Walking through the City

Which strategy is faster?

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Overview

- I had an argument with my father about whether different strategy details when choosing a route affect time delay
- I wrote a computer simulation to clarify this issue
- Specific question was whether choosing when to cross to the other side of the street affects time delay
- Another related question is whether the choice of longer vs. shorter blocks has any effect on overall travel time

Hypothesis

I hypothesised that:

1. Longer blocks are more time effective than shorter blocks
2. Going straight until you reach a red light is more time effective than crossing to the other side the moment a green light is available to do so

Model

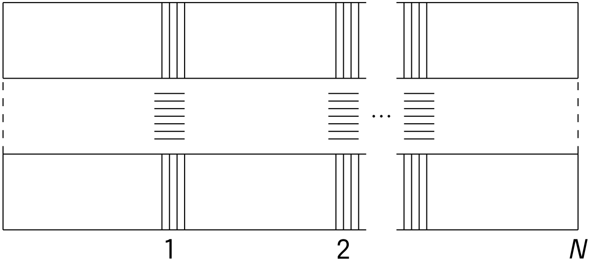
Key assumptions:

1. Blocks of equal length
2. Random traffic light switching
3. Equal traffic light duration

Relative delay

$$R = \frac{t}{t_{gw}} = \frac{t}{N(1+W)}$$

Walk time relative to "green wave" time



City blocks model: N blocks of equal length separated by crosswalks with traffic lights.
Block walking time is W times longer than crossing time.

Methodology

Simulation approach:

- Random traffic light distribution
- Traffic light at every crosswalk
- Street crossing time is the basic unit
- Each simulation run 100000 times

Strategies considered:

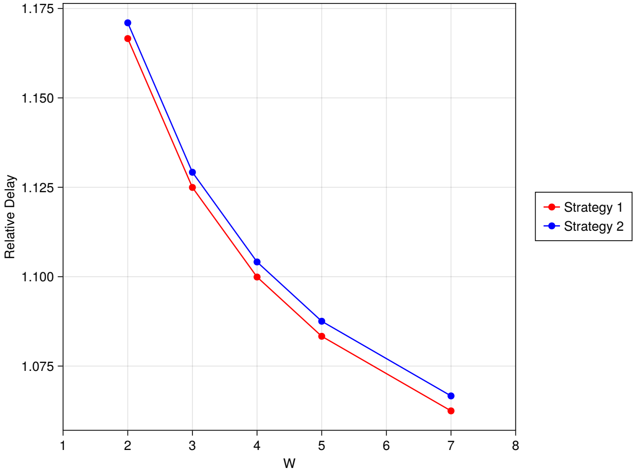
1. Continue walking straight until reaching a red light
2. Cross to the other side as soon as you have a chance

Long or short blocks?

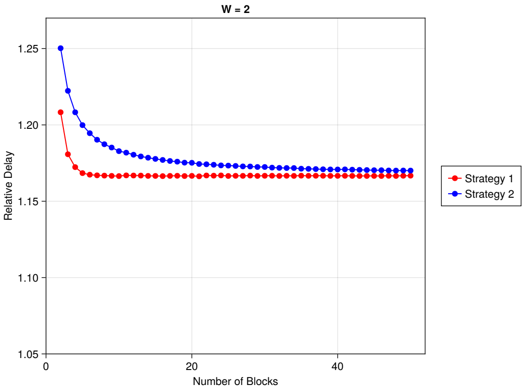
W	N	$N(1+W)$	$R_{av}^{(1)}$	$R_{std}^{(1)}$	$R_{av}^{(2)}$	$R_{std}^{(2)}$
2	40	120	1.17	0.03	1.17	0.03
3	30	120	1.12	0.02	1.13	0.02
4	24	120	1.10	0.02	1.10	0.02
5	20	120	1.08	0.02	1.09	0.02
7	15	120	1.06	0.02	1.07	0.02

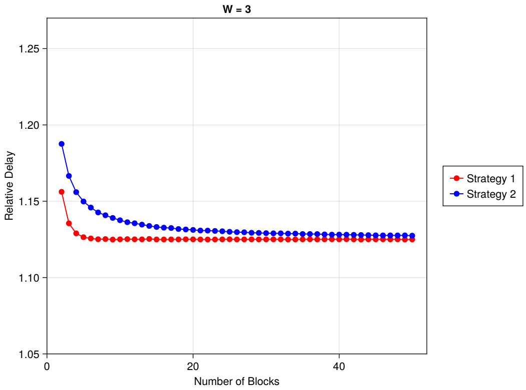
Average values and standard deviations of the relative walking delay computed for the Strategy 1 and Strategy 2 ($R_{av}^{(1)}$ and $R_{std}^{(1)}$, $R_{av}^{(2)}$ and $R_{std}^{(2)}$, respectively), for different combinations of block length parameter W and the number of blocks N. The total route distance $N(1+W)$ is kept constant. 100000 simulations were performed for each combination of parameters to compute the averages and standard deviations.

Long or short blocks?

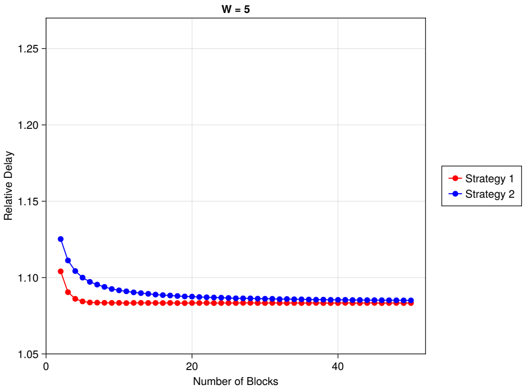


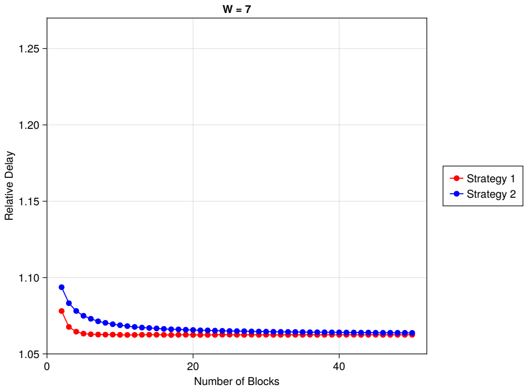
Walking strategies





Walking strategies





Longer route limit

Finding: As the number of blocks grows, the delay approaches a constant value.

Probability perspective: about half of crosswalks will have red lights for larger N values.

Adding $N/2$ to the travel time:

$$R_{lim} = \frac{N(1+W) + N/2}{N(1+W)} = 1 + \frac{1}{2N(1+W)}$$

Summary and limitations

- Longer blocks over shorter blocks are preferred
- Cross to the other side only if you cannot continue going straight

Limitations and further research

- Can be extended to consider specific traffic light patterns
- Assumes that walking speed is constant
- Blocks of equal length along a single route
- Can be used for planning ”green waves”
- Can also be used for planning slow streets

References

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