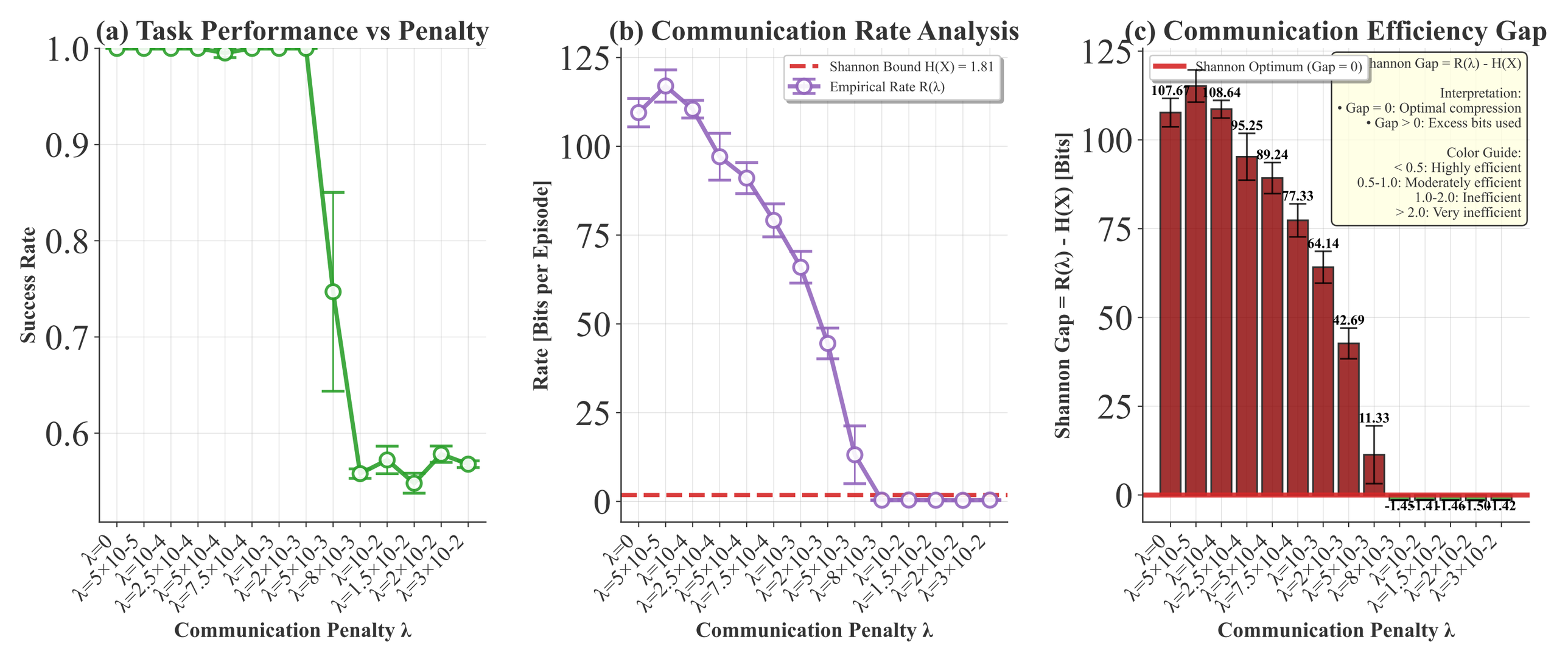
(a) Task Performance vs Penalty
Success Rate
1.0
0.9
0.8
0.7
0.6
λ=0
λ=5×10-5
λ=10-4
λ=2.5×10-4
λ=5×10-4
λ=7.5×10-4
λ=10-3
λ=2×10-3
λ=5×10-3
λ=8×10-3
λ=10-2
λ=1.5×10-2
λ=2×10-2
λ=3×10-2
Communication Penalty λ
(b) Communication Rate Analysis
Rate [Bits per Episode]
125
100
75
50
25
0
Shannon Bound H(X) = 1.81
Empirical Rate R(λ)
Communication Penalty λ
(c) Communication Efficiency Gap
Shannon Gap = R(λ) - H(X) [Bits]
125
100
75
50
25
0
Shannon Optimum (Gap = 0)
hannon Gap = R(λ) - H(X)
Interpretation:
• Gap = 0: Optimal compression
• Gap > 0: Excess bits used
Color Guide:
< 0.5: Highly efficient
0.5-1.0: Moderately efficient
1.0-2.0: Inefficient
> 2.0: Very inefficient
107.67
108.64
95.25
89.24
77.33
64.14
42.69
11.33
-1.45
1.41
1.46
1.50
1.42
Communication Penalty λ