Inverse Square Safety

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1 Introduction

I noticed a heuristic that can influence decisions having applications in safety engineering.

2 Examples

Imagine a sailor is standing next to a high power communication antenna on a naval vessel. I have been told that the power from the antenna can cause burns. The weakening of a beam follows an inverse square law as power weakens over distance from the transmitter. Again image a person is trying to keep distance from a gas pump while smoking a cigarette. Although this model has variation due to wind, because just like the antenna releases on average a constant number of photons per second, and the gas fumes are released at a roughly constant rate of particles in the air per second, we can again suggest that the vapor density weakens as an inverse square of the distance from the pump.

3 Safety Analysis

Consider for example standing 10 feet away from the antenna on the ship, and suppose the signal power (with no units given) is $1/10^2$ which is 0.01. Now consider that the sailor backs away to 20 feet. Then the power of the signal is now $1/20^2$ which is 0.0025.

4 Safety Conclusions

Therefore, by doubling our distance from a dangerous inverse square source, we have increased our safety by 4 times. This means that a small change in operating protocol, can have significant gains in safety for personnel.

5 Further Analysis

This phenomenon is called a second order effect. It is different than, for example the following. Suppose a person works on a submarine with a nuclear reactor for 30 minutes, and this increases their chance of getting cancer in the next 5 years by 20%. This is a first order phenomenon. Our conclusion is second order, because we are not saying how safe it is to stand 10 feet or 20 feet from a transmitter or a gas pump, we are saying that the safety can quadruple by a 2 fold improvement.