Will a simple replacement of your doghouse left turn signal with a flashing yellow arrow magically fix your traffic congestion, get rid of your gridlock, and eliminate all of your crashes?
NO.
Are Your Flashing Yellow Arrow Turn Signals Lipstick on a Pig?

Why lagging behind is a good thing...

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Principal Traffic Engineer
City of Lakewood Colorado
A reminder why the flashing yellow arrow was created:

- To provide a wider variety of left turn sequences by removing the dangerous yellow trap sequence
- To enable variable left turn protection modes by time of day
Coordinated System
Retiming
CO121 & CO391

51 intersections, 2 corridors, 3 common problems

1. Inefficient use of splits
2. Left turn bay challenges
3. Correctable (?) crashes
“Early Returns” and Late Releases

Challenge: Opposing left turn phase does not serve, platoon released early into next red.

Challenge: Ped actuation delays start of green, approaching platoon arrives into red.
“Early Returns” and Late Releases

Using lead-lag phasing with FYA

- Efficient green use for arriving platoons
- Concern for permissive “lead” left turning driver when facing extended green
- FYA allows protected only by TOD
“Early Returns” and Late Releases

Using lag-lag phasing with FYA

- More predictable releases of bi-directional platoons
- Reduced mainline red time
- Decreased need for protected left interval
“Early Returns” and Late Releases

On a corridor of 32 signals, 64 crossing pedestrian movements, how often do all intersections during the same signal cycle not have a ped actuation?
NEVER!

How often do your offsets work as designed?
“Early Returns” and Late Releases

**Lead-left phasing**
- Protected Left Ph3
- Pedestrian Interval with Ph4
- 8s 4s 3s
- 30s

**Lag-left phasing**
- Pedestrian Interval with Ph4, Permissive Left
- Unused Ph3 time returned to mainline
- 30s
- 15s
“Early Returns” and Late Releases

Preference is to lag-lag

- Lags gap-out as opposed to maxing out with coordinated phase

- Phantom green time of one approach outweighed by avoidable protected interval
  - Best for comparable lefts

- Removes yellow clearance chaos
With a leading turn operation, six movements clear on yellow…

...with lagging left turns, pedestrian and through movements start and terminate together. The forced turn on yellow across the crosswalk is removed.
Left Turn Bay Challenges

- Negative left turn lane offsets limit sight distance
- Lagging left turns reduce the need for a blind, forced turn on yellow
Left Turn Bay Challenges

• Lagging left turns allow traffic to accumulate in the storage bays before the left turn arrow is served.

*For efficiency, ensure adequate extension time
Alcohol Related Crashes

- Keep in your mind your drivers’ abilities, this can vary by time of day.
- Better to have faith in a signal’s protection, or be on guard with FYA? (approach turns).

DUI Crashes by Time of Day:

- 2am: 57%
- 6pm: 29%
- 9pm: 16%

Vehicle 1: Straight 57%
Vehicle 2: Turning 16%
**Before-After Results**

**Crash Locations**

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Lead-lead</th>
<th>Lag-lag</th>
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<tbody>
<tr>
<td>Intersection</td>
<td>Oct 2015-16</td>
<td>Oct 2016-17</td>
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<tr>
<td>Wadsworth &amp; 26th</td>
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<td>2</td>
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<td>Wadsworth &amp; Mississippi</td>
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<td>3</td>
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<tr>
<td><strong>Kipling &amp; Dartmouth</strong></td>
<td><strong>2013 (2)</strong></td>
<td><strong>7</strong></td>
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<td></td>
<td><strong>2014 (1)</strong></td>
<td><strong>lead-lag prot/perm</strong></td>
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<tr>
<td></td>
<td><strong>2015 (0)</strong></td>
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- Before approach-turn crashes 36
- After FYA, total crashes 16 (includes protection-mode changes by TOD)
The Virtual Left Turn Trap

**Before-After Results**

**Lakewood Police Department**

**Case #**: 15-046316  
**Date**: 11/05/2015

**Describe Accident**

TU-1 (Cunningham) was W/B #1 LEFT TURN LANE W Alameda Ave at S Garrison St.  
TU-2 (Banks) was E/B LANE #2 W Alameda Ave.  
TU-1 observing W/B through lanes signal turned red believed he needed to clear intersection, but failed to yield on flashing yellow arrow making a left and colliding with TU-2 E/A in intersection.  
Airbags deployed and serious bodily injury.

**On S Kipling Pkwy at W Dartmouth Ave**

A stated she had flashing yellow arrow and other NB lights turned yellow A did not realize that SB lights were still green. A turned left missed one car and was struck by V2 on rear quarter panel.
The Virtual Left Turn Trap
Why the Virtual Trap?

- Intersection has had FYA for 4 years (2\textsuperscript{nd} longest in city)
- Other FYA locations < 1 mi
- Driver familiarity high (residential, school)
- Operated lead-lag 5a to 11p; SB leads 5a-330p, NB leads 330p-11p
- 7 of 7 crashes are by time of day on lead approach
Why the Virtual Trap?

• Through heads offset by 40 ft SB, 30 ft NB

• Side street FYA’s not an issue

• Follow through (far left side of pole) signals

• LTYFYA signs

• Don’t assume... talk to your cops!
Questions...