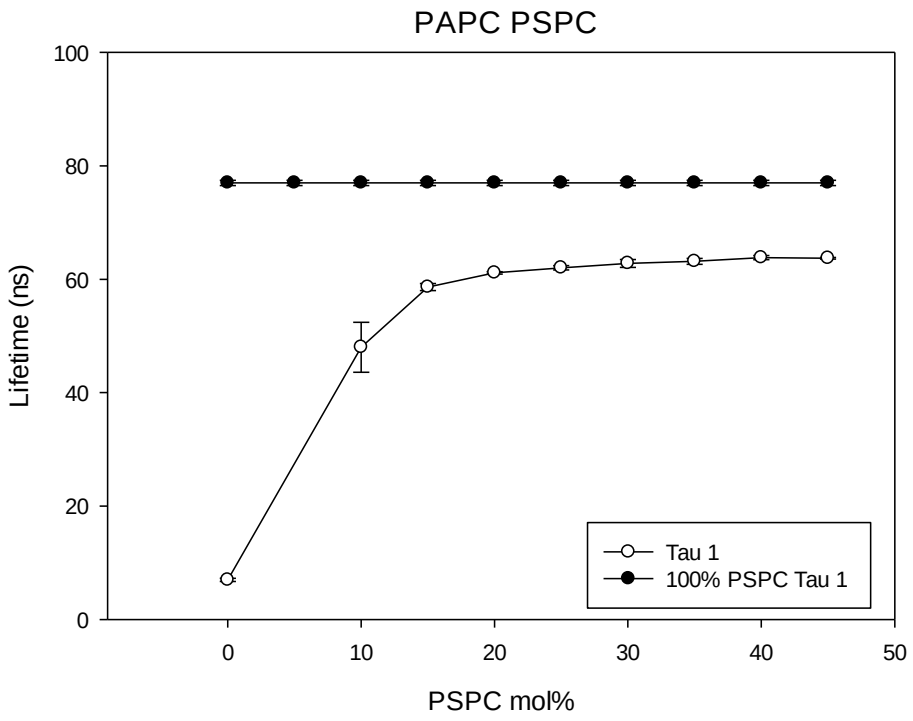
Figure S4. The longest lifetime component (τ_1) of tPA is given for pure PSPC (filled symbols), and for PSPC in unsaturated phosphatidylcholine bilayers (open symbols).






PAPC PSPC
Lifetime (ns)
PSPC mol%
Tau 1
100% PSPC Tau 1
0
20
40
60
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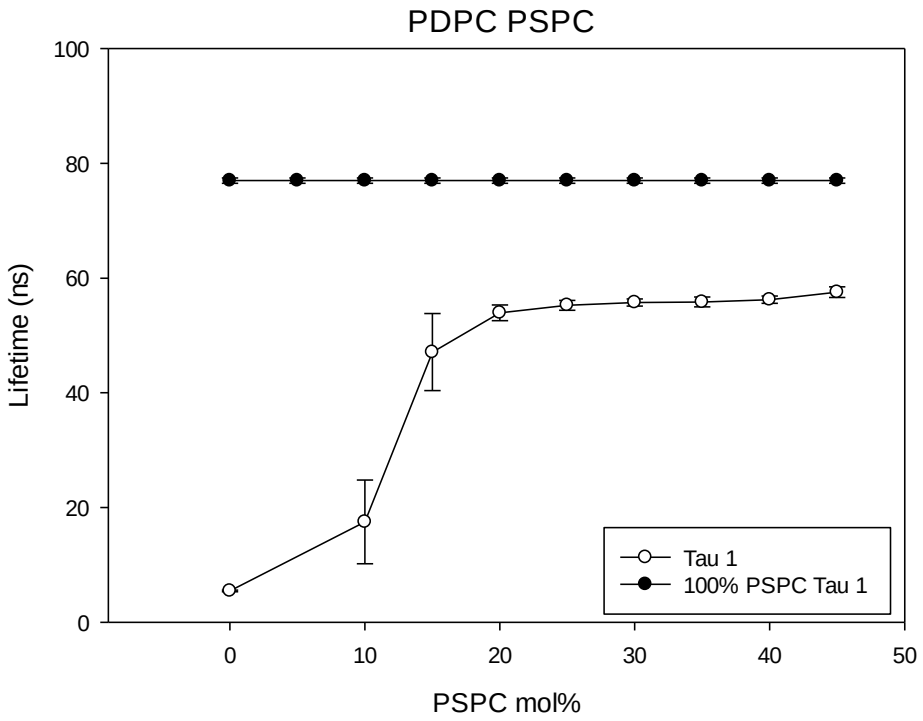
PDPC PSPC
Lifetime (ns)
PSPC mol%
Tau 1
100% PSPC Tau 1
0
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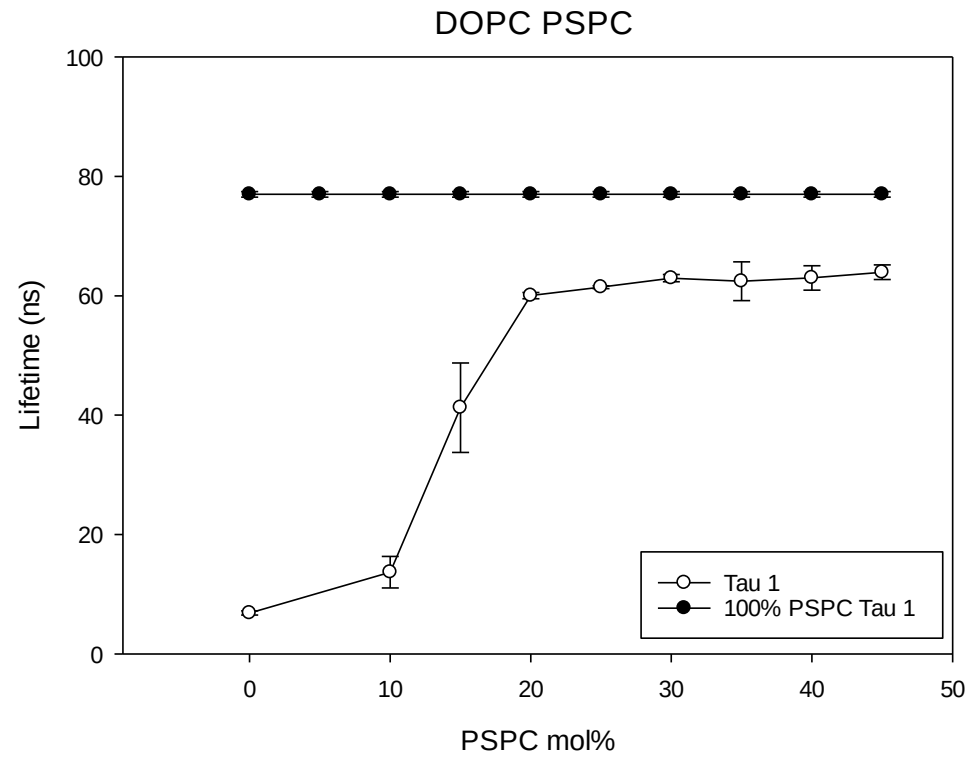
DOPC PSPC
Lifetime (ns)
PSPC mol%
Tau 1
100% PSPC Tau 1
0
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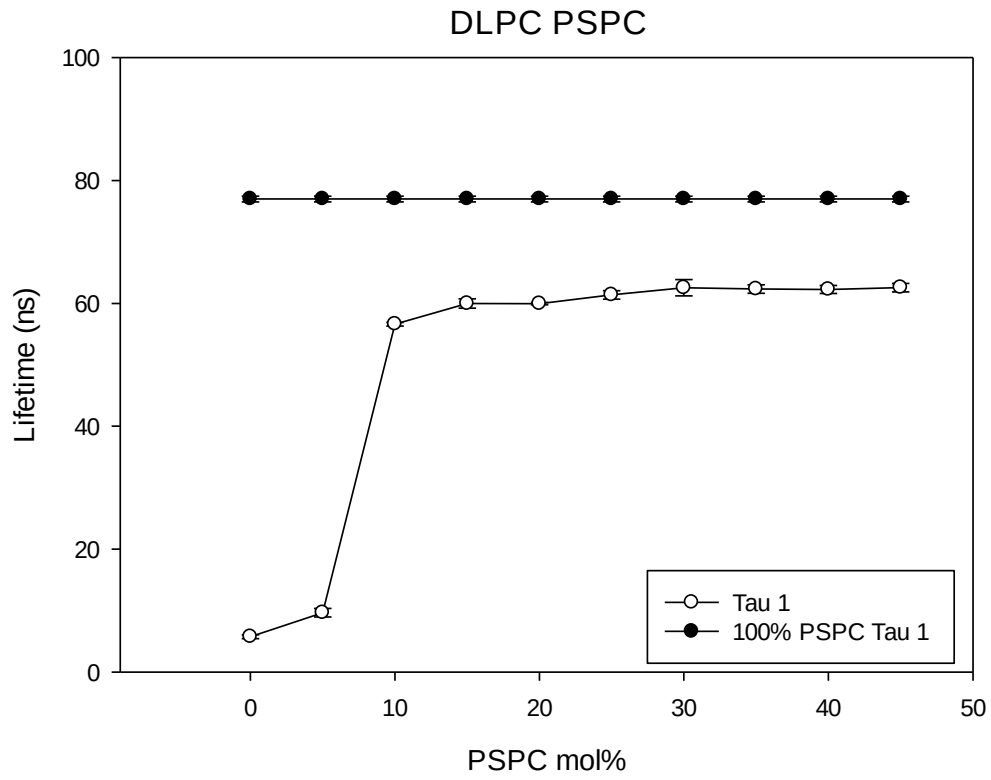
DLPC PSPC
Lifetime (ns)
PSPC mol%
Tau 1
100% PSPC Tau 1
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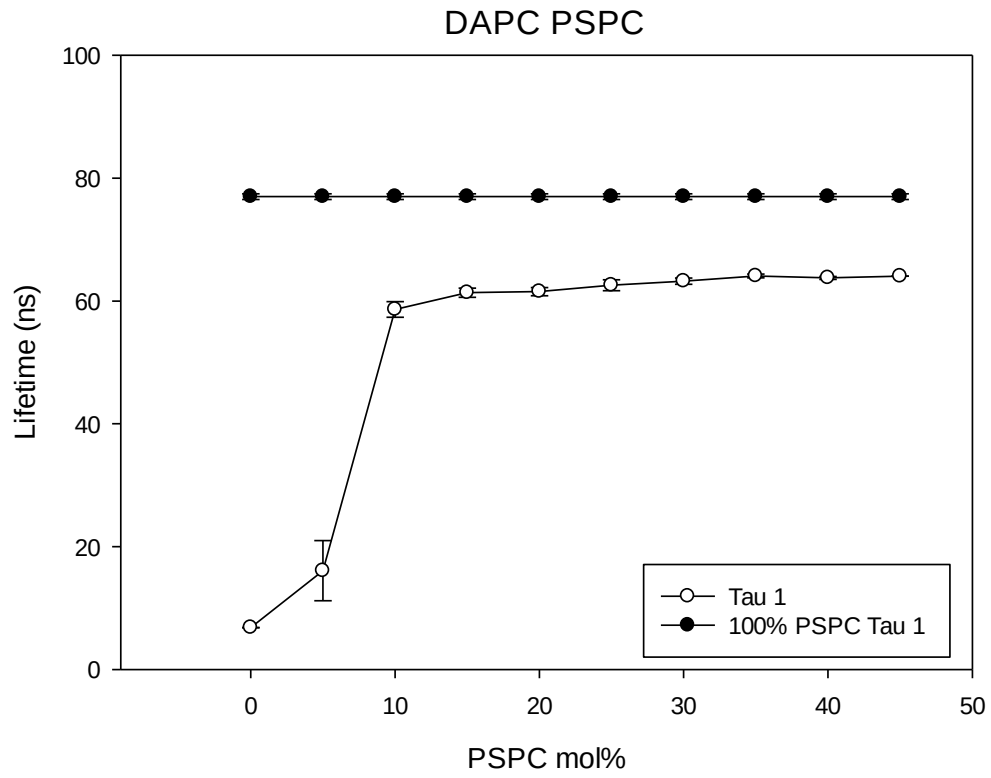
DAPC PSPC
Lifetime (ns)
PSPC mol%
Tau 1
100% PSPC Tau 1
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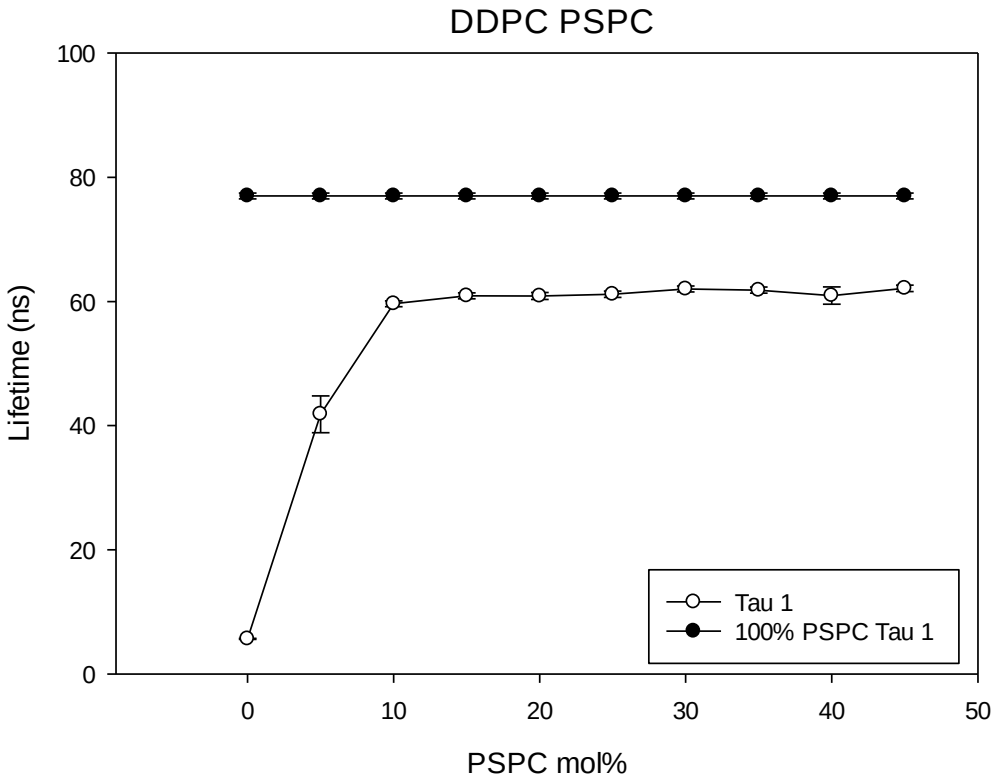
DDPC PSPC
Lifetime (ns)
PSPC mol%
Tau 1
100% PSPC Tau 1
0
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Table S1 Comparison of time-resolved fluorescence decays of tPA (1 mol%) in different bilayers at 23 ˚C

Sample	τ_1	f_1	α_1	τ_2	f_2	α_2	τ_3	f_3	α_3	τ_{AV}
POPC				6.5 ± 0.2	50.5 ± 3.5	34.5 ± 3.5	3.4 ± 0.0	49.5 ± 3.5	65.5 ± 3.5	5.0 ± 0.0
POPC/PSM (90:10)				6.9 ± 0.2	45.5 ± 3.5	30.5 ± 2.1	3.7 ± 0.1	54.5 ± 3.5	69.5 ± 2.1	5.2 ± 0.1
POPC/PSM (85:15)				7.8 ± 0.3	44.0 ± 1.4	27.5 ± 2.1	3.7 ± 0.1	56.0 ± 1.4	72.5 ± 2.1	5.5 ± 0.0
POPC/PSM (80:20)	13.4 ± 0.6	7.5 ± 0.7	2.5 ± 0.7	5.5 ± 0.0	82.5 ± 0.7	72.0 ± 1.4	1.9 ± 0.2	10.0 ± 1.4	25.0 ± 1.4	5.8 ± 0.1
POPC/PSM (75:25)	14.9 ± 3.5	10.0 ± 4.2	4.0 ± 2.8	6.1 ± 0.5	77.0 ± 0.0	66.5 ± 3.5	2.3 ± 0.4	13.0 ± 4.2	29.5 ± 6.4	6.4 ± 0.2
POPC/PSM (70:30)	16.1 ± 2.2	11.0 ± 1.4	4.0 ± 1.4	6.0 ± 0.0	78.0 ± 2.8	69.0 ± 1.4	2.1 ± 0.1	10.5 ± 0.7	27.0 ± 0.0	6.7 ± 0.1
POPC/PSM (65:35)	20.9 ± 4.7	13.0 ± 0.0	3.5 ± 0.7	6.8 ± 0.0	71.5 ± 0.7	62.0 ± 0.0	2.6 ± 0.1	15.5 ± 0.7	34.5 ± 0.7	7.9 ± 0.6
POPC/PSM (60:40)	26.4 ± 4.9	17.5 ± 0.7	4.5 ± 0.7	8.2 ± 0.6	60.0 ± 7.1	49.0 ± 8.5	3.2 ± 0.3	22.5 ± 6.4	46.5 ± 9.2	10.2 ± 1.1
POPC/PSM (55:45)	30.2 ± 1.8	22.5 ± 0.7	6.0 ± 0.0	9.6 ± 0.7	53.5 ± 0.7	43.5 ± 0.7	3.6 ± 0.2	24.0 ± 0.0	50.5 ± 0.7	12.9 ± 0.7
PLPC				7.4 ± 0.3	27.0 ± 2.8	15.0 ± 1.4	3.4 ± 0.1	72.5 ± 2.1	85.0 ± 1.4	4.5 ± 0.2
PLPC/PSM (90:10)				7.8 ± 0.2	26.0 ± 0.0	13.5 ± 0.7	3.5 ± 0.0	74.0 ± 0.0	86.5 ± 0.7	4.6 ± 0.0
PLPC/PSM (85:15)				7.3 ± 0.1	44.5 ± 4.9	27.0 ± 2.8	3.4 ± 0.2	55.5 ± 4.9	73.0 ± 2.8	5.2 ± 0.1
PLPC/PSM (80:20)	13.0 ± 0.8	7.5 ± 0.7	2.5 ± 0.7	5.0 ± 0.0	78.5 ± 2.1	67.5 ± 2.1	2.0 ± 0.0	13.5 ± 0.7	29.5 ± 2.1	5.2 ± 0.0
PLPC/PSM (75:25)	15.3 ± 0.2	8.5 ± 0.7	2.5 ± 0.7	5.3 ± 0.2	75.0 ± 0.0	61.0 ± 1.4	1.9 ± 0.4	16.5 ± 2.1	36.5 ± 0.7	5.6 ± 0.1
PLPC/PSM (70:30)	19.0 ± 1.0	8.0 ± 0.0	2.0 ± 0.0	6.1 ± 0.4	71.0 ± 1.4	57.0 ± 1.4	2.5 ± 0.2	21.0 ± 1.4	40.5 ± 2.1	6.4 ± 0.3
PLPC/PSM (65:35)	20.8 ± 3.5	10.5 ± 0.7	2.5 ± 0.7	6.2 ± 0.3	66.5 ± 4.9	53.5 ± 6.4	2.6 ± 0.1	23.0 ± 4.2	43.5 ± 6.4	7.0 ± 0.5
PLPC/PSM (60:40)	25.3 ± 0.6	17.0 ± 1.4	4.0 ± 0.0	7.6 ± 0.4	61.5 ± 0.7	50.0 ± 0.0	2.8 ± 0.1	21.0 ± 1.4	46.5 ± 0.7	9.6 ± 0.6
PLPC/PSM (55:45)	34.6 ± 0.9	24.0 ± 0.0	5.0 ± 0.0	10.5 ± 0.2	46.0 ± 1.4	32.0 ± 1.4	3.6 ± 0.1	30.0 ± 1.4	62.0 ± 1.4	14.3 ± 0.5
PAPC				5.6 ± 1.1	47.0 ± 15.6	26.5 ± 10.6	2.2 ± 0.5	53.0 ± 15.6	73.5 ± 10.6	3.7 ± 0.3
PAPC/PSM (90:10)				6.4 ± 0.1	42.0 ± 4.2	19.5 ± 2.1	2.2 ± 0.6	58.0 ± 4.2	80.5 ± 2.1	3.9 ± 0.3
PAPC/PSM (85:15)				6.8 ± 0.4	37.0 ± 1.4	19.5 ± 0.7	2.8 ± 0.1	63.0 ± 1.4	80.5 ± 0.7	4.3 ± 0.1
PAPC/PSM (80:20)	12.8 ± 0.5	7.5 ± 2.1	2.0 ± 0.0	4.4 ± 0.1	75.5 ± 3.5	57.5 ± 7.8	1.5 ± 0.3	17.0 ± 1.4	40.5 ± 7.8	4.5 ± 0.0
PAPC/PSM (75:25)	13.7 ± 0.6	8.0 ± 1.4	2.0 ± 0.0	4.6 ± 0.0	77.5 ± 0.7	61.5 ± 2.1	1.6 ± 0.2	15.5 ± 0.7	37.0 ± 1.4	4.9 ± 0.1
PAPC/PSM (70:30)	19.3 ± 2.5	8.0 ± 1.4	1.5 ± 0.7	5.4 ± 0.4	71.0 ± 1.4	52.5 ± 2.1	1.9 ± 0.6	36.5 ± 24.7	46.5 ± 2.1	5.7 ± 0.3
PAPC/PSM (65:35)	23.3 ± 7.0	10.5 ± 2.1	2.5 ± 0.7	6.2 ± 0.7	65.0 ± 4.2	48.0 ± 4.2	2.3 ± 0.6	24.5 ± 6.4	49.5 ± 4.9	7.0 ± 0.8
PAPC/PSM (60:40)	29.0 ± 1.4	16.0 ± 1.4	3.0 ± 0.0	7.4 ± 0.5	57.5 ± 3.5	42.5 ± 3.5	2.7 ± 0.5	26.5 ± 4.9	54.5 ± 3.5	9.6 ± 0.1
PAPC/PSM (55:45)	36.6 ± 1.6	29.5 ± 0.7	6.0 ± 0.0	9.8 ± 0.1	44.5 ± 0.7	18.0 ± 21.2	3.2 ± 0.2	26.5 ± 0.7	61.0 ± 0.0	15.9 ± 0.6
PDPC				6.0 ± 0.2	34.5 ± 0.7	17.5 ± 0.7	2.4 ± 0.2	65.5 ± 0.7	82.5 ± 0.7	3.6 ± 0.0
PDPC/PSM (90:10)				6.3 ± 0.0	36.5 ± 6.4	18.5 ± 2.1	2.4 ± 0.2	63.5 ± 6.4	81.5 ± 2.1	3.8 ± 0.1
PDPC/PSM (85:15)				6.7 ± 0.5	40.5 ± 2.1	20.5 ± 4.9	2.5 ± 0.3	59.5 ± 2.1	79.5 ± 4.9	4.2 ± 0.1
PDPC/PSM (80:20)	14.7 ± 5.5	10.0 ± 2.8	2.5 ± 2.1	4.3 ± 0.1	69.0 ± 5.7	49.0 ± 11.3	1.3 ± 0.1	21.0 ± 8.5	48.0 ± 12.7	4.6 ± 0.1
PDPC/PSM (75:25)	18.4 ± 7.8	9.5 ± 3.5	2.0 ± 1.4	4.7 ± 0.1	69.0 ± 2.8	51.0 ± 4.2	1.6 ± 0.2	21.5 ± 6.4	46.5 ± 6.4	5.2 ± 0.2
PDPC/PSM (70:30)	18.5 ± 4.6	13.0 ± 4.2	3.0 ± 1.4	5.0 ± 0.2	67.5 ± 0.7	49.5 ± 0.7	1.5 ± 0.3	19.5 ± 4.9	48.5 ± 2.1	5.9 ± 0.1
PDPC/PSM (65:35)	29.7 ± 1.1	18.5 ± 2.1	3.0 ± 0.0	6.9 ± 0.3	55.0 ± 2.8	38.0 ± 4.2	2.2 ± 0.2	26.5 ± 0.7	59.5 ± 3.5	9.8 ± 0.4
PDPC/PSM (60:40)	35.8 ± 1.1	35.5 ± 0.7	6.5 ± 0.7	8.5 ± 0.4	41.0 ± 1.4	31.0 ± 2.8	2.3 ± 0.1	23.5 ± 2.1	63.0 ± 2.8	16.8 ± 0.2
PDPC/PSM (55:45)	38.7 ± 0.9	49.0 ± 1.4	11.5 ± 0.7	10.9 ± 0.4	33.5 ± 2.1	28.5 ± 3.5	2.7 ± 0.1	17.5 ± 0.7	60.0 ± 2.8	23.0 ± 0.9

Each value is the average from at least two separate experiments ± SEM. τ, lifetimes (ns); f, fractional intensites (%);
α, fractional amplitudes (%); τAV, intensity-weighted average lifetimes (ns).

Table S2 Comparison of time-resolved fluorescence decays of tPA (1 mol%) in different bilayers at 23 ˚C

Sample	τ_1	f_1	α_1	τ_2	f_2	α_2	τ_3	f_3	α_3	τ_{AV}
DOPC				7.2 ± 1.8	31.5 ± 6.4	16.0 ± 0.0	2.9 ± 0.1	68.5 ± 6.4	84.0 ± 0.0	4.3 ± 0.8
DOPC/PSM (90:10)				8.0 ± 0.7	16.0 ± 2.8	7.5 ± 2.1	3.4 ± 0.1	84.0 ± 2.8	92.5 ± 2.1	4.1 ± 0.1
DOPC/PSM (85:15)				9.7 ± 0.9	15.0 ± 4.2	6.5 ± 2.1	3.6 ± 0.1	84.5 ± 3.5	93.5 ± 2.1	4.5 ± 0.0
DOPC/PSM (80:20)	25.3 ± 1.9	4.0 ± 0.0	1.0 ± 0.0	5.2 ± 0.0	70.0 ± 4.2	55.5 ± 3.5	2.4 ± 0.1	25.5 ± 3.5	44.0 ± 4.2	5.4 ± 0.0
DOPC/PSM (75:25)	16.9 ± 4.2	5.5 ± 0.7	1.5 ± 0.7	5.1 ± 0.5	77.0 ± 4.2	65.0 ± 7.1	2.1 ± 0.2	16.5 ± 4.9	33.5 ± 7.8	5.3 ± 0.4
DOPC/PSM (70:30)	24.7 ± 6.4	6.5 ± 0.7	1.5 ± 0.7	6.1 ± 0.4	66.0 ± 7.1	51.0 ± 8.5	2.7 ± 0.3	27.5 ± 7.8	47.5 ± 9.2	6.3 ± 0.3
DOPC/PSM (65:35)	22.6 ± 4.0	9.5 ± 0.7	2.0 ± 0.0	6.5 ± 0.8	64.0 ± 7.1	50.0 ± 8.5	2.8 ± 0.4	26.5 ± 6.4	48.0 ± 8.5	7.1 ± 0.8
DOPC/PSM (60:40)	35.8 ± 2.3	19.0 ± 8.5	3.5 ± 2.1	8.8 ± 0.4	47.5 ± 4.9	35.0 ± 1.4	3.5 ± 0.0	33.0 ± 2.8	62.0 ± 0.0	12.3 ± 3.0
DOPC/PSM (55:45)	41.2 ± 1.9	37.0 ± 9.9	8.5 ± 3.5	11.5 ± 0.9	36.5 ± 6.4	28.5 ± 2.1	3.8 ± 0.2	27.0 ± 4.2	63.5 ± 0.7	20.4 ± 4.4
DLPC				7.7 ± 1.0	20.5 ± 0.7	6.5 ± 0.7	2.0 ± 0.0	79.5 ± 0.7	93.5 ± 0.7	3.2 ± 0.2
DLPC/PSM (90:10)				7.7 ± 0.3	20.0 ± 1.4	6.5 ± 0.7	2.1 ± 0.0	80.0 ± 1.4	93.5 ± 0.7	3.2 ± 0.1
DLPC/PSM (85:15)				8.2 ± 0.2	20.5 ± 0.7	7.0 ± 0.0	2.3 ± 0.0	79.5 ± 0.7	93.0 ± 0.0	3.5 ± 0.0
DLPC/PSM (80:20)	21.9 ± 5.0	6.5 ± 0.7	1.0 ± 0.0	4.4 ± 0.2	47.5 ± 6.4	29.5 ± 4.9	1.8 ± 0.1	46.0 ± 5.7	69.5 ± 4.9	4.3 ± 0.5
DLPC/PSM (75:25)	25.7 ± 2.4	9.5 ± 3.5	1.0 ± 0.0	4.5 ± 0.2	52.0 ± 1.4	33.0 ± 1.4	1.7 ± 0.2	38.0 ± 1.4	66.0 ± 1.4	5.5 ± 0.7
DLPC/PSM (70:30)	40.0 ± 0.8	44.5 ± 0.7	6.0 ± 0.0	7.0 ± 0.4	28.5 ± 3.5	21.5 ± 3.5	2.0 ± 0.1	27.0 ± 2.8	72.5 ± 3.5	20.4 ± 0.1
DLPC/PSM (65:35)	41.4 ± 0.8	53.5 ± 2.1	10.0 ± 0.0	10.8 ± 1.2	23.0 ± 0.0	17.0 ± 2.8	2.5 ± 0.1	23.5 ± 2.1	73.0 ± 2.8	25.1 ± 0.9
DLPC/PSM (60:40)	43.2 ± 1.0	62.0 ± 1.4	16.5 ± 0.7	13.9 ± 0.2	22.5 ± 0.7	18.5 ± 0.7	2.7 ± 0.0	15.5 ± 0.7	65.0 ± 0.0	30.4 ± 1.0
DLPC/PSM (55:45)	43.3 ± 0.8	64.5 ± 3.5	20.5 ± 2.1	15.0 ± 0.3	23.5 ± 2.1	21.5 ± 0.7	2.8 ± 0.1	12.0 ± 1.4	58.0 ± 1.4	31.8 ± 1.7
DAPC				6.3 ± 0.1	23.5 ± 7.8	7.0 ± 0.0	2.0 ± 0.1	81.0 ± 1.4	93.0 ± 0.0	2.8 ± 0.1
DAPC/PSM (90:10)				8.4 ± 2.2	19.0 ± 2.8	6.5 ± 2.1	2.3 ± 0.0	81.0 ± 2.8	93.5 ± 2.1	3.4 ± 0.3
DAPC/PSM (85:15)				9.5 ± 2.8	17.5 ± 7.8	5.5 ± 3.5	2.2 ± 0.1	82.5 ± 7.8	94.5 ± 3.5	3.4 ± 0.0
DAPC/PSM (80:20)	38.5 ± 0.6	25.5 ± 13.4	2.0 ± 1.4	5.0 ± 0.1	34.0 ± 4.2	22.5 ± 2.1	1.8 ± 0.4	40.5 ± 9.2	75.0 ± 1.4	12.2 ± 4.4
DAPC/PSM (75:25)	39.1 ± 0.3	39.5 ± 0.7	4.5 ± 0.7	6.5 ± 0.4	26.0 ± 0.0	17.5 ± 0.7	2.0 ± 0.1	34.5 ± 0.7	78.0 ± 0.0	17.8 ± 0.0
DAPC/PSM (70:30)	42.4 ± 0.1	60.0 ± 1.4	12.5 ± 0.7	11.4 ± 1.4	20.5 ± 0.7	16.5 ± 0.7	2.4 ± 0.0	19.0 ± 1.4	71.0 ± 0.0	28.3 ± 0.6
DAPC/PSM (65:35)	42.5 ± 0.2	64.0 ± 0.0	17.5 ± 0.7	13.8 ± 0.2	22.0 ± 0.0	19.0 ± 0.0	2.5 ± 0.0	14.0 ± 0.0	64.0 ± 0.0	30.5 ± 0.0
DAPC/PSM (60:40)	43.1 ± 0.0	69.5 ± 2.1	23.5 ± 2.1	14.8 ± 0.1	22.0 ± 1.4	21.5 ± 0.7	2.3 ± 0.1	8.5 ± 0.7	54.5 ± 0.7	33.3 ± 0.8
DAPC/PSM (55:45)	44.1 ± 0.4	68.5 ± 0.7	28.0 ± 1.4	17.0 ± 0.6	24.0 ± 1.4	25.0 ± 1.4	2.9 ± 0.3	7.5 ± 0.7	47.5 ± 0.7	34.5 ± 0.7
DDPC				9.1 ± 1.1	21.5 ± 0.7	5.5 ± 0.7	1.8 ± 0.0	78.5 ± 0.7	94.5 ± 0.7	3.4 ± 0.1
DDPC/PSM (90:10)				17.2 ± 1.3	21.0 ± 4.2	3.0 ± 0.0	2.1 ± 0.3	79.0 ± 4.2	97.0 ± 0.0	5.3 ± 0.7
DDPC/PSM (85:15)				32.2 ± 3.8	44.0 ± 7.1	5.5 ± 0.7	2.3 ± 0.1	56.0 ± 7.1	94.5 ± 0.7	15.5 ± 3.7
DDPC/PSM (80:20)	38.1 ± 4.0	53.0 ± 0.0	6.5 ± 0.7	7.0 ± 0.4	21.5 ± 2.1	14.5 ± 0.7	1.6 ± 0.3	26.0 ± 1.4	78.5 ± 0.7	22.1 ± 2.4
DDPC/PSM (75:25)	41.2 ± 0.2	63.5 ± 0.7	15.5 ± 4.9	12.4 ± 3.8	22.0 ± 4.2	18.0 ± 2.8	2.0 ± 0.0	14.0 ± 5.7	67.0 ± 7.1	29.4 ± 1.9
DDPC/PSM (70:30)	41.8 ± 1.1	68.5 ± 6.4	23.5 ± 0.7	15.0 ± 1.1	23.5 ± 6.4	22.0 ± 5.7	2.1 ± 0.0	8.0 ± 1.4	54.5 ± 4.9	32.4 ± 1.9
DDPC/PSM (65:35)	42.8 ± 1.0	70.5 ± 3.5	25.0 ± 2.8	15.4 ± 0.1	22.0 ± 2.8	22.0 ± 1.4	2.2 ± 0.1	7.5 ± 0.7	53.5 ± 0.7	33.6 ± 1.8
DDPC/PSM (60:40)	42.8 ± 0.9	69.5 ± 4.9	26.5 ± 3.5	15.8 ± 0.2	23.5 ± 4.9	24.5 ± 2.1	2.3 ± 0.0	7.5 ± 0.7	49.5 ± 2.1	33.6 ± 2.1
DDPC/PSM (55:45)	43.6 ± 0.1	73.0 ± 2.8	31.5 ± 3.5	16.4 ± 0.2	21.5 ± 2.1	24.5 ± 0.7	2.3 ± 0.1	5.5 ± 0.7	44.5 ± 3.5	35.4 ± 0.9

Each value is the average from at least two separate experiments ± SEM. τ, lifetimes (ns); f, fractional intensites (%);
α, fractional amplitudes (%); τAV, intensity-weighted average lifetimes (ns).

Table S3 Comparison of time-resolved fluorescence decays of tPA (1 mol%) in different bilayers at 23 ˚C

Sample	τ_1	f_1	α_1	τ_2	f_2	α_2	τ_3	f_3	α_3	τ_{AV}
POPC				5.7 ± 0.1	47.0 ± 4.2	33.0 ± 2.8	3.2 ± 0.2	53.0 ± 4.2	67.0 ± 2.8	4.4 ± 0.0
POPC/DPPC (90:10)				6.2 ± 0.0	48.0 ± 1.4	33.0 ± 1.4	3.4 ± 0.0	52.0 ± 1.4	67.0 ± 1.4	4.7 ± 0.1
POPC/DPPC (85:15)				6.6 ± 0.1	47.0 ± 1.4	31.5 ± 0.7	3.5 ± 0.0	53.0 ± 1.4	68.5 ± 0.7	5.0 ± 0.1
POPC/DPPC (80:20)	15.2 ± 2.4	4.5 ± 0.7	1.5 ± 0.7	5.3 ± 0.1	83.0 ± 1.4	69.5 ± 0.7	1.9 ± 0.4	12.5 ± 0.7	29.0 ± 1.4	5.3 ± 0.0
POPC/DPPC (75:25)	17.6 ± 0.5	4.0 ± 0.0	1.0 ± 0.0	5.7 ± 0.0	79.0 ± 0.0	65.5 ± 0.7	2.4 ± 0.0	17.0 ± 0.0	33.5 ± 0.7	5.7 ± 0.1
POPC/DPPC (70:30)	34.0 ± 2.4	10.5 ± 3.5	1.5 ± 0.7	6.8 ± 0.4	62.0 ± 5.7	49.5 ± 4.9	3.0 ± 0.2	27.5 ± 2.1	49.0 ± 4.2	8.7 ± 1.3
POPC/DPPC (65:35)	42.1 ± 0.3	32.5 ± 0.7	6.0 ± 0.0	9.4 ± 0.4	34.5 ± 0.7	28.0 ± 1.4	3.8 ± 0.1	32.5 ± 0.7	66.0 ± 1.4	18.2 ± 0.3
POPC/DPPC (60:40)	45.5 ± 0.3	49.5 ± 2.1	12.0 ± 1.4	13.3 ± 0.7	24.5 ± 0.7	20.5 ± 0.7	4.1 ± 0.1	25.5 ± 0.7	68.0 ± 0.0	27.0 ± 0.9
POPC/DPPC (55:45)	46.7 ± 0.1	56.0 ± 1.4	16.5 ± 0.7	16.2 ± 0.4	23.0 ± 0.0	19.0 ± 0.0	4.3 ± 0.0	20.5 ± 0.7	65.0 ± 1.4	30.9 ± 0.4
PLPC				5.4 ± 0.2	43.5 ± 3.5	30.0 ± 2.8	3.0 ± 0.1	56.5 ± 3.5	70.0 ± 2.8	4.1 ± 0.1
PLPC/DPPC (90:10)				5.6 ± 0.0	47.5 ± 4.9	33.5 ± 4.9	3.1 ± 0.0	52.5 ± 4.9	66.5 ± 4.9	4.3 ± 0.1
PLPC/DPPC (85:15)				6.2 ± 0.5	41.5 ± 9.2	28.0 ± 8.5	3.3 ± 0.2	58.5 ± 9.2	72.0 ± 8.5	4.5 ± 0.0
PLPC/DPPC (80:20)	16.9 ± 4.8	4.0 ± 1.4	1.0 ± 0.0	4.8 ± 0.1	83.0 ± 2.8	70.5 ± 3.5	1.9 ± 0.3	14.0 ± 4.2	29.0 ± 4.2	4.8 ± 0.1
PLPC/DPPC (75:25)	27.4 ± 3.4	3.0 ± 0.0	0.0 ± 0.0	5.4 ± 0.1	73.0 ± 2.8	58.5 ± 2.1	2.6 ± 0.1	24.0 ± 2.8	41.0 ± 2.8	5.4 ± 0.3
PLPC/DPPC (70:30)	35.8 ± 1.5	9.0 ± 1.4	1.0 ± 0.0	5.9 ± 0.0	66.5 ± 0.7	54.5 ± 0.7	2.7 ± 0.0	24.5 ± 0.7	44.5 ± 0.7	7.8 ± 0.5
PLPC/DPPC (65:35)	42.7 ± 1.7	20.5 ± 3.5	2.5 ± 0.7	7.6 ± 0.6	38.5 ± 7.8	30.0 ± 7.1	3.5 ± 0.2	41.0 ± 4.2	67.5 ± 6.4	13.2 ± 1.7
PLPC/DPPC (60:40)	45.7 ± 0.2	40.5 ± 0.7	7.0 ± 0.0	9.0 ± 0.1	28.5 ± 0.7	24.5 ± 0.7	3.6 ± 0.0	31.0 ± 1.4	68.5 ± 0.7	22.2 ± 0.3
PLPC/DPPC (55:45)	46.9 ± 0.1	49.5 ± 0.7	10.5 ± 0.7	12.0 ± 0.3	22.0 ± 0.0	18.0 ± 0.0	3.9 ± 0.0	28.5 ± 0.7	72.0 ± 0.0	27.0 ± 0.5
PAPC				6.6 ± 0.5	20.0 ± 1.4	10.0 ± 1.4	2.9 ± 0.0	80.0 ± 1.4	90.0 ± 1.4	3.7 ± 0.0
PAPC/DPPC (90:10)				5.7 ± 0.0	36.0 ± 0.0	22.0 ± 0.0	2.9 ± 0.0	64.0 ± 0.0	78.0 ± 0.0	3.9 ± 0.0
PAPC/DPPC (85:15)				6.2 ± 0.6	32.5 ± 6.4	19.5 ± 4.9	3.1 ± 0.2	67.5 ± 6.4	80.5 ± 4.9	4.1 ± 0.1
PAPC/DPPC (80:20)	17.9 ± 4.8	3.0 ± 0.0	1.0 ± 0.0	4.8 ± 0.1	70.0 ± 1.4	55.0 ± 0.0	2.3 ± 0.1	27.0 ± 1.4	44.5 ± 0.7	4.5 ± 0.2
PAPC/DPPC (75:25)	20.2 ± 6.3	3.0 ± 0.0	1.0 ± 0.0	5.1 ± 0.2	69.5 ± 3.5	53.5 ± 4.9	2.4 ± 0.1	27.5 ± 3.5	46.0 ± 4.2	4.8 ± 0.3
PAPC/DPPC (70:30)	41.7 ± 3.3	19.5 ± 7.8	2.5 ± 0.7	6.7 ± 0.5	44.0 ± 9.9	34.0 ± 7.1	2.9 ± 0.2	36.0 ± 2.8	63.5 ± 6.4	12.2 ± 3.5
PAPC/DPPC (65:35)	46.2 ± 0.4	38.0 ± 2.8	5.5 ± 0.7	8.9 ± 0.3	26.0 ± 0.0	20.5 ± 0.7	3.3 ± 0.0	35.5 ± 2.1	74.0 ± 1.4	21.1 ± 1.1
PAPC/DPPC (60:40)	47.5 ± 0.5	52.0 ± 1.4	10.0 ± 0.0	11.1 ± 0.9	20.5 ± 2.1	17.0 ± 2.8	3.4 ± 0.2	27.0 ± 1.4	73.0 ± 1.4	28.0 ± 0.9
PAPC/DPPC (55:45)	48.6 ± 0.1	59.0 ± 1.4	13.5 ± 0.7	14.2 ± 0.7	19.0 ± 0.0	15.5 ± 0.7	3.5 ± 0.1	22.0 ± 1.4	71.0 ± 1.4	32.1 ± 0.6
PDPC				5.6 ± 0.2	30.0 ± 1.4	17.0 ± 0.0	2.7 ± 0.0	70.0 ± 1.4	83.0 ± 0.0	3.5 ± 0.1
PDPC/DPPC (90:10)				5.9 ± 0.5	34.0 ± 5.7	20.0 ± 4.2	2.8 ± 0.1	66.0 ± 5.7	80.0 ± 4.2	3.9 ± 0.0
PDPC/DPPC (85:15)				8.0 ± 0.1	20.0 ± 0.0	9.0 ± 0.0	3.2 ± 0.1	80.0 ± 0.0	91.0 ± 0.0	4.2 ± 0.1
PDPC/DPPC (80:20)	23.5 ± 0.8	3.0 ± 0.0	0.5 ± 0.7	4.8 ± 0.0	69.5 ± 2.1	52.5 ± 2.1	2.2 ± 0.1	28.0 ± 2.8	46.5 ± 2.1	4.7 ± 0.1
PDPC/DPPC (75:25)	28.6 ± 7.4	5.5 ± 3.5	0.5 ± 0.7	5.2 ± 0.0	67.5 ± 0.7	50.5 ± 0.7	2.2 ± 0.2	27.0 ± 2.8	49.0 ± 0.0	5.7 ± 1.2
PDPC/DPPC (70:30)	35.8 ± 7.7	15.0 ± 7.1	2.5 ± 0.7	6.5 ± 0.3	50.5 ± 6.4	38.0 ± 4.2	2.8 ± 0.0	34.5 ± 0.7	60.5 ± 3.5	9.9 ± 3.5
PDPC/DPPC (65:35)	41.1 ± 4.0	27.0 ± 7.1	4.0 ± 1.4	8.6 ± 1.0	35.0 ± 7.1	24.5 ± 4.9	3.2 ± 0.2	37.5 ± 0.7	71.5 ± 3.5	15.5 ± 3.9
PDPC/DPPC (60:40)	46.5 ± 0.3	47.0 ± 0.0	9.0 ± 0.0	10.8 ± 0.9	24.5 ± 0.7	19.5 ± 2.1	3.4 ± 0.1	28.0 ± 1.4	72.0 ± 1.4	25.6 ± 0.2
PDPC/DPPC (55:45)	48.2 ± 0.3	58.0 ± 1.4	13.5 ± 0.7	13.6 ± 0.3	20.5 ± 0.7	17.0 ± 1.4	3.5 ± 0.1	21.5 ± 0.7	69.5 ± 0.7	31.5 ± 0.5

Each value is the average from at least two separate experiments ± SEM. τ, lifetimes (ns); f, fractional intensites (%);
α, fractional amplitudes (%); τAV, intensity-weighted average lifetimes (ns).

Table S4 Comparison of time-resolved fluorescence decays of tPA (1 mol%) in different bilayers at 23 ˚C

Sample	τ_1	f_1	α_1	τ_2	f_2	α_2	τ_3	f_3	α_3	τ_{AV}
DOPC				5.4 ± 0.2	26.0 ± 5.7	15.0 ± 4.2	2.8 ± 0.1	74.0 ± 5.7	85.0 ± 4.2	3.4 ± 0.1
DOPC/DPPC (90:10)				5.8 ± 0.4	28.5 ± 2.1	17.5 ± 2.1	3.0 ± 0.1	71.5 ± 2.1	82.5 ± 2.1	3.8 ± 0.1
DOPC/DPPC (85:15)				7.2 ± 1.0	19.5 ± 6.4	10.0 ± 4.2	3.3 ± 0.2	80.5 ± 6.4	90.0 ± 4.2	4.0 ± 0.1
DOPC/DPPC (80:20)	30.2 ± 2.4	4.0 ± 0.0	0.0 ± 0.0	4.6 ± 0.2	69.5 ± 0.7	55.5 ± 0.7	2.3 ± 0.1	27.0 ± 0.0	43.5 ± 0.7	4.9 ± 0.3
DOPC/DPPC (75:25)	34.9 ± 1.8	6.0 ± 1.4	1.0 ± 0.0	4.8 ± 0.2	68.0 ± 8.5	55.5 ± 9.2	2.3 ± 0.2	26.0 ± 7.1	44.0 ± 8.5	6.0 ± 0.5
DOPC/DPPC (70:30)	44.2 ± 0.3	19.5 ± 0.7	2.0 ± 0.0	5.7 ± 0.2	46.0 ± 2.8	39.0 ± 4.2	2.7 ± 0.1	34.0 ± 2.8	59.0 ± 4.2	12.3 ± 0.3
DOPC/DPPC (65:35)	47.2 ± 0.5	45.0 ± 4.2	6.5 ± 0.7	7.8 ± 0.5	23.0 ± 1.4	21.5 ± 3.5	3.1 ± 0.2	32.0 ± 5.7	72.0 ± 4.2	23.9 ± 2.1
DOPC/DPPC (60:40)	49.3 ± 0.3	58.5 ± 3.5	12.5 ± 2.1	14.7 ± 1.3	15.0 ± 0.0	10.5 ± 0.7	3.6 ± 0.0	26.5 ± 3.5	77.0 ± 2.8	32.1 ± 2.2
DOPC/DPPC (55:45)	50.0 ± 1.3	61.5 ± 2.1	15.0 ± 1.4	17.0 ± 2.0	16.0 ± 0.0	11.5 ± 0.7	3.7 ± 0.1	22.5 ± 0.7	73.5 ± 0.7	34.4 ± 1.8
DLPC				5.1 ± 0.3	30.5 ± 2.1	13.0 ± 1.4	1.8 ± 0.0	69.5 ± 2.1	87.0 ± 1.4	2.8 ± 0.0
DLPC/DPPC (90:10)				5.5 ± 0.0	30.0 ± 1.4	13.0 ± 0.0	2.0 ± 0.1	70.0 ± 1.4	87.0 ± 0.0	3.0 ± 0.0
DLPC/DPPC (85:15)				5.8 ± 0.6	30.5 ± 6.4	13.5 ± 3.5	2.1 ± 0.2	69.5 ± 6.4	86.5 ± 3.5	3.2 ± 0.1
DLPC/DPPC (80:20)	16.4 ± 2.2	4.0 ± 0.0	1.0 ± 0.0	3.7 ± 0.2	63.0 ± 1.4	42.5 ± 0.7	1.5 ± 0.2	33.5 ± 2.1	57.0 ± 1.4	3.5 ± 0.2
DLPC/DPPC (75:25)	31.6 ± 7.4	7.5 ± 3.5	0.5 ± 0.7	4.1 ± 0.0	57.0 ± 4.2	37.0 ± 2.8	1.5 ± 0.0	36.0 ± 0.0	62.5 ± 2.1	5.3 ± 1.6
DLPC/DPPC (70:30)	45.2 ± 0.8	34.5 ± 0.7	3.0 ± 0.0	5.0 ± 0.2	34.0 ± 1.4	27.0 ± 2.8	1.8 ± 0.0	31.5 ± 2.1	70.0 ± 2.8	17.8 ± 0.8
DLPC/DPPC (65:35)	46.8 ± 0.3	52.0 ± 1.4	6.0 ± 0.0	6.2 ± 0.2	22.0 ± 1.4	20.0 ± 0.0	2.0 ± 0.1	26.5 ± 0.7	74.0 ± 0.0	26.1 ± 0.7
DLPC/DPPC (60:40)	47.2 ± 0.9	59.5 ± 2.1	8.5 ± 0.7	7.6 ± 0.6	17.0 ± 1.4	16.0 ± 1.4	2.1 ± 0.1	23.0 ± 0.0	75.5 ± 0.7	29.9 ± 1.4
DLPC/DPPC (55:45)	48.0 ± 0.6	65.5 ± 0.7	12.5 ± 0.7	11.4 ± 1.9	15.5 ± 0.7	12.5 ± 0.7	2.4 ± 0.1	19.5 ± 0.7	75.0 ± 0.0	33.5 ± 0.3
DAPC				6.7 ± 0.1	18.0 ± 0.0	6.5 ± 0.7	2.1 ± 0.0	82.0 ± 0.0	93.5 ± 0.7	3.0 ± 0.0
DAPC/DPPC (90:10)				13.2 ± 3.9	11.5 ± 2.1	3.0 ± 1.4	2.6 ± 0.0	88.5 ± 2.1	97.0 ± 1.4	3.8 ± 0.2
DAPC/DPPC (85:15)				18.7 ± 1.6	10.0 ± 0.0	2.0 ± 0.0	2.8 ± 0.0	90.0 ± 0.0	98.0 ± 0.0	4.3 ± 0.2
DAPC/DPPC (80:20)	33.4 ± 4.0	6.0 ± 1.4	1.0 ± 0.0	4.6 ± 0.1	42.0 ± 2.8	27.0 ± 1.4	2.1 ± 0.1	52.0 ± 1.4	73.0 ± 1.4	5.1 ± 0.6
DAPC/DPPC (75:25)	44.4 ± 2.9	13.5 ± 3.5	1.0 ± 0.0	5.1 ± 0.1	39.5 ± 0.7	26.5 ± 0.7	2.2 ± 0.0	47.0 ± 2.8	72.5 ± 0.7	9.1 ± 1.7
DAPC/DPPC (70:30)	53.4 ± 1.1	60.5 ± 0.7	9.0 ± 0.0	8.7 ± 0.9	13.5 ± 0.7	12.5 ± 2.1	2.6 ± 0.1	26.0 ± 1.4	79.0 ± 1.4	34.2 ± 1.1
DAPC/DPPC (65:35)	54.4 ± 0.6	76.0 ± 0.0	19.5 ± 0.7	13.8 ± 0.0	10.0 ± 0.0	10.0 ± 0.0	2.7 ± 0.1	14.0 ± 0.0	70.5 ± 0.7	43.2 ± 0.7
DAPC/DPPC (60:40)	54.8 ± 1.0	78.5 ± 0.7	22.5 ± 0.7	14.5 ± 1.3	10.0 ± 1.4	10.5 ± 0.7	2.7 ± 0.0	11.5 ± 0.7	67.0 ± 1.4	44.9 ± 0.8
DAPC/DPPC (55:45)	54.7 ± 0.3	81.0 ± 1.4	30.0 ± 2.8	17.5 ± 0.1	10.5 ± 0.7	12.0 ± 0.0	2.8 ± 0.0	8.0 ± 1.4	57.5 ± 2.1	46.6 ± 0.5
DDPC				7.2 ± 1.7	23.5 ± 2.1	7.0 ± 1.4	1.7 ± 0.2	76.5 ± 2.1	93.0 ± 1.4	3.0 ± 0.5
DDPC/DPPC (90:10)	21.1 ± 4.0	8.5 ± 2.1	1.0 ± 0.0	3.5 ± 0.1	51.0 ± 2.8	31.5 ± 4.9	1.3 ± 0.0	40.5 ± 4.9	67.5 ± 4.9	4.0 ± 0.1
DDPC/DPPC (85:15)	31.8 ± 2.7	11.5 ± 0.7	1.0 ± 0.0	4.0 ± 0.2	46.5 ± 2.1	27.5 ± 0.7	1.4 ± 0.1	42.0 ± 1.4	71.5 ± 0.7	6.1 ± 0.1
DDPC/DPPC (80:20)	51.1 ± 0.6	63.5 ± 3.5	6.5 ± 0.7	4.9 ± 0.4	17.5 ± 2.1	18.5 ± 2.1	1.4 ± 0.0	20.0 ± 1.4	75.0 ± 1.4	33.4 ± 1.3
DDPC/DPPC (75:25)	52.2 ± 1.1	77.5 ± 0.7	14.5 ± 0.7	8.0 ± 0.7	9.5 ± 0.7	11.5 ± 0.7	1.6 ± 0.0	13.0 ± 0.0	74.5 ± 0.7	41.5 ± 0.5
DDPC/DPPC (70:30)	52.3 ± 0.6	82.0 ± 0.0	20.5 ± 0.7	10.8 ± 0.6	9.0 ± 0.0	11.0 ± 0.0	1.8 ± 0.0	9.5 ± 0.7	69.0 ± 0.0	43.8 ± 0.4
DDPC/DPPC (65:35)	53.4 ± 1.1	82.5 ± 2.1	23.5 ± 2.1	13.5 ± 1.0	9.5 ± 0.7	10.5 ± 0.7	1.9 ± 0.0	8.0 ± 1.4	66.0 ± 1.4	45.5 ± 1.8
DDPC/DPPC (60:40)	51.7 ± 1.7	84.0 ± 0.0	30.0 ± 0.0	15.1 ± 1.2	10.0 ± 0.0	12.0 ± 0.0	1.9 ± 0.0	6.0 ± 0.0	58.0 ± 0.0	45.2 ± 1.7
DDPC/DPPC (55:45)	54.2 ± 0.1	85.0 ± 0.0	32.0 ± 2.8	16.5 ± 1.9	9.5 ± 0.7	12.0 ± 0.0	1.9 ± 0.0	5.5 ± 0.7	56.0 ± 2.8	47.7 ± 0.5

Each value is the average from at least two separate experiments ± SEM. τ, lifetimes (ns); f, fractional intensites (%);
α, fractional amplitudes (%); τAV, intensity-weighted average lifetimes (ns).

Table S5 Comparison of time-resolved fluorescence decays of tPA (1 mol%) in different bilayers at 23 ˚C

Sample	τ_1	f_1	α_1	τ_2	f_2	α_2	τ_3	f_3	α_3	τ_{AV}
POPC				6.9 ± 0.3	41.0 ± 5.7	25.0 ± 5.7	3.3 ± 0.4	59.0 ± 5.7	75.0 ± 5.7	4.8 ± 0.6
POPC/SSM (90:10)				8.1 ± 0.5	40.5 ± 2.1	24.0 ± 2.8	3.8 ± 0.6	59.5 ± 2.1	76.0 ± 2.8	5.5 ± 0.6
POPC/SSM (85:15)	38.3 ± 1.5	7.0 ± 0.0	1.0 ± 0.0	6.7 ± 0.7	70.5 ± 0.7	55.0 ± 2.8	2.7 ± 0.4	22.5 ± 0.7	44.0 ± 2.8	8.0 ± 0.8
POPC/SSM (80:20)	32.1 ± 3.8	8.5 ± 0.7	1.5 ± 0.7	7.3 ± 0.6	68.5 ± 3.5	53.5 ± 4.9	2.9 ± 0.3	23.0 ± 2.8	44.5 ± 4.9	8.5 ± 0.2
POPC/SSM (75:25)	42.7 ± 1.9	22.5 ± 2.1	4.0 ± 1.4	9.6 ± 0.4	49.5 ± 3.5	39.0 ± 5.7	3.6 ± 0.2	28.0 ± 5.7	57.5 ± 6.4	15.3 ± 0.7
POPC/SSM (70:30)	48.5 ± 0.6	52.5 ± 2.1	15.5 ± 0.7	15.0 ± 0.4	28.5 ± 0.7	26.5 ± 0.7	4.6 ± 0.2	19.0 ± 1.4	58.0 ± 1.4	30.6 ± 1.1
POPC/SSM (65:35)	49.4 ± 0.3	64.0 ± 0.0	24.0 ± 1.4	17.0 ± 0.6	24.0 ± 0.0	26.0 ± 1.4	4.4 ± 0.5	12.0 ± 0.0	50.5 ± 2.1	36.2 ± 0.3
POPC/SSM (60:40)	50.6 ± 0.7	72.5 ± 0.7	35.5 ± 0.7	19.4 ± 1.6	20.5 ± 0.7	26.0 ± 0.0	4.4 ± 0.6	6.5 ± 0.7	38.5 ± 0.7	41.0 ± 0.4
POPC/SSM (55:45)	52.1 ± 1.1	73.0 ± 0.0	41.0 ± 0.0	22.8 ± 1.3	21.0 ± 0.0	26.5 ± 0.7	5.2 ± 0.1	6.0 ± 0.0	32.5 ± 0.7	43.2 ± 1.0
PLPC				7.6 ± 1.2	27.0 ± 8.5	15.0 ± 7.1	3.5 ± 0.2	73.0 ± 8.5	85.0 ± 7.1	4.5 ± 0.1
PLPC/SSM (90:10)				9.1 ± 1.1	31.0 ± 1.4	16.5 ± 0.7	4.1 ± 0.5	69.0 ± 1.4	83.5 ± 0.7	5.6 ± 0.7
PLPC/SSM (85:15)	42.6 ± 6.4	9.0 ± 2.8	1.0 ± 0.0	6.5 ± 0.1	62.5 ± 0.7	48.0 ± 0.0	2.8 ± 0.1	28.5 ± 2.1	51.0 ± 0.0	8.9 ± 1.7
PLPC/SSM (80:20)	46.1 ± 0.9	14.5 ± 0.7	2.0 ± 0.0	7.7 ± 0.1	53.5 ± 0.7	40.5 ± 0.7	3.2 ± 0.0	31.5 ± 0.7	57.5 ± 0.7	12.0 ± 0.5
PLPC/SSM (75:25)	46.2 ± 2.3	35.0 ± 10.1	6.7 ± 2.5	9.9 ± 0.6	40.7 ± 6.8	34.7 ± 3.2	3.6 ± 0.3	24.3 ± 3.5	58.7 ± 2.3	21.2 ± 4.8
PLPC/SSM (70:30)	48.4 ± 0.5	54.0 ± 2.8	15.0 ± 0.0	13.6 ± 1.3	28.5 ± 2.1	27.5 ± 0.7	4.1 ± 0.5	17.5 ± 0.7	57.5 ± 0.7	30.8 ± 1.0
PLPC/SSM (65:35)	48.7 ± 0.2	65.5 ± 2.1	24.5 ± 0.7	15.7 ± 0.4	23.5 ± 2.1	27.0 ± 1.4	4.0 ± 0.4	10.5 ± 0.7	48.5 ± 0.7	36.1 ± 0.9
PLPC/SSM (60:40)	50.8 ± 0.9	73.0 ± 0.0	35.0 ± 1.4	18.8 ± 0.9	20.5 ± 0.7	26.0 ± 0.0	4.2 ± 0.5	7.0 ± 0.0	39.0 ± 1.4	41.2 ± 1.0
PLPC/SSM (55:45)	52.0 ± 0.7	76.5 ± 0.7	42.0 ± 1.4	21.0 ± 1.1	18.5 ± 0.7	25.5 ± 0.7	4.3 ± 0.4	5.0 ± 0.0	32.5 ± 0.7	43.9 ± 0.9
PAPC				7.6 ± 1.9	20.5 ± 7.8	10.5 ± 6.4	3.2 ± 0.1	79.5 ± 7.8	89.5 ± 6.4	4.0 ± 0.1
PAPC/SSM (90:10)	28.1 ± 2.6	4.0 ± 0.0	1.0 ± 0.0	4.9 ± 0.0	68.0 ± 1.4	52.0 ± 0.0	2.2 ± 0.2	28.0 ± 1.4	47.5 ± 0.7	5.2 ± 0.2
PAPC/SSM (85:15)	38.0 ± 1.2	7.5 ± 0.7	1.0 ± 0.0	5.6 ± 0.2	63.5 ± 3.5	48.0 ± 4.2	2.4 ± 0.1	29.5 ± 3.5	51.0 ± 4.2	7.0 ± 0.5
PAPC/SSM (80:20)	46.5 ± 2.7	16.5 ± 2.1	2.0 ± 0.0	6.8 ± 0.3	48.0 ± 4.2	36.0 ± 2.8	2.9 ± 0.2	35.5 ± 2.1	62.5 ± 2.1	12.0 ± 1.6
PAPC/SSM (75:25)	48.7 ± 2.0	45.0 ± 7.1	7.5 ± 2.1	9.4 ± 1.1	28.5 ± 6.4	25.0 ± 4.2	3.3 ± 0.3	27.0 ± 1.4	67.5 ± 2.1	25.4 ± 4.1
PAPC/SSM (70:30)	49.9 ± 0.8	63.5 ± 0.7	17.0 ± 0.0	13.2 ± 1.3	20.0 ± 0.0	21.0 ± 1.4	3.5 ± 0.3	16.5 ± 0.7	62.5 ± 0.7	35.0 ± 0.6
PAPC/SSM (65:35)	52.8 ± 4.8	73.3 ± 3.5	30.3 ± 9.3	17.4 ± 4.1	18.7 ± 0.6	23.3 ± 3.2	3.6 ± 0.7	8.0 ± 3.6	46.3 ± 12.4	38.9 ± 0.4
PAPC/SSM (60:40)	51.3 ± 0.6	76.0 ± 1.4	35.0 ± 0.0	18.9 ± 0.8	18.0 ± 1.4	22.5 ± 0.7	3.7 ± 0.2	6.5 ± 0.7	42.5 ± 0.7	42.4 ± 0.8
PAPC/SSM (55:45)	52.0 ± 0.6	79.0 ± 2.8	41.5 ± 0.7	18.9 ± 2.1	16.5 ± 2.1	23.0 ± 1.4	3.4 ± 0.7	4.5 ± 0.7	35.5 ± 2.1	44.5 ± 1.1
PDPC				6.0 ± 0.2	32.0 ± 2.8	16.5 ± 0.7	2.6 ± 0.1	68.0 ± 2.8	83.5 ± 0.7	3.7 ± 0.1
PDPC/SSM (90:10)	30.6 ± 10.3	5.5 ± 2.1	1.0 ± 0.0	4.8 ± 0.1	64.0 ± 2.8	46.0 ± 2.8	2.0 ± 0.0	30.5 ± 0.7	53.0 ± 2.8	5.6 ± 1.1
PDPC/SSM (85:15)	51.1 ± 5.1	15.5 ± 3.5	1.5 ± 0.7	6.5 ± 0.8	47.0 ± 2.8	33.0 ± 4.2	2.6 ± 0.5	37.5 ± 6.4	65.0 ± 4.2	11.9 ± 0.6
PDPC/SSM (80:20)	44.1 ± 2.2	21.5 ± 0.7	2.5 ± 0.7	7.0 ± 0.1	45.0 ± 1.4	32.5 ± 0.7	2.6 ± 0.2	33.5 ± 2.1	65.0 ± 1.4	13.4 ± 0.0
PDPC/SSM (75:25)	48.4 ± 0.5	60.5 ± 4.9	13.5 ± 2.1	10.9 ± 0.2	22.0 ± 1.4	21.0 ± 0.0	2.8 ± 0.2	18.0 ± 2.8	65.5 ± 2.1	32.2 ± 2.3
PDPC/SSM (70:30)	49.1 ± 0.7	70.5 ± 3.5	22.5 ± 2.1	14.2 ± 0.4	19.0 ± 1.4	21.0 ± 0.0	2.9 ± 0.3	10.5 ± 2.1	56.5 ± 2.1	37.6 ± 1.9
PDPC/SSM (65:35)	50.2 ± 0.4	75.0 ± 0.0	32.0 ± 1.4	17.5 ± 0.7	18.0 ± 0.0	21.5 ± 0.7	3.2 ± 0.1	7.0 ± 0.0	46.5 ± 2.1	41.0 ± 0.1
PDPC/SSM (60:40)	51.2 ± 0.7	78.0 ± 1.4	38.0 ± 0.0	18.2 ± 1.5	17.0 ± 1.4	23.5 ± 0.7	3.1 ± 0.2	5.0 ± 0.0	38.5 ± 0.7	43.3 ± 0.9
PDPC/SSM (55:45)	52.1 ± 0.7	79.5 ± 0.7	43.5 ± 0.7	20.3 ± 0.5	17.0 ± 0.0	24.0 ± 0.0	3.3 ± 0.2	4.0 ± 0.0	33.0 ± 1.4	44.8 ± 0.4

Each value is the average from at least two separate experiments ± SEM. τ, lifetimes (ns); f, fractional intensites (%);
α, fractional amplitudes (%); τAV, intensity-weighted average lifetimes (ns).

Table S6 Comparison of time-resolved fluorescence decays of tPA (1 mol%) in different bilayers at 23 ˚C

Sample	τ_1	f_1	α_1	τ_2	f_2	α_2	τ_3	f_3	α_3	τ_{AV}
DOPC				5.6 ± 0.1	21.0 ± 1.4	12.0 ± 1.4	2.8 ± 0.0	79.0 ± 1.4	88.0 ± 1.4	3.4 ± 0.0
DOPC/SSM (90:10)	17.6 ± 7.9	3.5 ± 0.7	0.5 ± 0.7	4.6 ± 0.5	69.5 ± 10.6	55.5 ± 12.0	2.2 ± 0.4	27.0 ± 11.3	44.0 ± 12.7	4.4 ± 0.3
DOPC/SSM (85:15)	39.6 ± 1.5	5.0 ± 0.0	1.0 ± 0.0	5.7 ± 0.1	57.0 ± 0.0	40.5 ± 0.7	2.7 ± 0.0	38.5 ± 0.7	59.0 ± 0.0	6.2 ± 0.2
DOPC/SSM (80:20)	46.9 ± 0.2	8.5 ± 0.7	1.0 ± 0.0	6.9 ± 0.2	52.0 ± 0.0	35.0 ± 0.0	2.9 ± 0.1	40.0 ± 0.0	64.0 ± 0.0	8.7 ± 0.1
DOPC/SSM (75:25)	49.7 ± 1.0	16.0 ± 1.4	2.0 ± 0.0	8.7 ± 0.2	45.0 ± 1.4	30.5 ± 0.7	3.4 ± 0.1	39.0 ± 1.4	67.5 ± 0.7	13.2 ± 1.1
DOPC/SSM (70:30)	53.8 ± 0.3	44.5 ± 0.7	8.0 ± 0.0	11.8 ± 0.2	28.0 ± 0.0	22.5 ± 0.7	3.7 ± 0.0	27.5 ± 0.7	69.5 ± 0.7	28.3 ± 0.2
DOPC/SSM (65:35)	55.7 ± 0.4	63.0 ± 0.0	17.5 ± 0.7	15.2 ± 0.6	21.5 ± 0.7	21.5 ± 0.7	3.9 ± 0.1	15.5 ± 0.7	60.5 ± 0.7	39.1 ± 0.4
DOPC/SSM (60:40)	56.7 ± 0.1	70.5 ± 0.7	25.5 ± 0.7	17.9 ± 0.1	19.5 ± 0.7	23.0 ± 0.0	4.0 ± 0.1	10.0 ± 0.0	52.0 ± 1.4	43.7 ± 0.3
DOPC/SSM (55:45)	57.3 ± 0.2	75.0 ± 0.0	33.0 ± 0.0	19.4 ± 0.6	18.0 ± 0.0	24.0 ± 0.0	4.1 ± 0.1	7.0 ± 0.0	43.0 ± 0.0	46.7 ± 0.1
DLPC				4.9 ± 0.0	29.0 ± 0.0	12.5 ± 0.7	1.7 ± 0.0	71.0 ± 0.0	87.5 ± 0.7	2.7 ± 0.0
DLPC/SSM (90:10)	47.3 ± 2.3	9.5 ± 0.7	1.0 ± 0.0	4.2 ± 0.2	47.0 ± 2.8	29.0 ± 2.8	1.6 ± 0.0	43.5 ± 2.1	70.5 ± 3.5	7.1 ± 0.6
DLPC/SSM (85:15)	52.9 ± 0.2	20.5 ± 0.7	1.0 ± 0.0	4.6 ± 0.4	44.0 ± 2.8	30.0 ± 2.8	1.6 ± 0.2	35.0 ± 2.8	68.5 ± 2.1	13.6 ± 0.4
DLPC/SSM (80:20)	56.2 ± 1.3	49.5 ± 3.5	5.0 ± 0.0	6.3 ± 0.6	24.5 ± 0.7	21.5 ± 2.1	1.9 ± 0.2	26.0 ± 2.8	73.5 ± 2.1	30.1 ± 2.4
DLPC/SSM (75:25)	56.4 ± 0.2	65.0 ± 1.4	11.0 ± 1.4	10.3 ± 0.7	16.5 ± 0.7	15.0 ± 0.0	2.3 ± 0.1	18.5 ± 0.7	74.5 ± 0.7	38.8 ± 1.1
DLPC/SSM (70:30)	56.2 ± 0.0	72.0 ± 0.0	16.0 ± 0.0	12.5 ± 0.4	15.5 ± 0.7	16.0 ± 0.0	2.3 ± 0.0	12.5 ± 0.7	68.0 ± 0.0	42.7 ± 0.2
DLPC/SSM (65:35)	56.2 ± 0.4	74.5 ± 0.7	20.0 ± 1.4	13.7 ± 0.6	15.5 ± 0.7	17.0 ± 0.0	2.3 ± 0.1	10.0 ± 0.0	63.0 ± 1.4	44.2 ± 0.2
DLPC/SSM (60:40)	56.5 ± 0.4	77.5 ± 0.7	25.0 ± 1.4	14.9 ± 0.2	15.0 ± 0.0	18.5 ± 0.7	2.3 ± 0.0	7.5 ± 0.7	56.5 ± 2.1	46.2 ± 0.2
DLPC/SSM (55:45)	57.8 ± 0.2	79.5 ± 0.7	29.0 ± 1.4	16.2 ± 1.0	15.0 ± 1.4	19.5 ± 0.7	2.4 ± 0.1	6.0 ± 0.0	51.5 ± 2.1	48.3 ± 0.3
DAPC				6.5 ± 0.3	18.0 ± 5.7	6.5 ± 2.1	2.0 ± 0.0	82.0 ± 5.7	93.5 ± 2.1	2.8 ± 0.3
DAPC/SSM (90:10)	46.4 ± 0.1	9.0 ± 0.0	1.0 ± 0.0	4.4 ± 0.3	41.5 ± 4.9	26.0 ± 4.2	1.8 ± 0.1	49.0 ± 5.7	73.0 ± 4.2	7.1 ± 0.0
DAPC/SSM (85:15)	57.6 ± 0.7	52.0 ± 5.7	5.5 ± 2.1	7.3 ± 1.8	19.0 ± 5.7	16.0 ± 5.7	2.2 ± 0.2	29.5 ± 0.7	78.5 ± 4.9	31.8 ± 2.9
DAPC/SSM (80:20)	57.4 ± 1.5	69.5 ± 0.7	14.0 ± 0.0	13.0 ± 0.4	13.5 ± 0.7	12.0 ± 1.4	2.6 ± 0.1	17.0 ± 0.0	74.5 ± 0.7	42.1 ± 1.6
DAPC/SSM (75:25)	57.6 ± 1.5	77.5 ± 0.7	23.0 ± 1.4	15.3 ± 1.3	13.5 ± 0.7	15.0 ± 1.4	2.6 ± 0.1	9.5 ± 0.7	62.0 ± 0.0	46.7 ± 1.7
DAPC/SSM (70:30)	57.9 ± 1.4	78.5 ± 0.7	28.5 ± 0.7	17.2 ± 0.2	14.5 ± 0.7	18.5 ± 0.7	2.7 ± 0.1	7.0 ± 0.0	53.0 ± 0.0	48.2 ± 1.5
DAPC/SSM (65:35)	58.0 ± 0.7	79.0 ± 0.0	33.0 ± 1.4	18.4 ± 0.7	15.5 ± 0.7	20.5 ± 0.7	2.8 ± 0.2	5.0 ± 0.0	46.5 ± 0.7	48.9 ± 0.9
DAPC/SSM (60:40)	58.5 ± 0.4	80.0 ± 0.0	37.0 ± 1.4	18.7 ± 0.8	16.0 ± 0.0	22.5 ± 0.7	2.8 ± 0.1	4.0 ± 0.0	40.5 ± 0.7	49.9 ± 0.5
DAPC/SSM (55:45)	58.7 ± 1.0	81.0 ± 0.0	40.5 ± 0.7	19.4 ± 0.7	15.5 ± 0.7	24.0 ± 0.0	3.0 ± 0.3	4.0 ± 0.0	36.0 ± 1.4	50.6 ± 1.0
DDPC				8.5 ± 0.3	21.0 ± 1.4	5.5 ± 0.7	1.9 ± 0.0	79.0 ± 1.4	94.5 ± 0.7	3.3 ± 0.1
DDPC/SSM (95:5)	18.3 ± 2.5	10.5 ± 2.1	1.0 ± 0.0	3.4 ± 0.4	47.5 ± 6.4	28.5 ± 4.9	1.2 ± 0.3	42.5 ± 9.2	70.5 ± 4.9	4.0 ± 0.1
DDPC/SSM (90:10)	60.3 ± 0.6	71.0 ± 1.4	8.5 ± 0.7	6.3 ± 0.9	11.5 ± 0.7	14.0 ± 2.8	1.7 ± 0.0	17.0 ± 1.4	77.0 ± 4.2	44.0 ± 1.1
DDPC/SSM (85:15)	58.6 ± 1.0	82.5 ± 3.5	19.5 ± 3.5	11.0 ± 0.3	9.5 ± 2.1	11.5 ± 0.7	1.7 ± 0.0	9.0 ± 1.4	69.0 ± 2.8	49.3 ± 2.6
DDPC/SSM (80:20)	58.3 ± 0.1	83.5 ± 0.7	26.0 ± 1.4	14.5 ± 0.2	10.0 ± 0.0	13.0 ± 0.0	1.9 ± 0.1	6.5 ± 0.7	61.0 ± 1.4	50.2 ± 0.3
DDPC/SSM (75:25)	55.9 ± 1.8	86.0 ± 2.8	31.0 ± 4.2	14.0 ± 0.0	9.0 ± 1.4	13.5 ± 0.7	1.7 ± 0.0	4.5 ± 0.7	56.0 ± 4.2	49.4 ± 0.5
DDPC/SSM (70:30)	56.9 ± 0.9	85.0 ± 1.4	32.0 ± 2.8	14.7 ± 0.2	11.0 ± 1.4	15.5 ± 0.7	1.8 ± 0.1	4.5 ± 0.7	52.0 ± 1.4	50.0 ± 0.0
DDPC/SSM (65:35)	58.4 ± 0.6	85.5 ± 2.1	36.5 ± 2.1	16.4 ± 0.3	11.0 ± 1.4	16.5 ± 0.7	1.9 ± 0.1	3.5 ± 0.7	47.5 ± 0.7	51.7 ± 1.3
DDPC/SSM (60:40)	58.0 ± 0.2	85.0 ± 0.0	39.0 ± 0.0	17.1 ± 0.3	11.5 ± 0.7	18.0 ± 1.4	2.0 ± 0.0	3.0 ± 0.0	44.0 ± 1.4	51.5 ± 0.4
DDPC/SSM (55:45)	58.0 ± 0.5	86.0 ± 0.0	40.5 ± 2.1	17.3 ± 1.1	11.0 ± 0.0	17.0 ± 0.0	2.0 ± 0.2	3.0 ± 0.0	42.5 ± 2.1	51.7 ± 0.5

Each value is the average from at least two separate experiments ± SEM. τ, lifetimes (ns); f, fractional intensites (%);
α, fractional amplitudes (%); τAV, intensity-weighted average lifetimes (ns).

Table S7 Comparison of time-resolved fluorescence decays of tPA (1 mol%) in different bilayers at 23 ˚C

Sample	τ_1	f_1	α_1	τ_2	f_2	α_2	τ_3	f_3	α_3	τ_{AV}
POPC				6.7 ± 0.1	53.0 ± 1.4	37.0 ± 1.4	3.4 ± 0.0	47.0 ± 1.4	63.0 ± 1.4	5.1 ± 0.0
POPC/PSPC (90:10)	35.5 ± 5.1	5.0 ± 1.4	1.0 ± 0.0	6.4 ± 0.2	74.5 ± 0.7	59.5 ± 0.7	2.7 ± 0.0	20.0 ± 0.0	39.5 ± 0.7	7.1 ± 0.3
POPC/PSPC (85:15)	54.1 ± 1.9	21.5 ± 3.5	2.5 ± 0.7	7.2 ± 0.2	57.5 ± 4.9	51.5 ± 3.5	3.0 ± 0.2	21.0 ± 1.4	46.0 ± 2.8	16.3 ± 2.3
POPC/PSPC (80:20)	58.1 ± 0.9	58.5 ± 0.7	12.0 ± 0.0	8.9 ± 0.1	25.0 ± 0.0	33.0 ± 1.4	3.4 ± 0.1	16.5 ± 0.7	56.0 ± 1.4	36.8 ± 0.9
POPC/PSPC (75:25)	58.9 ± 0.4	69.5 ± 0.7	19.0 ± 0.0	11.4 ± 0.4	16.0 ± 0.0	22.0 ± 1.4	3.9 ± 0.1	14.5 ± 0.7	59.0 ± 1.4	43.4 ± 0.1
POPC/PSPC (70:30)	59.9 ± 0.3	75.0 ± 0.0	24.0 ± 0.0	15.0 ± 0.1	12.5 ± 0.7	16.0 ± 0.0	4.2 ± 0.0	13.0 ± 0.0	59.5 ± 0.7	47.2 ± 0.3
POPC/PSPC (65:35)	60.5 ± 0.0	78.0 ± 0.0	29.0 ± 1.4	16.1 ± 0.5	12.0 ± 0.0	16.5 ± 0.7	4.1 ± 0.0	10.0 ± 0.0	54.5 ± 0.7	49.5 ± 0.4
POPC/PSPC (60:40)	62.2 ± 0.4	78.5 ± 0.7	31.5 ± 0.7	18.7 ± 0.4	12.0 ± 0.0	16.0 ± 0.0	4.3 ± 0.0	9.5 ± 0.7	53.0 ± 1.4	51.6 ± 0.1
POPC/PSPC (55:45)	61.4 ± 0.5	82.5 ± 0.7	37.5 ± 0.7	18.8 ± 1.3	10.5 ± 0.7	16.0 ± 0.0	4.0 ± 0.3	6.5 ± 0.7	45.5 ± 0.7	52.5 ± 0.7
PLPC				7.5 ± 0.1	24.0 ± 1.4	13.5 ± 0.7	3.6 ± 0.0	76.0 ± 1.4	86.5 ± 0.7	4.5 ± 0.0
PLPC/PSPC (90:10)	16.5 ± 0.5	3.3 ± 0.6	1.0 ± 0.0	5.2 ± 0.2	78.7 ± 2.9	65.0 ± 3.5	2.2 ± 0.2	18.0 ± 3.5	34.3 ± 3.8	5.1 ± 0.0
PLPC/PSPC (85:15)	38.5 ± 3.3	4.5 ± 0.7	1.0 ± 0.0	5.9 ± 0.0	70.5 ± 0.7	55.0 ± 0.0	2.7 ± 0.0	26.0 ± 0.0	44.0 ± 0.0	6.5 ± 0.4
PLPC/PSPC (80:20)	60.9 ± 0.2	49.5 ± 2.1	7.0 ± 0.0	7.7 ± 0.4	26.5 ± 2.1	29.5 ± 4.9	3.4 ± 0.2	24.5 ± 4.9	63.0 ± 5.7	32.8 ± 1.3
PLPC/PSPC (75:25)	62.3 ± 0.2	61.5 ± 0.7	11.5 ± 0.7	9.1 ± 0.5	17.5 ± 2.1	22.0 ± 2.8	3.6 ± 0.1	20.5 ± 0.7	66.5 ± 2.1	40.9 ± 0.3
PLPC/PSPC (70:30)	62.5 ± 0.8	73.0 ± 1.4	19.0 ± 1.4	11.9 ± 0.1	11.0 ± 0.0	14.5 ± 0.7	3.8 ± 0.1	16.0 ± 1.4	66.5 ± 2.1	47.6 ± 0.3
PLPC/PSPC (65:35)	62.6 ± 1.0	78.0 ± 1.4	24.0 ± 1.4	14.3 ± 0.2	9.5 ± 0.7	12.5 ± 0.7	4.0 ± 0.0	13.0 ± 1.4	63.5 ± 2.1	50.5 ± 0.0
PLPC/PSPC (60:40)	63.7 ± 0.8	80.0 ± 0.0	28.5 ± 0.7	18.4 ± 0.5	9.0 ± 0.0	11.5 ± 0.7	4.1 ± 0.1	11.0 ± 0.0	60.5 ± 0.7	53.0 ± 0.4
PLPC/PSPC (55:45)	64.4 ± 1.0	81.0 ± 0.0	31.5 ± 0.7	20.1 ± 0.6	9.5 ± 0.7	12.0 ± 0.0	4.2 ± 0.0	9.5 ± 0.7	56.5 ± 0.7	54.5 ± 0.6
PAPC				6.8 ± 0.2	25.5 ± 0.7	13.5 ± 0.7	3.2 ± 0.1	74.5 ± 0.7	86.5 ± 0.7	4.1 ± 0.0
PAPC/PSPC (90:10)	45.5 ± 1.1	8.0 ± 0.0	1.0 ± 0.0	5.2 ± 0.1	62.5 ± 0.7	49.0 ± 1.4	2.4 ± 0.1	29.5 ± 0.7	50.5 ± 2.1	7.6 ± 0.0
PAPC/PSPC (85:15)	58.3 ± 0.6	32.5 ± 2.1	3.0 ± 0.0	6.1 ± 0.2	37.0 ± 4.2	34.5 ± 3.5	2.8 ± 0.1	30.5 ± 2.1	62.5 ± 3.5	22.2 ± 1.3
PAPC/PSPC (80:20)	61.3 ± 0.1	58.5 ± 2.1	9.5 ± 0.7	9.4 ± 0.9	15.0 ± 2.8	15.5 ± 3.5	3.4 ± 0.1	26.5 ± 0.7	76.0 ± 2.8	38.2 ± 1.0
PAPC/PSPC (75:25)	61.9 ± 0.5	70.5 ± 0.7	15.0 ± 0.0	11.6 ± 0.2	10.5 ± 0.7	42.5 ± 43.1	3.4 ± 0.0	19.0 ± 0.0	72.5 ± 0.7	45.4 ± 0.1
PAPC/PSPC (70:30)	62.6 ± 0.8	76.0 ± 0.0	20.5 ± 0.7	15.1 ± 3.1	9.5 ± 0.7	11.0 ± 1.4	3.5 ± 0.2	14.0 ± 0.0	68.5 ± 0.7	49.6 ± 1.1
PAPC/PSPC (65:35)	63.0 ± 0.5	78.5 ± 0.7	25.0 ± 1.4	16.9 ± 0.6	9.0 ± 0.0	11.0 ± 0.0	3.6 ± 0.0	11.5 ± 0.7	65.0 ± 1.4	51.6 ± 0.1
PAPC/PSPC (60:40)	63.9 ± 0.5	82.0 ± 0.0	31.0 ± 1.4	18.5 ± 1.3	9.0 ± 0.0	12.0 ± 0.0	3.6 ± 0.1	8.5 ± 0.7	57.0 ± 1.4	54.4 ± 0.8
PAPC/PSPC (55:45)	63.8 ± 0.1	83.0 ± 0.0	33.5 ± 0.7	19.9 ± 1.0	9.5 ± 0.7	12.0 ± 0.0	3.7 ± 0.0	8.0 ± 0.0	54.5 ± 0.7	54.9 ± 0.1
PDPC				5.4 ± 0.2	43.5 ± 2.1	14.5 ± 0.7	1.2 ± 0.0	56.5 ± 2.1	85.5 ± 0.7	3.0 ± 0.0
PDPC/PSPC (90:10)	13.6 ± 4.2	12.0 ± 2.8	1.5 ± 0.7	3.3 ± 0.3	48.5 ± 0.7	22.5 ± 0.7	0.8 ± 0.0	39.5 ± 2.1	76.5 ± 2.1	3.5 ± 0.3
PDPC/PSPC (85:15)	50.9 ± 1.8	30.5 ± 4.9	1.5 ± 0.7	4.2 ± 0.2	36.0 ± 2.8	19.0 ± 0.0	0.9 ± 0.0	33.5 ± 2.1	80.0 ± 0.0	17.5 ± 2.9
PDPC/PSPC (80:20)	54.8 ± 0.0	54.5 ± 2.1	3.5 ± 0.7	4.4 ± 0.4	23.5 ± 0.7	18.0 ± 1.4	0.9 ± 0.1	21.5 ± 2.1	78.5 ± 2.1	31.1 ± 1.4
PDPC/PSPC (75:25)	55.3 ± 0.9	64.5 ± 10.6	5.0 ± 2.8	4.7 ± 0.4	18.5 ± 4.9	17.5 ± 0.7	0.9 ± 0.1	17.0 ± 5.7	77.5 ± 3.5	36.6 ± 6.3
PDPC/PSPC (70:30)	55.5 ± 0.7	77.5 ± 0.7	10.0 ± 0.0	5.5 ± 0.5	12.0 ± 0.0	16.5 ± 0.7	1.0 ± 0.1	10.5 ± 0.7	73.5 ± 0.7	43.7 ± 0.1
PDPC/PSPC (65:35)	56.3 ± 0.1	81.5 ± 2.1	13.0 ± 2.8	6.1 ± 1.1	9.5 ± 0.7	15.0 ± 1.4	1.1 ± 0.1	8.5 ± 0.7	72.0 ± 1.4	46.8 ± 1.0
PDPC/PSPC (60:40)	56.3 ± 0.9	87.0 ± 1.4	21.5 ± 3.5	8.0 ± 0.7	7.5 ± 0.7	13.0 ± 0.0	1.2 ± 0.0	6.0 ± 1.4	65.5 ± 3.5	49.5 ± 1.6
PDPC/PSPC (55:45)	57.1 ± 0.8	87.5 ± 0.7	22.0 ± 1.4	7.9 ± 0.4	7.0 ± 0.0	12.5 ± 0.7	1.1 ± 0.0	5.5 ± 0.7	65.5 ± 0.7	50.7 ± 0.2

Each value is the average from at least two separate experiments ± SEM. τ, lifetimes (ns); f, fractional intensites (%);
α, fractional amplitudes (%); τAV, intensity-weighted average lifetimes (ns).

Table S8 Comparison of time-resolved fluorescence decays of tPA (1 mol%) in different bilayers at 23 ˚C

Sample	τ_1	f_1	α_1	τ_2	f_2	α_2	τ_3	f_3	α_3	τ_{AV}
DOPC				6.7 ± 0.1	21.0 ± 0.0	11.0 ± 0.0	3.1 ± 0.0	79.0 ± 0.0	89.0 ± 0.0	3.8 ± 0.0
DOPC/PSPC (90:10)	15.2 ± 0.8	4.0 ± 0.0	1.0 ± 0.0	4.3 ± 0.0	79.0 ± 2.8	66.0 ± 2.8	1.9 ± 0.1	17.0 ± 2.8	33.0 ± 2.8	4.3 ± 0.0
DOPC/PSPC (85:15)	45.3 ± 3.8	7.0 ± 1.4	1.0 ± 0.0	5.0 ± 0.1	64.0 ± 2.8	51.5 ± 2.1	2.4 ± 0.1	29.0 ± 1.4	48.0 ± 1.4	7.1 ± 1.0
DOPC/PSPC (80:20)	60.3 ± 0.1	65.0 ± 1.4	11.0 ± 1.4	7.8 ± 1.3	13.0 ± 4.2	18.0 ± 7.1	3.1 ± 0.3	22.0 ± 2.8	71.5 ± 6.4	40.8 ± 1.0
DOPC/PSPC (75:25)	61.4 ± 0.3	74.0 ± 1.4	16.0 ± 1.4	8.6 ± 0.9	10.5 ± 2.1	16.0 ± 4.2	3.1 ± 0.2	16.0 ± 1.4	68.0 ± 2.8	46.7 ± 0.5
DOPC/PSPC (70:30)	63.3 ± 0.1	78.5 ± 0.7	20.0 ± 1.4	12.3 ± 0.8	7.5 ± 0.7	9.5 ± 0.7	3.3 ± 0.0	14.5 ± 0.7	70.0 ± 0.0	50.9 ± 0.5
DOPC/PSPC (65:35)	64.3 ± 0.3	81.5 ± 0.7	25.5 ± 0.7	16.8 ± 1.3	7.0 ± 0.0	8.5 ± 0.7	3.5 ± 0.1	11.5 ± 0.7	65.5 ± 0.7	54.0 ± 0.0
DOPC/PSPC (60:40)	62.0 ± 1.6	88.0 ± 1.4	42.0 ± 5.7	19.1 ± 1.7	6.0 ± 0.0	9.0 ± 0.0	3.6 ± 0.1	6.0 ± 1.4	49.0 ± 5.7	55.9 ± 0.5
DOPC/PSPC (55:45)	64.5 ± 1.0	86.0 ± 1.4	35.5 ± 3.5	19.4 ± 0.2	7.5 ± 0.7	10.0 ± 0.0	3.5 ± 0.1	7.5 ± 0.7	54.5 ± 3.5	56.9 ± 0.1
DLPC				5.6 ± 0.1	27.5 ± 0.7	10.5 ± 0.7	1.7 ± 0.0	72.5 ± 0.7	89.5 ± 0.7	2.8 ± 0.0
DLPC/PSPC (95:5)	9.3 ± 0.3	6.5 ± 0.7	1.5 ± 0.7	2.9 ± 0.0	65.5 ± 2.1	47.5 ± 2.1	1.1 ± 0.0	27.5 ± 2.1	51.0 ± 2.8	2.8 ± 0.1
DLPC/PSPC (90:10)	56.6 ± 0.3	29.5 ± 3.5	2.0 ± 0.0	4.0 ± 0.1	36.0 ± 1.4	28.5 ± 0.7	1.5 ± 0.1	34.5 ± 2.1	70.5 ± 0.7	18.8 ± 1.5
DLPC/PSPC (85:15)	60.4 ± 0.5	59.5 ± 3.5	5.5 ± 0.7	5.2 ± 0.4	17.0 ± 0.0	18.5 ± 2.1	1.8 ± 0.0	23.5 ± 3.5	75.5 ± 3.5	37.2 ± 1.9
DLPC/PSPC (80:20)	60.1 ± 0.0	73.5 ± 2.1	10.5 ± 0.7	5.6 ± 0.5	11.5 ± 2.1	17.5 ± 3.5	1.7 ± 0.1	15.0 ± 0.0	72.5 ± 2.1	45.2 ± 1.2
DLPC/PSPC (75:25)	61.5 ± 1.0	78.0 ± 1.4	13.0 ± 0.0	6.7 ± 0.5	9.0 ± 0.0	14.0 ± 1.4	1.8 ± 0.1	13.0 ± 1.4	73.0 ± 1.4	48.8 ± 1.3
DLPC/PSPC (70:30)	61.8 ± 0.0	83.0 ± 0.0	18.0 ± 1.4	8.7 ± 2.5	7.5 ± 0.7	11.5 ± 3.5	1.9 ± 0.1	10.0 ± 0.0	70.0 ± 2.8	51.8 ± 0.1
DLPC/PSPC (65:35)	62.1 ± 0.7	85.5 ± 2.1	22.0 ± 0.0	9.0 ± 3.3	6.5 ± 0.7	12.5 ± 3.5	1.9 ± 0.2	8.0 ± 1.4	66.0 ± 4.2	53.9 ± 0.0
DLPC/PSPC (60:40)	62.2 ± 0.9	87.0 ± 1.4	24.5 ± 0.7	9.2 ± 3.9	6.5 ± 0.7	13.0 ± 4.2	1.9 ± 0.2	6.5 ± 0.7	62.5 ± 3.5	54.7 ± 0.4
DLPC/PSPC (55:45)	62.2 ± 0.1	87.5 ± 0.7	26.0 ± 1.4	9.4 ± 4.1	6.0 ± 0.0	13.5 ± 4.9	1.8 ± 0.2	6.0 ± 0.0	60.0 ± 2.8	55.3 ± 0.1
DAPC				6.8 ± 0.0	19.5 ± 2.1	6.5 ± 0.7	2.1 ± 0.0	80.5 ± 2.1	93.5 ± 0.7	3.0 ± 0.0
DAPC/PSPC (95:5)	14.2 ± 5.2	30.0 ± 35.4	11.0 ± 14.1	6.9 ± 5.2	57.0 ± 2.8	30.0 ± 12.7	1.8 ± 0.7	41.0 ± 5.7	70.0 ± 12.7	3.3 ± 0.2
DAPC/PSPC (90:10)	59.1 ± 1.4	35.5 ± 2.1	2.0 ± 0.0	6.2 ± 0.2	17.0 ± 0.0	11.0 ± 0.0	2.2 ± 0.1	48.0 ± 1.4	87.0 ± 0.0	22.9 ± 1.5
DAPC/PSPC (85:15)	61.4 ± 1.1	72.5 ± 3.5	11.0 ± 1.4	8.3 ± 0.7	8.0 ± 1.4	9.0 ± 0.0	2.3 ± 0.0	20.0 ± 2.8	80.5 ± 2.1	45.4 ± 1.1
DAPC/PSPC (80:20)	61.2 ± 0.2	85.5 ± 0.7	22.0 ± 0.0	9.4 ± 1.4	5.0 ± 0.0	9.0 ± 1.4	2.2 ± 0.1	9.5 ± 0.7	69.0 ± 1.4	52.8 ± 0.3
DAPC/PSPC (75:25)	62.2 ± 0.9	85.0 ± 1.4	23.5 ± 0.7	10.8 ± 4.4	6.0 ± 0.0	10.0 ± 2.8	2.3 ± 0.2	8.5 ± 0.7	66.0 ± 2.8	53.9 ± 0.4
DAPC/PSPC (70:30)	63.2 ± 0.5	87.5 ± 0.7	32.0 ± 1.4	16.7 ± 0.3	6.0 ± 0.0	8.5 ± 0.7	2.5 ± 0.0	6.5 ± 0.7	60.0 ± 1.4	56.6 ± 0.1
DAPC/PSPC (65:35)	64.1 ± 0.3	87.5 ± 0.7	34.0 ± 4.2	17.5 ± 2.9	6.5 ± 0.7	9.0 ± 0.0	2.5 ± 0.1	5.5 ± 0.7	57.0 ± 4.2	57.5 ± 0.2
DAPC/PSPC (60:40)	63.8 ± 0.2	88.5 ± 0.7	38.0 ± 5.7	18.6 ± 3.0	7.0 ± 0.0	10.0 ± 0.0	2.6 ± 0.2	4.5 ± 0.7	51.5 ± 4.9	57.7 ± 0.9
DAPC/PSPC (55:45)	64.1 ± 0.0	88.5 ± 0.7	41.5 ± 3.5	19.5 ± 0.4	7.0 ± 0.0	11.0 ± 0.0	2.6 ± 0.1	4.5 ± 0.7	47.5 ± 3.5	58.3 ± 0.6
DDPC				5.6 ± 0.0	31.5 ± 0.7	11.5 ± 0.7	1.6 ± 0.1	68.5 ± 0.7	88.5 ± 0.7	2.8 ± 0.0
DDPC/PSPC (95:5)	40.3 ± 1.9	12.0 ± 1.4	1.0 ± 0.0	3.6 ± 0.0	43.5 ± 0.7	24.0 ± 0.0	1.2 ± 0.0	44.5 ± 0.7	76.0 ± 0.0	6.9 ± 0.8
DDPC/PSPC (90:10)	59.4 ± 0.2	63.5 ± 2.1	5.5 ± 0.7	5.1 ± 0.5	15.5 ± 2.1	16.0 ± 1.4	1.4 ± 0.2	21.0 ± 0.0	78.5 ± 0.7	38.7 ± 1.2
DDPC/PSPC (85:15)	61.1 ± 0.6	79.5 ± 3.5	12.0 ± 2.8	6.0 ± 1.0	8.5 ± 2.1	13.5 ± 2.1	1.4 ± 0.1	11.0 ± 1.4	74.5 ± 0.7	49.5 ± 2.6
DDPC/PSPC (80:20)	61.2 ± 0.1	84.0 ± 1.4	16.5 ± 3.5	7.8 ± 2.2	7.0 ± 1.4	11.0 ± 2.8	1.5 ± 0.2	8.5 ± 0.7	72.0 ± 1.4	52.2 ± 1.0
DDPC/PSPC (75:25)	60.9 ± 0.4	88.5 ± 0.7	27.0 ± 1.4	10.8 ± 0.2	5.5 ± 0.7	9.5 ± 0.7	1.6 ± 0.0	5.5 ± 0.7	63.5 ± 2.1	54.8 ± 0.1
DDPC/PSPC (70:30)	61.9 ± 0.6	88.5 ± 0.7	25.5 ± 4.9	10.5 ± 2.2	6.0 ± 0.0	10.5 ± 0.7	1.6 ± 0.1	5.5 ± 0.7	64.0 ± 4.2	55.4 ± 0.1
DDPC/PSPC (65:35)	62.1 ± 0.1	89.5 ± 0.7	30.0 ± 2.8	12.0 ± 0.6	6.0 ± 0.0	10.0 ± 0.0	1.6 ± 0.0	4.5 ± 0.7	60.0 ± 2.8	56.3 ± 0.3
DDPC/PSPC (60:40)	61.7 ± 0.5	90.5 ± 0.7	38.5 ± 3.5	15.6 ± 0.6	6.0 ± 0.0	10.0 ± 0.0	1.8 ± 0.0	3.5 ± 0.7	51.0 ± 2.8	56.8 ± 0.1
DDPC/PSPC (55:45)	62.4 ± 0.3	90.5 ± 0.7	38.5 ± 4.9	15.3 ± 1.7	6.0 ± 0.0	10.5 ± 0.7	1.8 ± 0.1	3.5 ± 0.7	51.0 ± 5.7	57.4 ± 0.2

Each value is the average from at least two separate experiments ± SEM. τ, lifetimes (ns); f, fractional intensites (%);
α, fractional amplitudes (%); τAV, intensity-weighted average lifetimes (ns).

Table S9

Measured polydispersity and Z-average values for multilamellar vesicles prepared from PSPC and the different unsaturated PC:s. The samples were hydrated and bath sonicates as described under Materials and Methods. Each value is the calculated average based on 45 scans of one sample.

Sample Composition		PDI	Z-average (nm)
PSPC (100 %)		0.29	994
PSPC/POPC	(45/55 by mol)	0.42	822
PSPC/PLPC	(45/55 by mol)	0.36	1002
PSPC/PAPC	(45/55 by mol)	0.67	1235
PSPC/PDPC	(45/55 by mol)	0.54	423
PSPC/DOPC	(45/55 by mol)	0.34	918
PSPC/DLPC	(45/55 by mol)	0.29	844
PSPC/DAPC	(45/55 by mol)	0.18	502
PSPC/DDPC	(45/55 by mol)	0.44	304

Table S10. Phase transition enthalpies for PSM and DPPC, and for their mixtures with unsaturated phosphatidylcholines. The lipid compositions were either 100 % PSM or DPPC; or 45 mol% saturated phospholipid in 55 mol% unsaturated PC. The total lipid concentration was 2-3 mM. In all bilayer systems, the molar enthalpy was calculated based on the saturated PC concentration only. DSC scans were recorded between 0 and 70 ^{o}C, with a temperature gradient of 1 ^{o}C/min. Data analysis was performed with Origin software. Since the peaks were broad, subtracting the correct baseline was not trivial, and will affect the measured enthalpies (approximately + 20%).

Composition	Enthalpy (kJ/mol)
PSM	26.5 (100%)
PSM/POPC	7.5 (28%)
PSM/PLPC	6.6 (25%)
PSM/PAPC	6.8 (26%)
PSM/PDPC	8.7 (33%)
PSM/DOPC	10.7 (40%)
PSM/DLPC	17.0 (64%)
PSM/DAPC	12.3 (47%)
PSM/DDPC	14.0 (53%)
DPPC	34.6 (100%)
DPPC/POPC	7.6 (22%)
DPPC/PLPC	14.9 (43%)
DPPC/PAPC	17.3 (50%)
DPPC/PDPC	13.3 (38%)
DPPC/DOPC	8.6 (25%)
DPPC/DLPC	16.5 (48%)
DPPC/DAPC	12.1 (35%)
DPPC/DDPC	17.9 (52%)

The value in parenthesis is the percentage of the enthalpy relative to the pure saturated PC enthalpy.