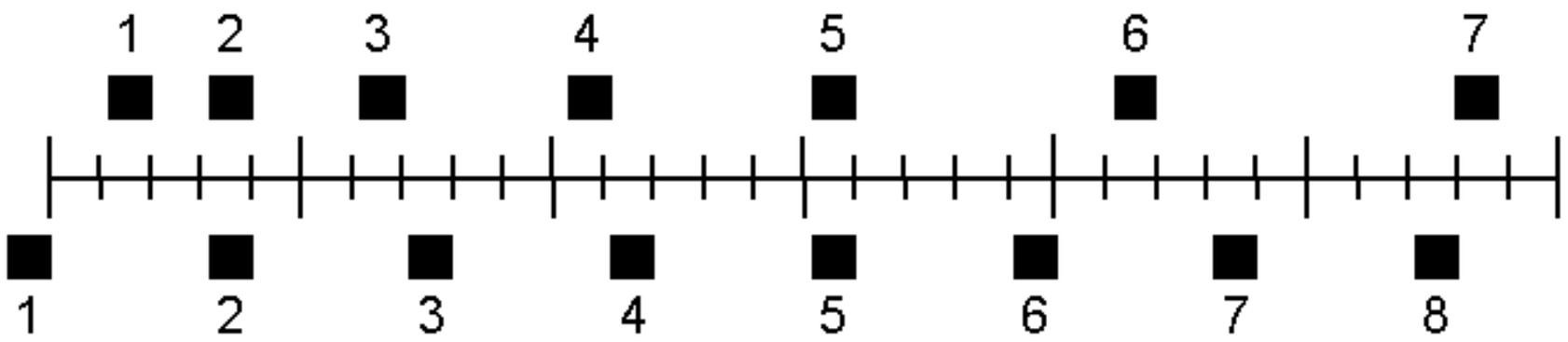
Exclusively-visual analysis of classroom group interactions

Laura Tucker, Rachel Scherr, Todd Zickler, and Eric Mazur

Standardized tests give important, but limited information

The positions of two blocks at successive 0.20 second time intervals are represented by the numbered squares in the diagram below. The blocks are moving toward the right.



20. Do the blocks ever have the same speed?

(A) No.
(B) Yes, at instant 2.
(C) Yes, at instant 5.
(D) Yes, at instants 2 and 5.
(E) Yes, at some time during interval 3 to 4.

Qualitative observations reveal a rich picture, but are resource-intensive

Could we discreetly measure the behavior of more students?

We started with previously-analyzed videos of students working on University of Maryland Tutorials

Newton's Third Law

Discuss your answers with your group and come to an agreement on the free body diagram
what you think is happening. Write down the group's prediction including the free body di
on the paper on the table.

We can model this situation with the Pasco carts. Put two bar weights into one of the ca
it cart 2. Call the other cart 1. In our model cart 2 will represent the truck. Cart 1 will b
small car.

Predict what the computer would show if you began pushing cart 2 with cart 1 very slo
and then faster always keeping contact between the two carts. Sketch your prediction
below.

PREDICTION

Force 1 & 2 (N)

Using the computer, the carts and the force probes, carry out the experiment. **Re**
exceed 10 N and remember to zero the force probes before taking measurem

Sketch the graph of the force probe measurements on the axes below.

OBSERVATION

group behaviors

qualitative codes for group behaviors

Blue: Worksheet code

Minimal interaction
Focus on worksheet

Scherr & Hammer, *Cognition and Instruction*, 2009.

Green: Discussion code

Intellectual and/or emotional engagement with group

Scherr & Hammer, *Cognition and Instruction*, 2009.

Red: TA code

Attention belongs to the TA

Scherr & Hammer, *Cognition and Instruction*, 2009.

Yellow: Joking code

Embarrassment,
perceived vulnerability

Scherr & Hammer, *Cognition and Instruction*, 2009.

no “right” coding answers

no “right” coding answers

coder

Procedure

coder

Procedure

Time	Code
0:00:00	
0:00:05	
0:00:10	
0:00:15	
0:00:20	
0:00:25	
0:00:30	
0:00:35	
0:00:40	
0:00:45	
0:00:50	
0:00:55	
0:01:00	
0:01:05	
0:01:10	

qualitative codes

coder

Procedure

Time	Code
0:00:00	
0:00:05	
0:00:10	
0:00:15	
0:00:20	
0:00:25	
0:00:30	
0:00:35	
0:00:40	
0:00:45	
0:00:50	
0:00:55	
0:01:00	
0:01:05	
0:01:10	

qualitative codes

mode: video only

(V)

coder

Procedure

Time	Code
0:00:00	
0:00:05	
0:00:10	
0:00:15	
0:00:20	
0:00:25	
0:00:30	
0:00:35	
0:00:40	
0:00:45	
0:00:50	
0:00:55	
0:01:00	
0:01:05	
0:01:10	

mode: video only (V)

coder

Time	Code
0:00:00	
0:00:05	
0:00:10	
0:00:15	
0:00:20	
0:00:25	
0:00:30	
0:00:35	
0:00:40	
0:00:45	
0:00:50	
0:00:55	
0:01:00	
0:01:05	
0:01:10	

mode: video and audio (AV)

Procedure

Time	Code
0:00:00	
0:00:05	
0:00:10	
0:00:15	
0:00:20	
0:00:25	
0:00:30	
0:00:35	
0:00:40	
0:00:45	
0:00:50	
0:00:55	
0:01:00	
0:01:05	
0:01:10	

Time	Code
0:00:00	
0:00:05	
0:00:10	
0:00:15	
0:00:20	
0:00:25	
0:00:30	
0:00:35	
0:00:40	
0:00:45	
0:00:50	
0:00:55	
0:01:00	
0:01:05	
0:01:10	

mode: video only

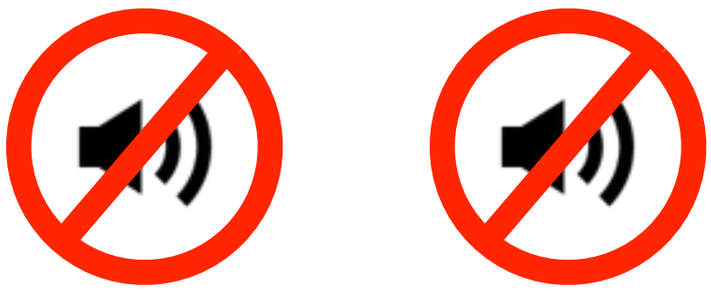
(V)

coder

mode: video and audio

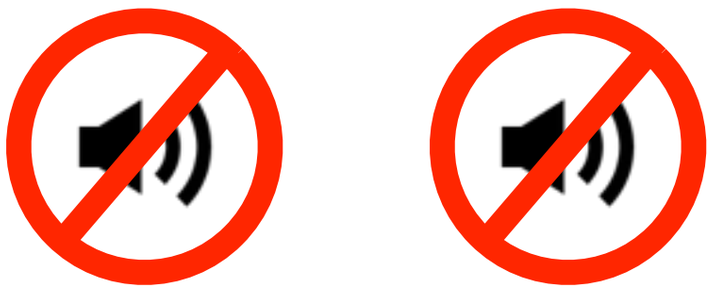
(AV)

Comparison types



V vs. V

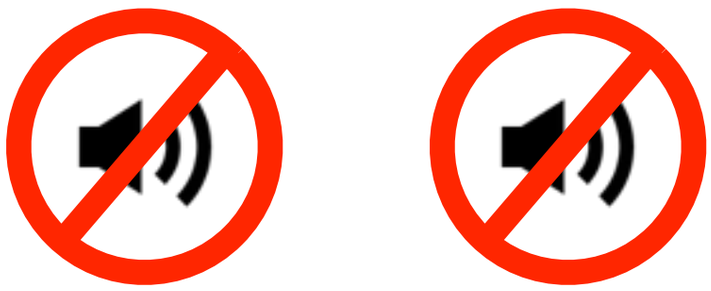
Comparison types



V vs. V

AV vs. AV

Comparison types



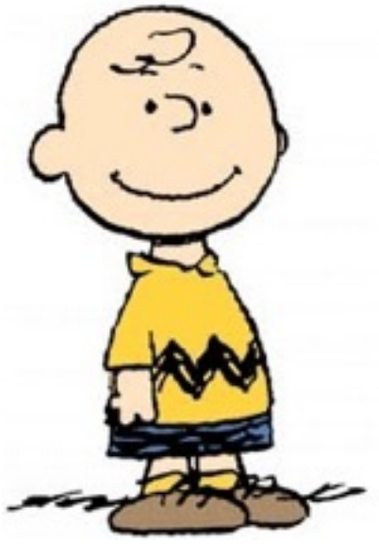
V vs. V

AV vs. AV

V vs. AV

4 coders

~900 time intervals



mode comparison	Cohen's kappa
V *vs* V	
AV *vs* AV	

mode comparison	Cohen's kappa
V *vs* V	0.815 ± 0.009
AV *vs* AV	0.79 ± 0.01

mode comparison	Cohen's kappa	percent agreement
V *vs* V	0.815 ± 0.009	87.4 ± 0.7
AV *vs* AV	0.79 ± 0.01	86 ± 1

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V *vs* AV	0.790 ± 0.008	85.7 ± 0.5

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Systematic differences?

vs

Make a key for each mode

Combine all coders in a single mode

Time	Code	Time	Code	Time	Code	Time	Code
0:00:00		0:00:00		0:00:00		0:00:00	
0:00:05		0:00:05		0:00:05		0:00:05	
0:00:10		0:00:10		0:00:10		0:00:10	
0:00:15		0:00:15		0:00:15		0:00:15	
0:00:20		0:00:20		0:00:20		0:00:20	
0:00:25		0:00:25		0:00:25		0:00:25	
0:00:30		0:00:30		0:00:30		0:00:30	
0:00:35		0:00:35		0:00:35		0:00:35	
0:00:40		0:00:40		0:00:40		0:00:40	
0:00:45		0:00:45		0:00:45		0:00:45	
0:00:50		0:00:50		0:00:50		0:00:50	
0:00:55		0:00:55		0:00:55		0:00:55	
0:01:00		0:01:00		0:01:00		0:01:00	
0:01:05		0:01:05		0:01:05		0:01:05	
0:01:10		0:01:10		0:01:10		0:01:10	








Combine all coders in a single mode

	BLUE	GREEN	RED	YELLOW
1:00	0%	50%	25%	25%
1:05	75%	0%	25%	0%

Combine all coders in a single mode

	BLUE	GREEN	RED	YELLOW
1:00	0%	50%	25%	25%
1:05	75%	0%	25%	0%

Combine all coders in a single mode

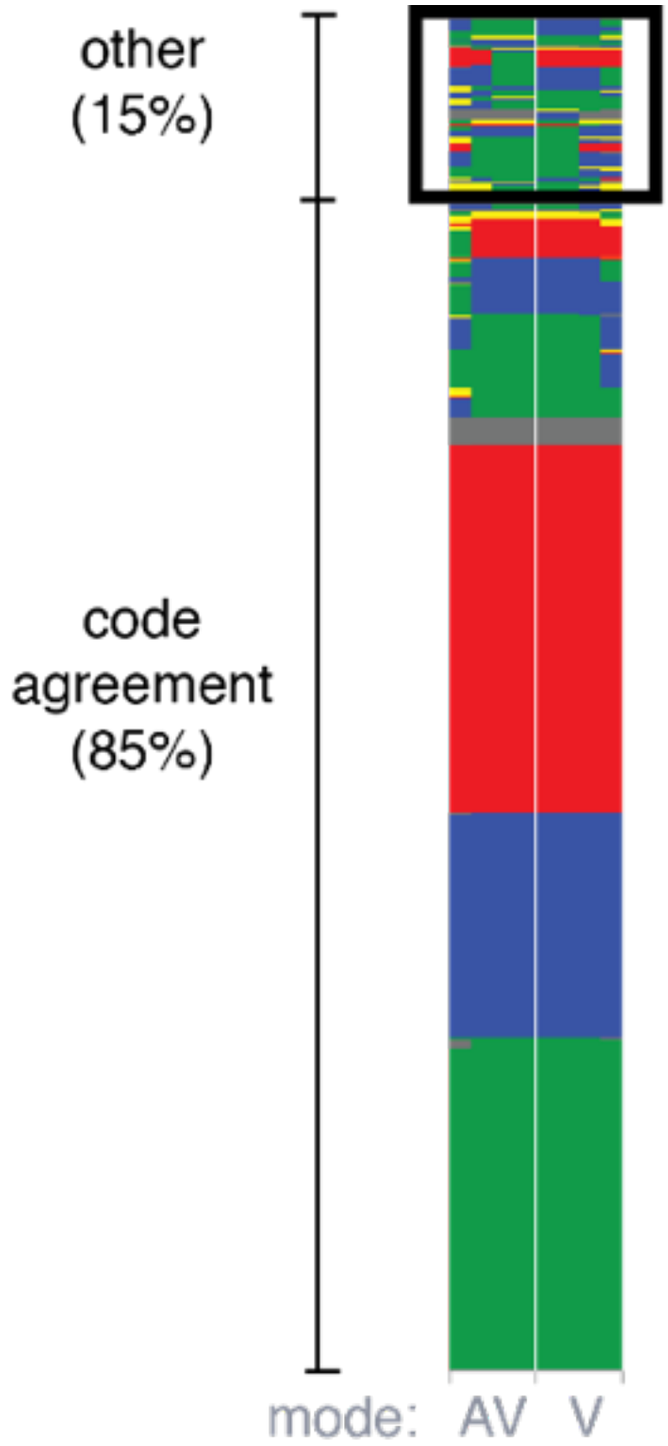
	BLUE	GREEN	RED	YELLOW
1:00	0%	50%	25%	25%
1:05	75%	0%	25%	0%

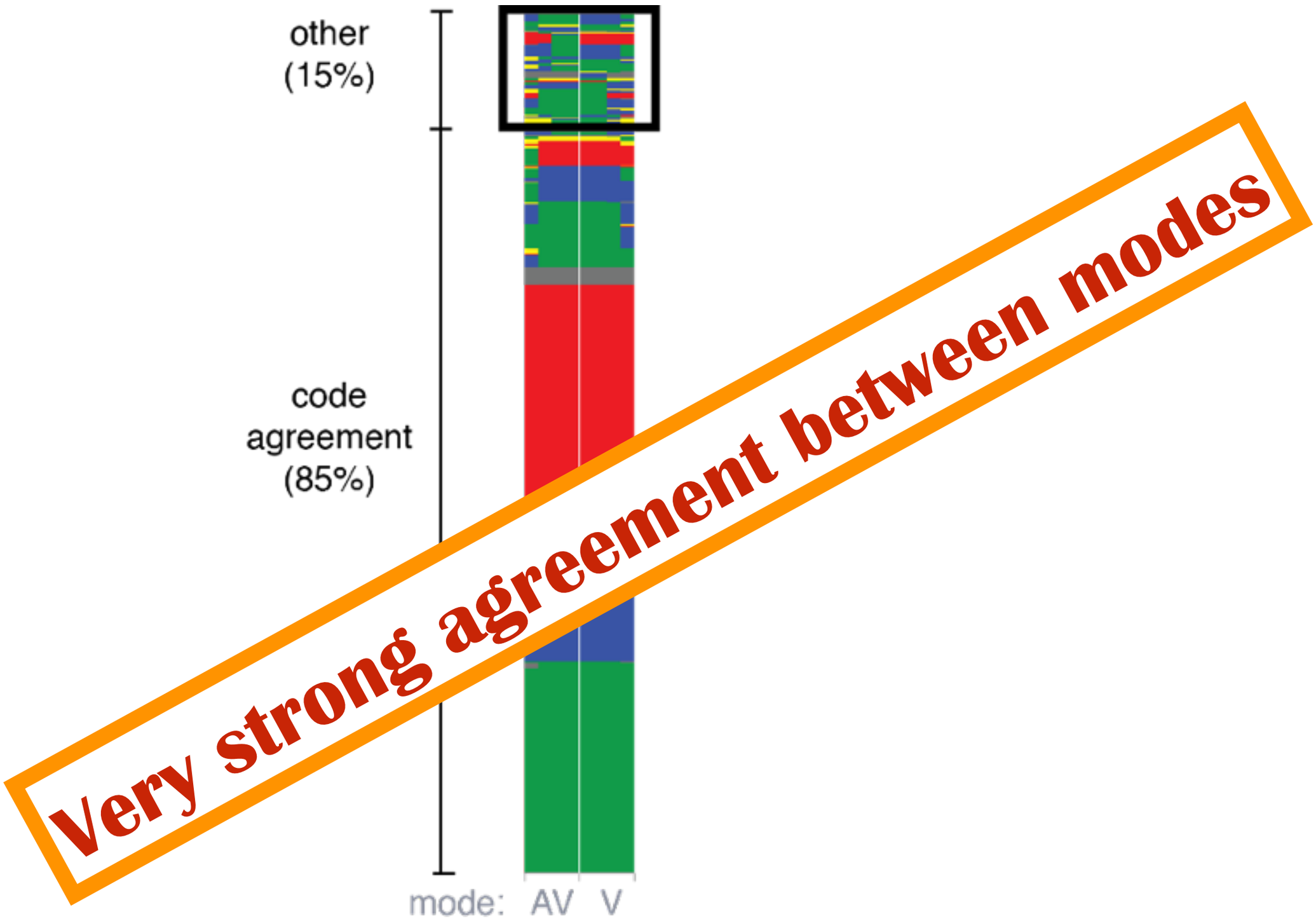
	BLUE	GREEN	RED	YELLOW
1:00	50%	50%	0%	0%
1:05	75%	0%	25%	0%

Compare modes: code agreement

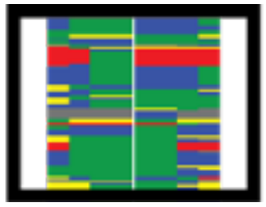
	BLUE	GREEN	RED	YELLOW
1:05	75%	0%	25%	0%
1:10	100%	0%	0%	0%

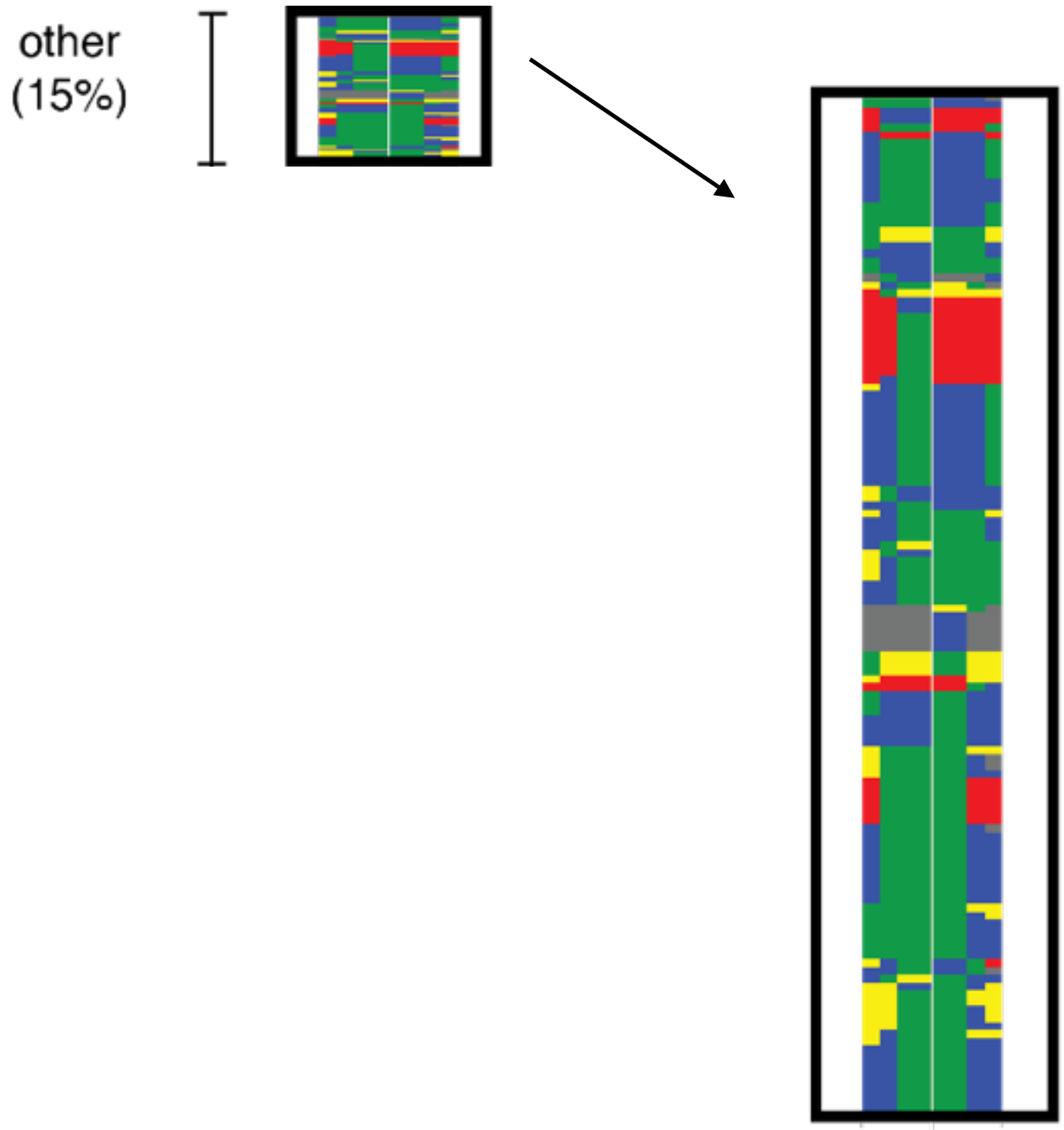
	BLUE	GREEN	RED	YELLOW
1:05	75%	25%	0%	0%
1:10	100%	0%	0%	0%


other
(15%)
code
agreement
(85%)
mode: AV V


other
(15%)
code
agreement
(85%)
mode: AV V
Very strong agreement between modes

other
(15%)

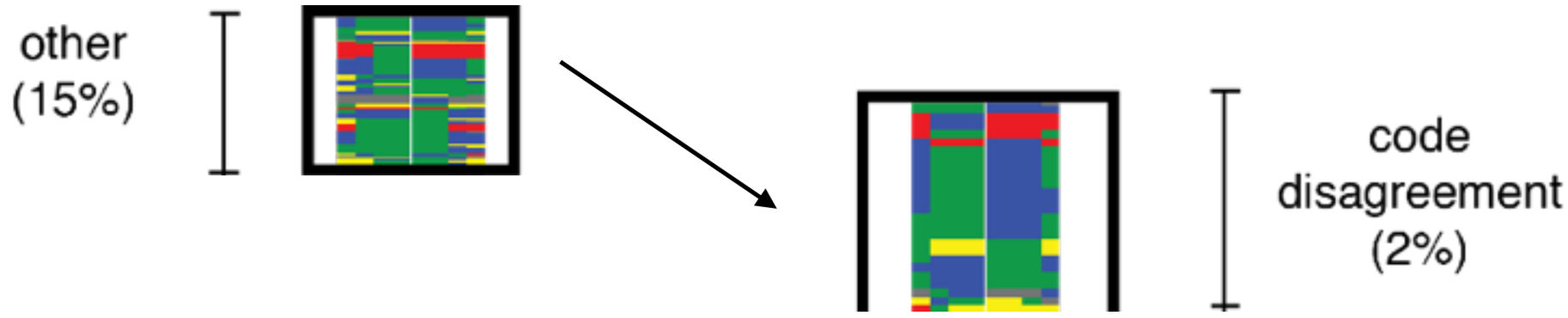



other
(15%)

Compare modes: code disagreement

	BLUE	GREEN	RED	YELLOW
1:15	75%	0%	25%	0%
1:20	100%	0%	0%	0%

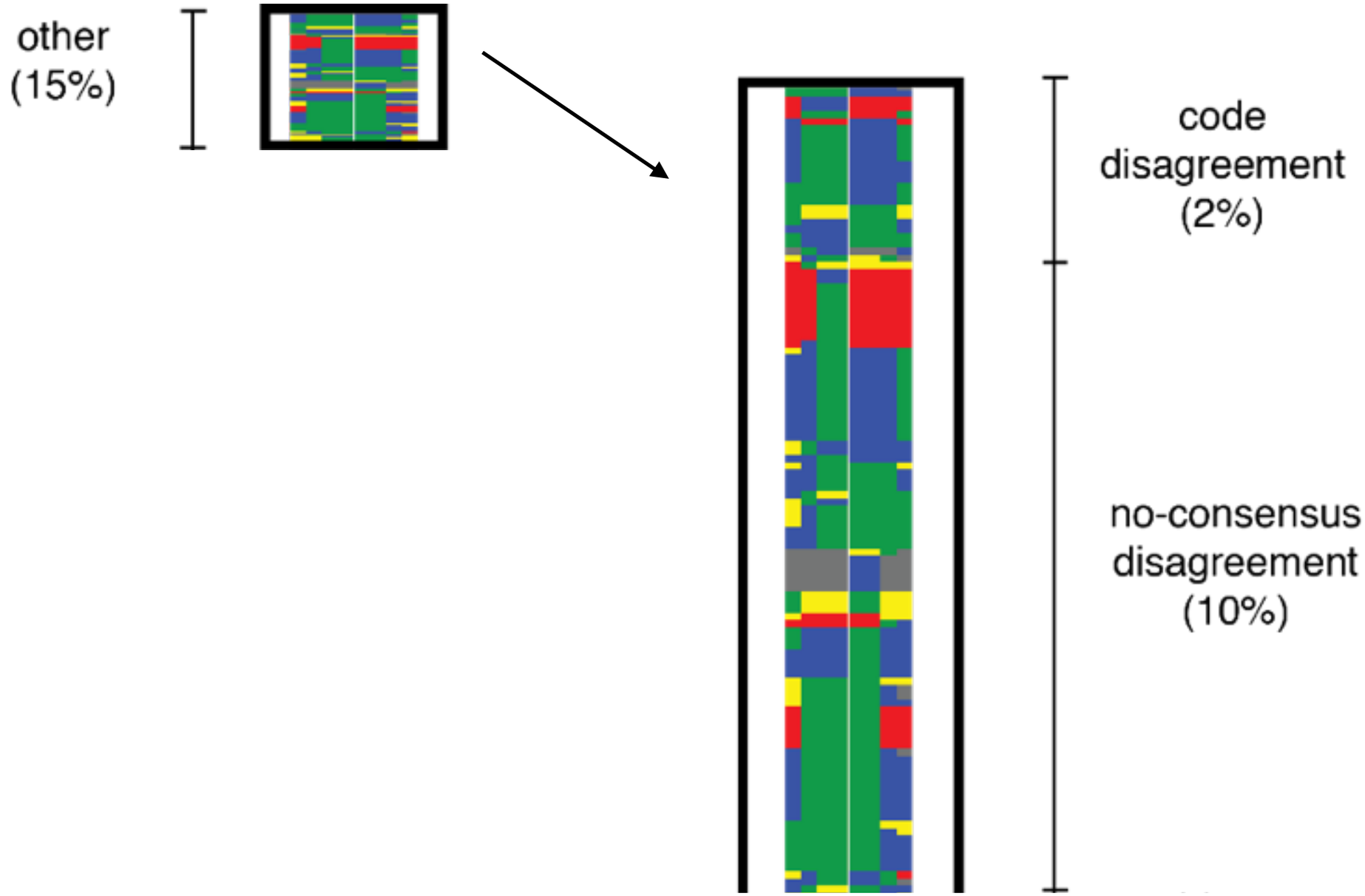
	BLUE	GREEN	RED	YELLOW
1:15	0%	75%	25%	0%
1:20	25%	75%	0%	0%


other
(15%)
code
disagreement
(2%)

Compare modes: no-consensus disagreement

	BLUE	GREEN	RED	YELLOW
1:10	75%	0%	25%	0%
1:15	100%	0%	0%	0%

	BLUE	GREEN	RED	YELLOW
1:10	0%	50%	25%	25%
1:15	50%	0%	50%	0%

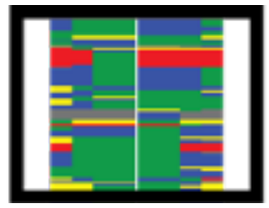

other
(15%)
code
disagreement
(2%)
no-consensus
disagreement
(10%)

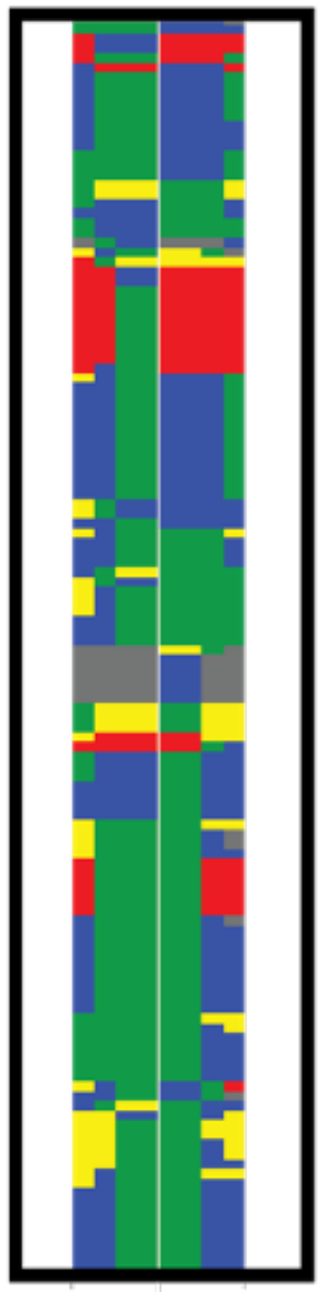
Compare modes: agreement (ambiguous behavior)

	BLUE	GREEN	RED	YELLOW
1:00	0%	50%	25%	25%
1:05	0%	50%	25%	25%

	BLUE	GREEN	RED	YELLOW
1:00	0%	50%	25%	25%
1:05	0%	25%	50%	25%

other
(15%)



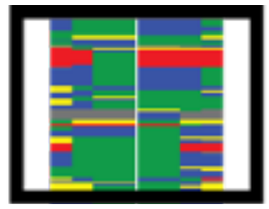


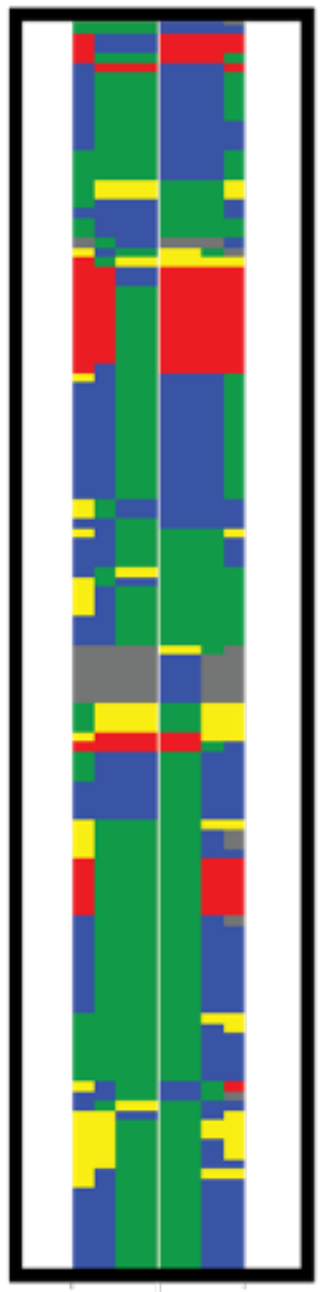
code
disagreement
(2%)

no-consensus
disagreement
(10%)

ambiguous
agreement
(2%)

other
(15%)



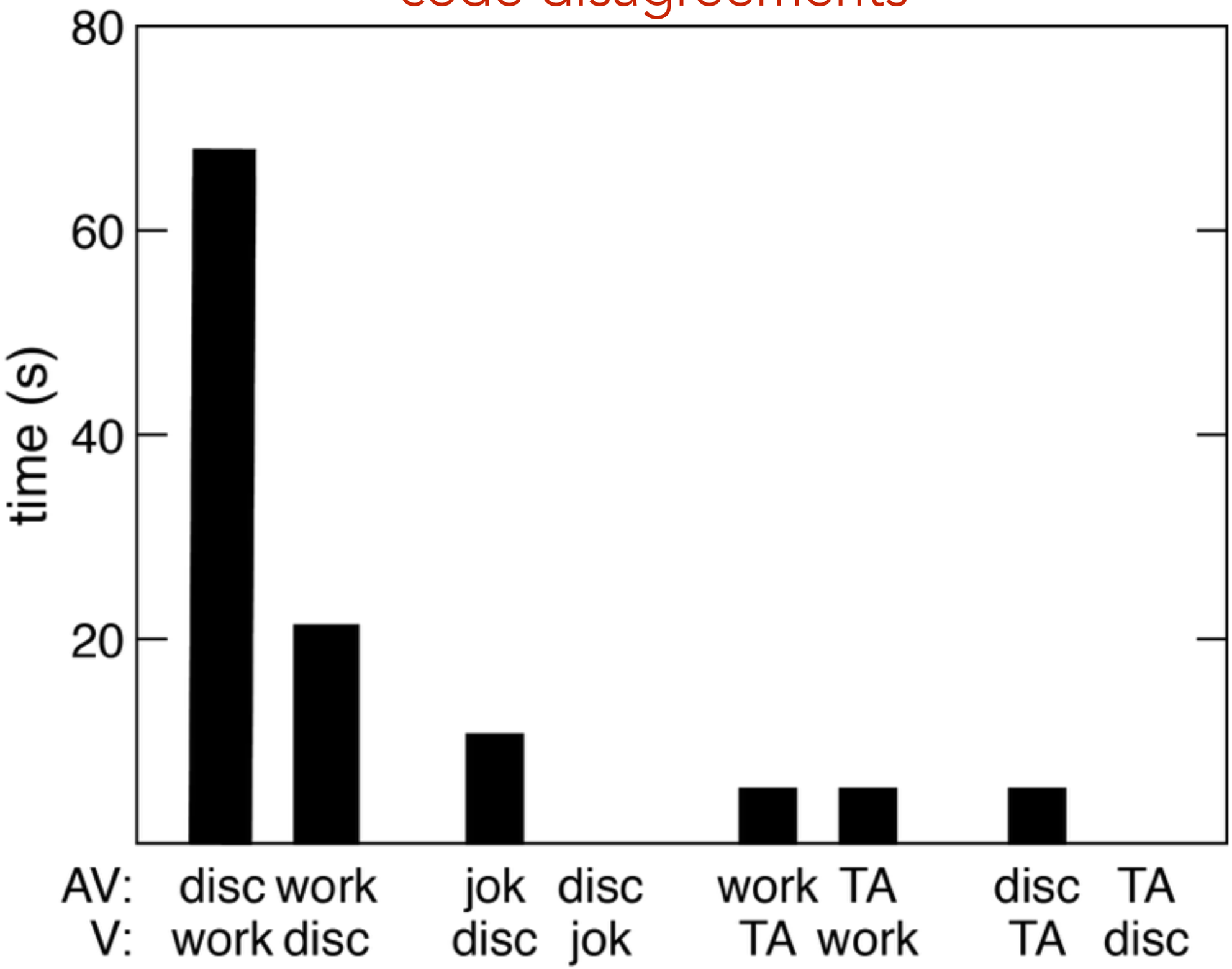


code
disagreement
(2%)

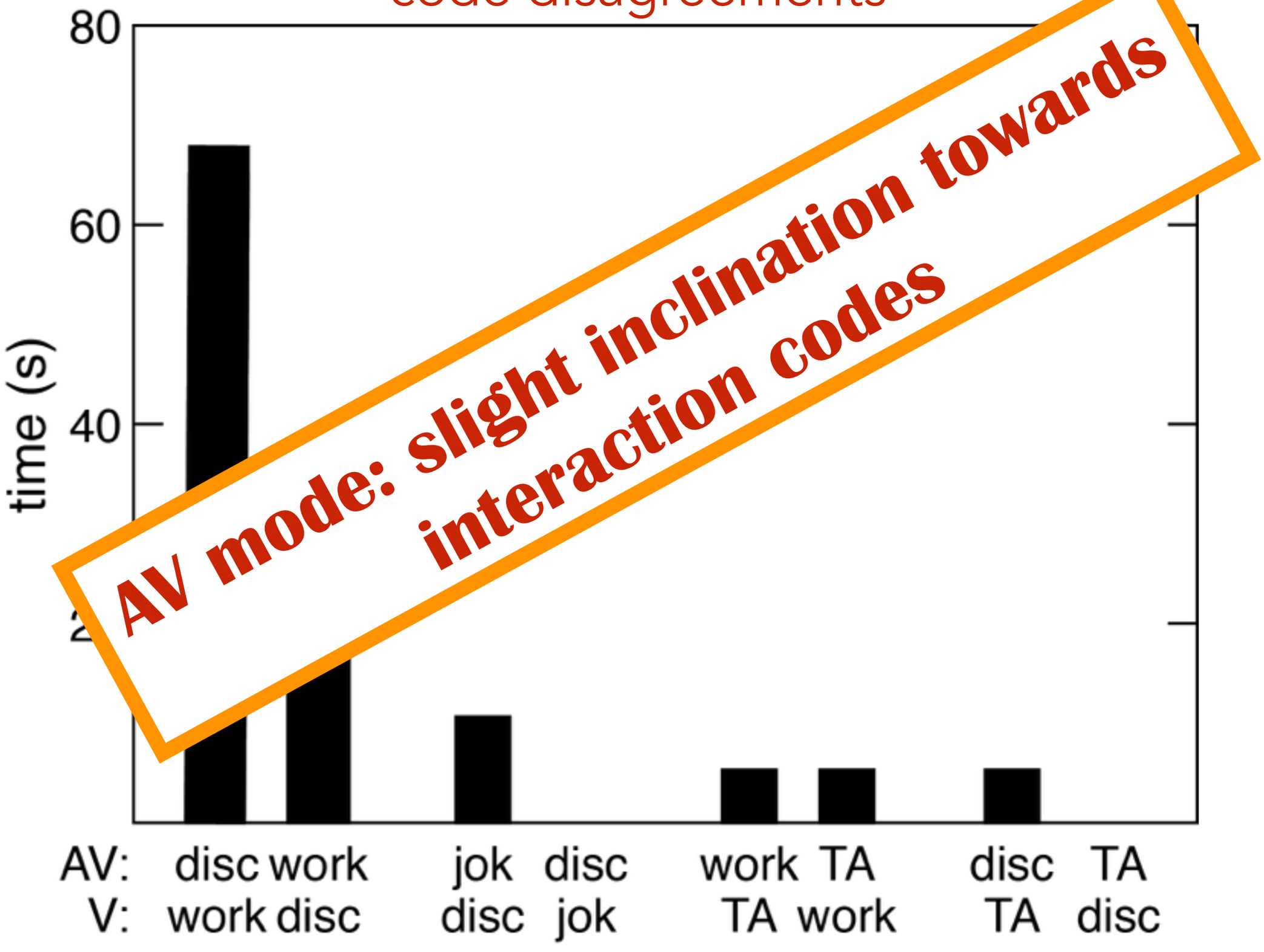
no-consensus
disagreement
(10%)

ambiguous
agreement
(2%)

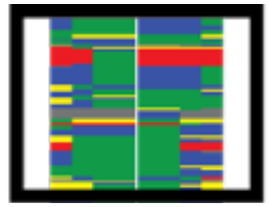
V-AV comparison: code disagreements

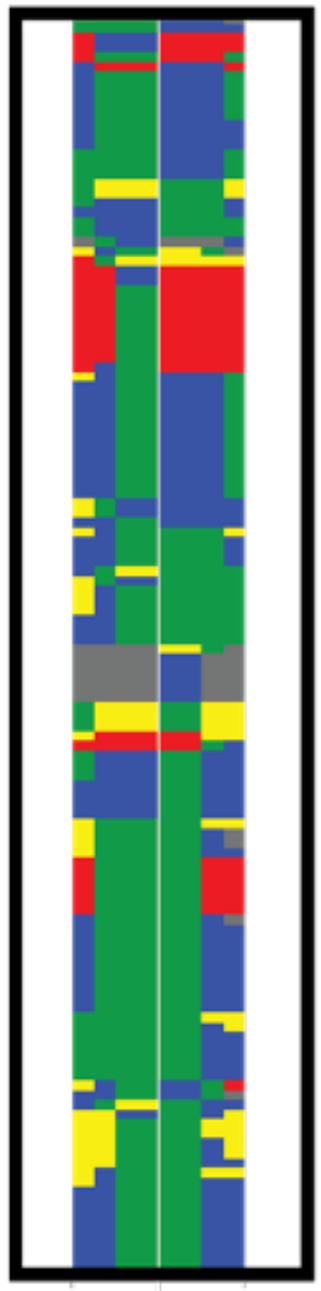


V-AV comparison: code disagreements



other
(15%)



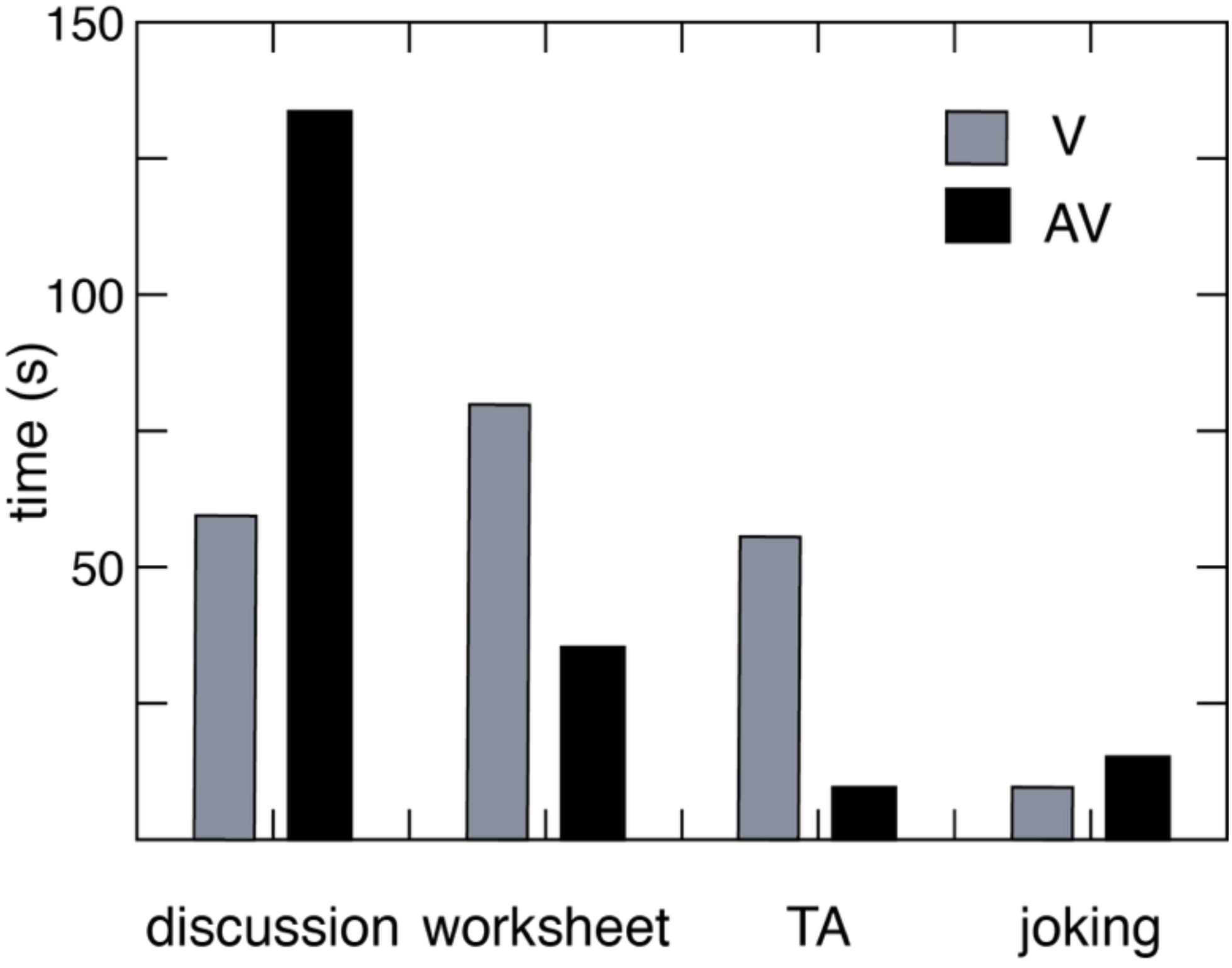


code
disagreement
(2%)

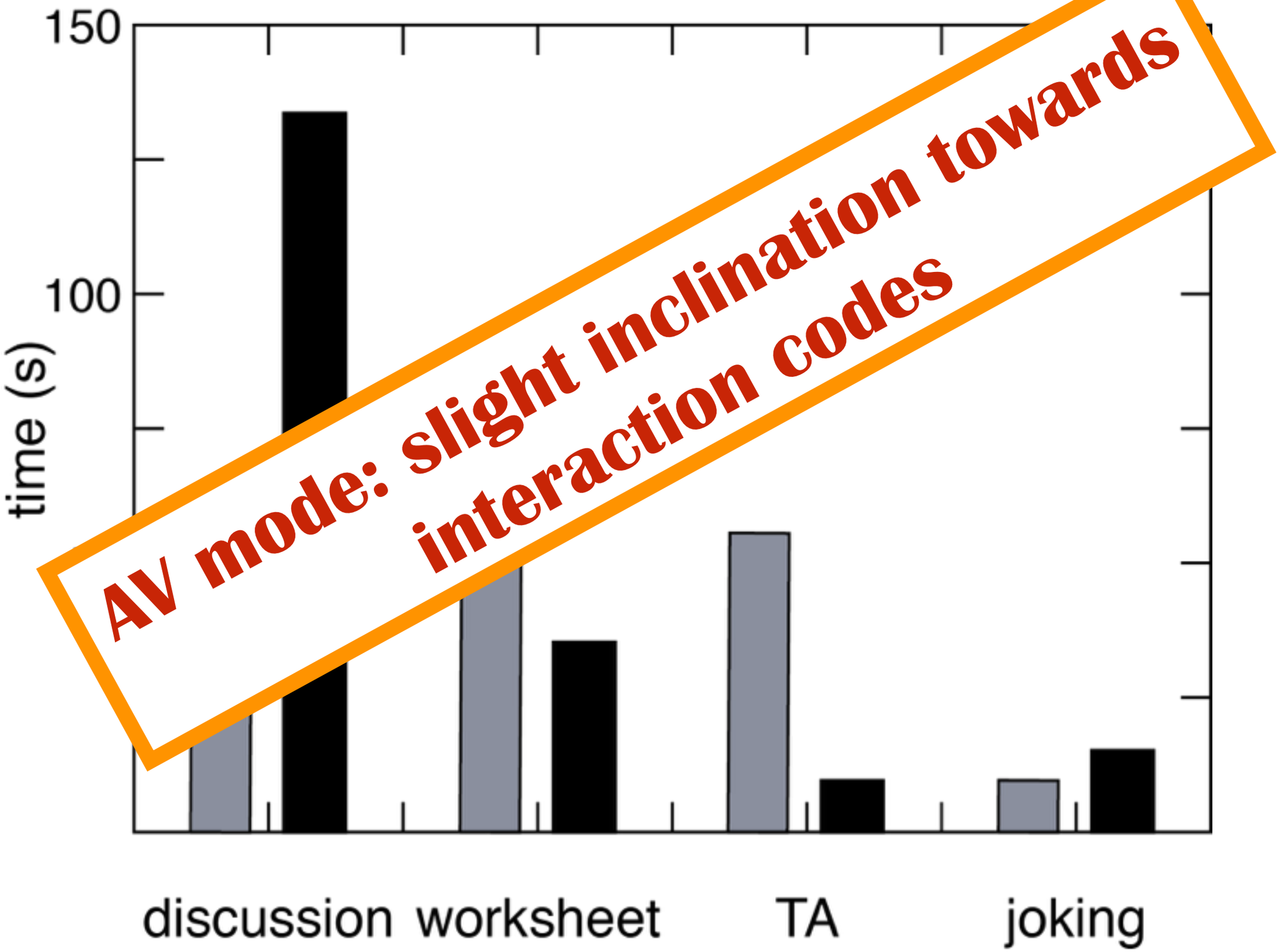
no-consensus
disagreement
(10%)

ambiguous
agreement
(2%)

V-AV comparison:
no-consensus disagreements



V-AV comparison: no-consensus disagreements



Could we discreetly measure the behavior of more students?

Visual cues give reliable information for this coding scheme

(AV mode has slight inclination towards interaction)

The future: automation

Image credits

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