

Bar display or numeric display – which punctuality display makes more sense for train drivers?



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Agenda

- Background
- Approach
- Usability criteria
- Prototypes
- Field test and results
- Conclusion



Bild: Markus Krebs



Bild: Robert Keller



Background





Home

Tour

Fahren

Formulare

Dokumente

Private Dokumente



km	-	+	AE	Wetzikon	R150	PRO	An	Ab
4.0	10	7	(1315) 1308	Pfäffikon SZ 60 - 100	100	60		09:51:2
1.8	2	7		<i>Hurden</i>	100	60	(09:53:4)	
1.2				km 1.200				
59.3	0	13	(1311) sms 1-5	Rapperswil 40 80-95	105	95	09:55:5	09:59:1
				→ Zurich via Meilen				
60.9	0	12	1303	RW Jona 95	105	95	10:01:1	10:01:4
62.4				Block P363				
63.0				Block P364				
65.9	0	12		Rüti ZH 95	115	100	10:05:5	10:06:3
65.9				<i>Kurve Ausfahrt</i> 95				
68.6	6	12	1301	Bubikon 115 110	110	95	10:09:0	10:09:4
70.8				Block				
71.9				Block P370				
74.5	11	0	1301	Wetzikon 110 125	125	100	10:14:1	10:15:1
				→ Stet via Effretikon				
75.6				Block P375/Q475				
77.1	12	0		Aathal	110	100	(10:17:2)	
79.5				Block Q478				
81.3	8	0	(1312) 1301	Uster 110 125	125	115	10:20:1	10:21:0
84.3				Nänikon P384/Q484				
84.5	6	1		Nänikon-Greifensee	125	115	(10:23:1)	

10:11:13

20.04.20

SBSP
18538
ADL



-00:01:20

Manövrieren



Spalten

10:09:0

Punctuality display for train drivers?

Supporting information for train drivers increases knowledge,

- improves situational awareness and
- forward planning (Tschirner et al., 2013)

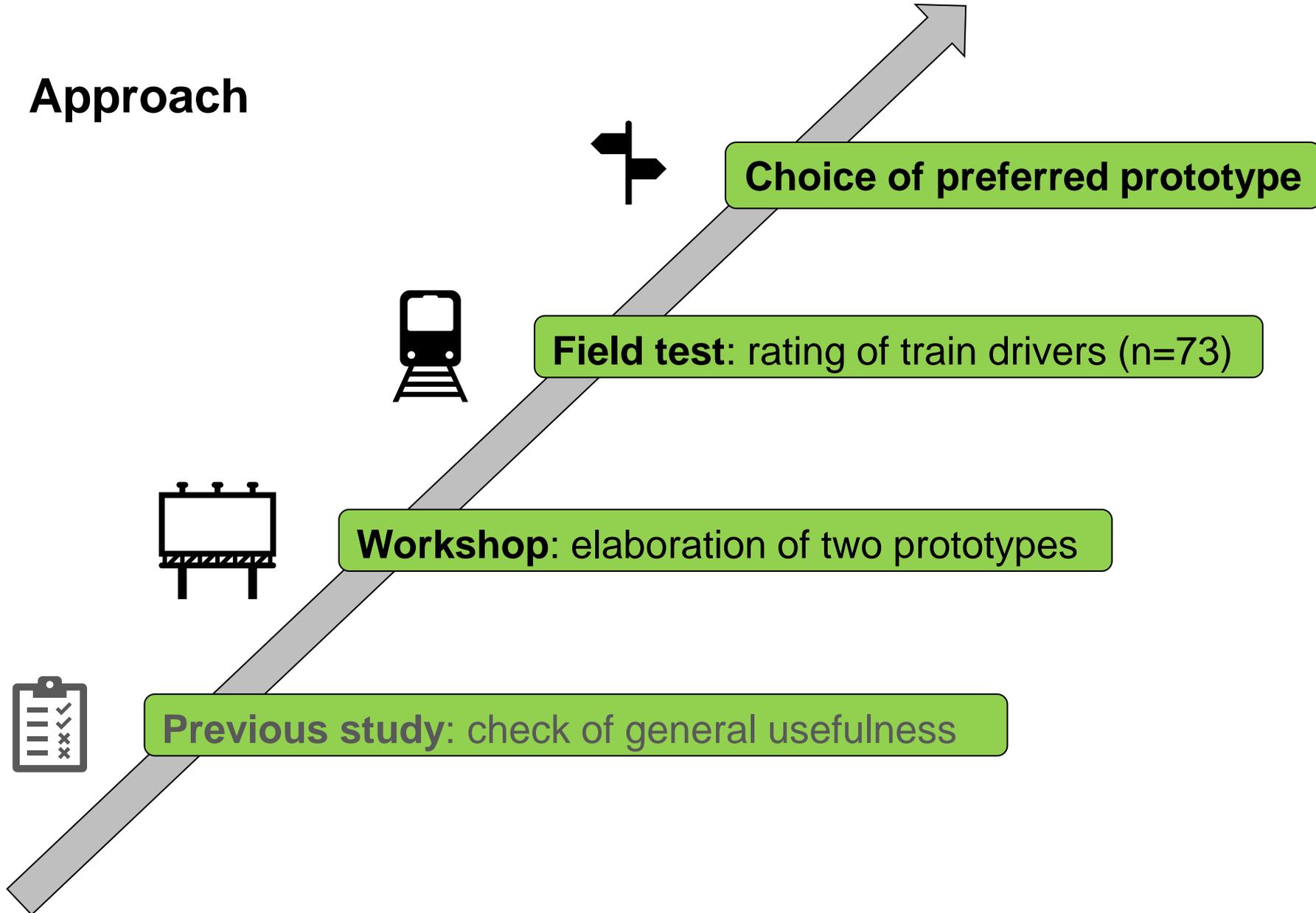
And: Supporting information for train drivers enhances energy safe driving (Graffagnino et al., 2019)

Could such a display also have negative effects?

Research questions

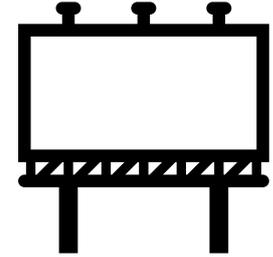
- Previous study for general usefulness
- How a punctuality display needs to be designed to support drivers in a smooth and safe journey without causing stress or distraction?

Approach



Previous study





Workshop

Aim

Elaboration of two prototypes

8 Experts

work psychology, train driving, statistics

Criteria

1. standards of usability
2. psychological principles
3. technical limitations

1. Standards of usability

- ❖ **Suitability for the user's tasks**
- ❖ **Conformity with user expectations**
- ❖ **User engagement**

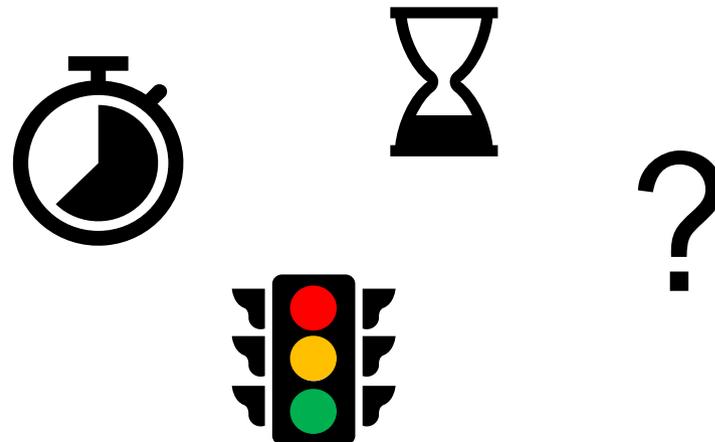
(ISO 9241-110 dialogue principles)

❖ Suitability for the user's tasks

Only use information that is relevant to the work task

What information is needed for the task?

- “5 min”
- “4 min 22 sec”

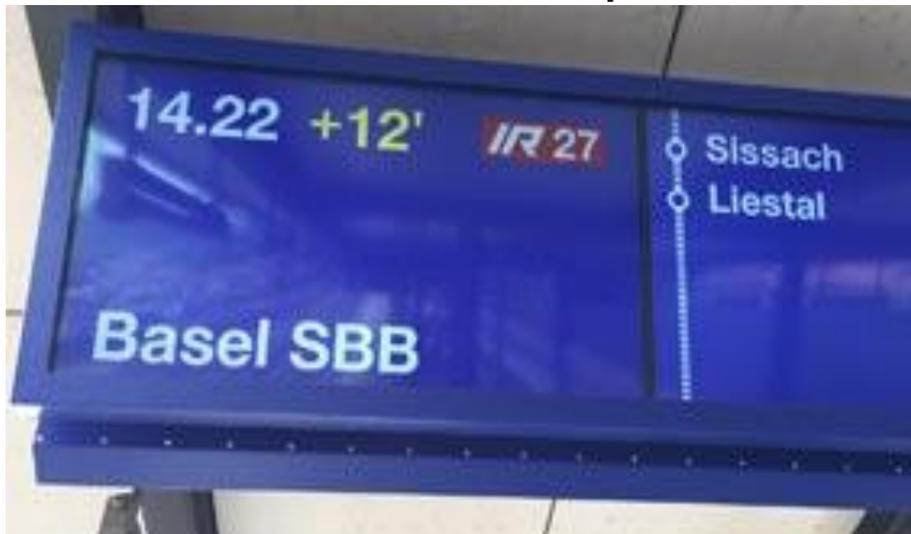


Or forms, colours?

❖ Conformity with user expectations

Use clear terms and symbols

At the platform



Mobile-App



❖ User engagement

Make individual adaptations possible for the user

- Can the train drivers switch the display on/off?
- Can they change size, position format?

	km	-	+	AE	ETCS	Meilen	R135	An	Ab
●	13.4	0	4			Erlenbach ZH	95 90	95 (23:21)	
	13.4					<i>Kurve Ausfahrt</i>	90		
●	14.6	7	7			Winkel am Zürichsee		95 (23:22)	
●	16.6	2	0			Herriberg-F.		85 (23:23)	
●	19.4	4	0	1307		Meilen	85 95	95 23:27	23:29
	20.9					<i>Kurve</i>	80		
●	22.4	0	5			Uetikon		95 23:32	23:32
●	23.6	6	2			<i>Männedorf</i>		85 23:33	23:33
	23.9					<i>Block</i>	P583		
	25.7					<i>Kurve</i>	75		
●	26.4	0	7			Stäfa	75 95	95 23:37	23:38
●	28.9	4	4	1307		Uerikon	95 85	95 23:40	23:40
	29.4					<i>Kurve Ausf.</i>	85		
●	31.4	0	0			Feldbach	95 75	85 23:44	23:46
	31.7					<i>Kurve Ausf.</i>	75		
●	33.8	7	0			Kempraten		85	
						<i>Kurve</i>	75		

2. Psychological principles

A punctuality display should...

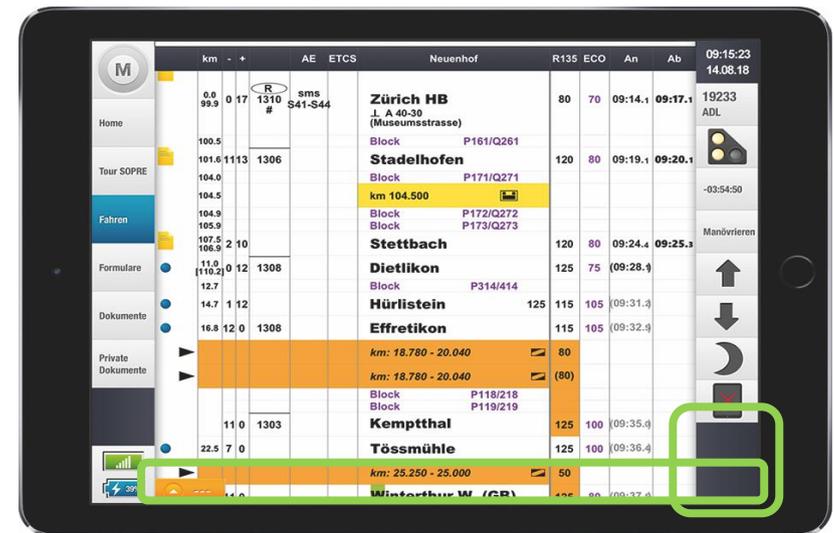
- ... increase transparency
- ... increase satisfaction
- ... increase safe work

A punctuality display must not ...

- ... increase stress / distraction
- ... reduce scope of action

3. Technical limitations

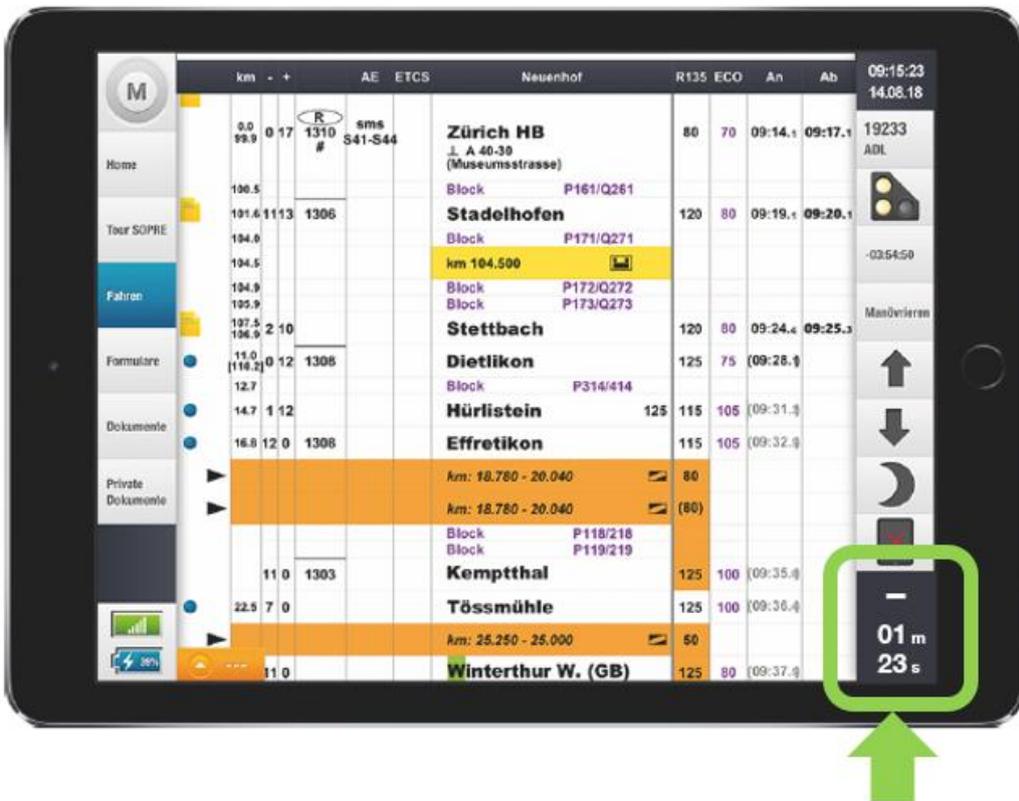
- restrictions on colours
- position / size



Result of workshop: Two prototypes

Numerical display

Bar display



Numeric display

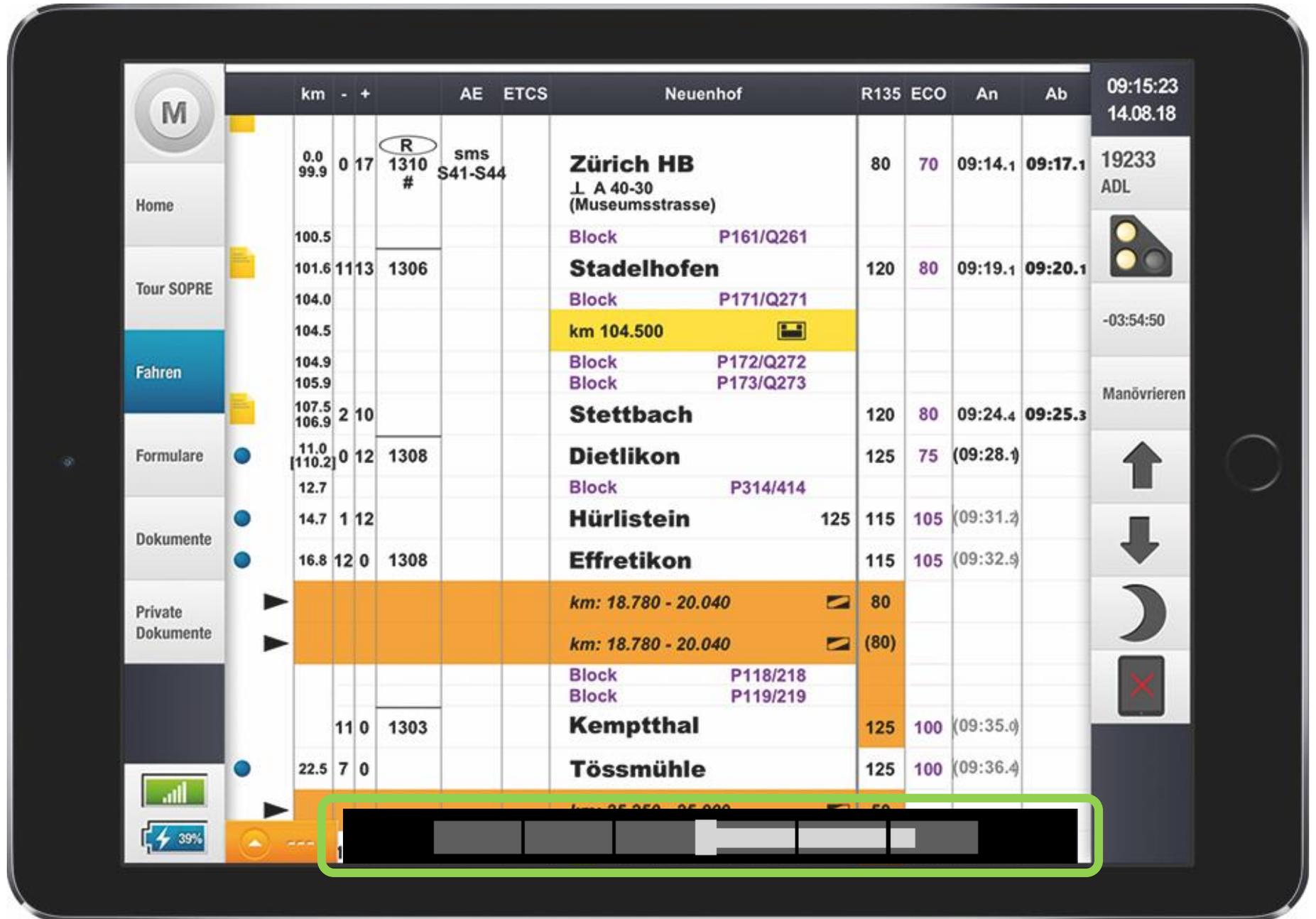
The screenshot shows a mobile application interface for a train schedule. The main content is a table with columns for distance (km), direction (+/-), train number, station name, and arrival/departure times. A green box highlights a numeric display in the bottom right corner showing '00 m' and '23 s'. The interface includes a sidebar with navigation options like 'Home', 'Tour SOPRE', 'Fahren', 'Formulare', 'Dokumente', and 'Private Dokumente'. The top right corner shows the current time and date: '09:15:23 14.08.18'.

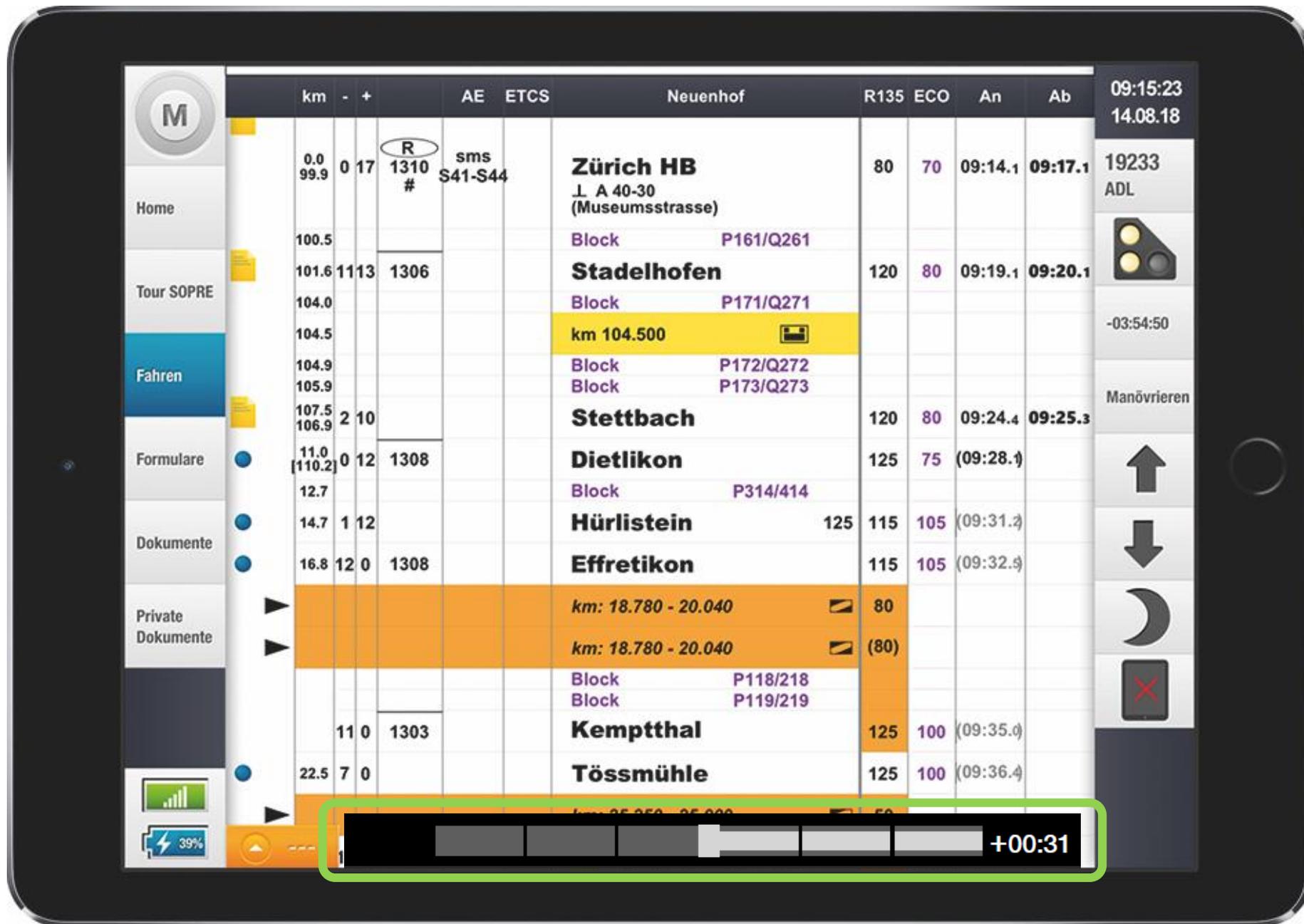
km	-	+	AE	ETCS	Neuenhof	R135	ECO	An	Ab
0.0					Zürich HB J. A 40-30 (Museumsstrasse)	80	70	09:14.1	09:17.1
99.9	0	17			Block P161/Q261				
100.5					Stadelhofen	120	80	09:19.1	09:20.1
101.6	11	13			Block P171/Q271				
104.0					km 104.500				
104.5					Block P172/Q272				
104.9					Block P173/Q273				
105.9					Stettbach	120	80	09:24.4	09:25.3
107.5	2	10			Block P314/414				
106.9					Dietlikon	125	75	(09:28.1)	
11.0	0	12			Hürlistein	125	115	105	(09:31.2)
110.2					Effretikon	115	105		(09:32.4)
12.7					km: 18.780 - 20.040	80			
14.7	1	12			km: 18.780 - 20.040	(80)			
16.8	12	0			Block P118/218				
					Block P119/219				
					Kempthal	125	100		(09:35.0)
	11	0			Tössmühle	125	100		(09:36.4)
22.5	7	0			km: 25.250 - 25.000	50			
					Winterthur W. (GB)	125	80		(09:37.4)

Numeric display

The screenshot shows a mobile application interface for a train schedule. The main content is a table with columns for distance (km), station names, and arrival/departure times. A green box highlights a numeric display in the bottom right corner showing '01 m 55 s'.

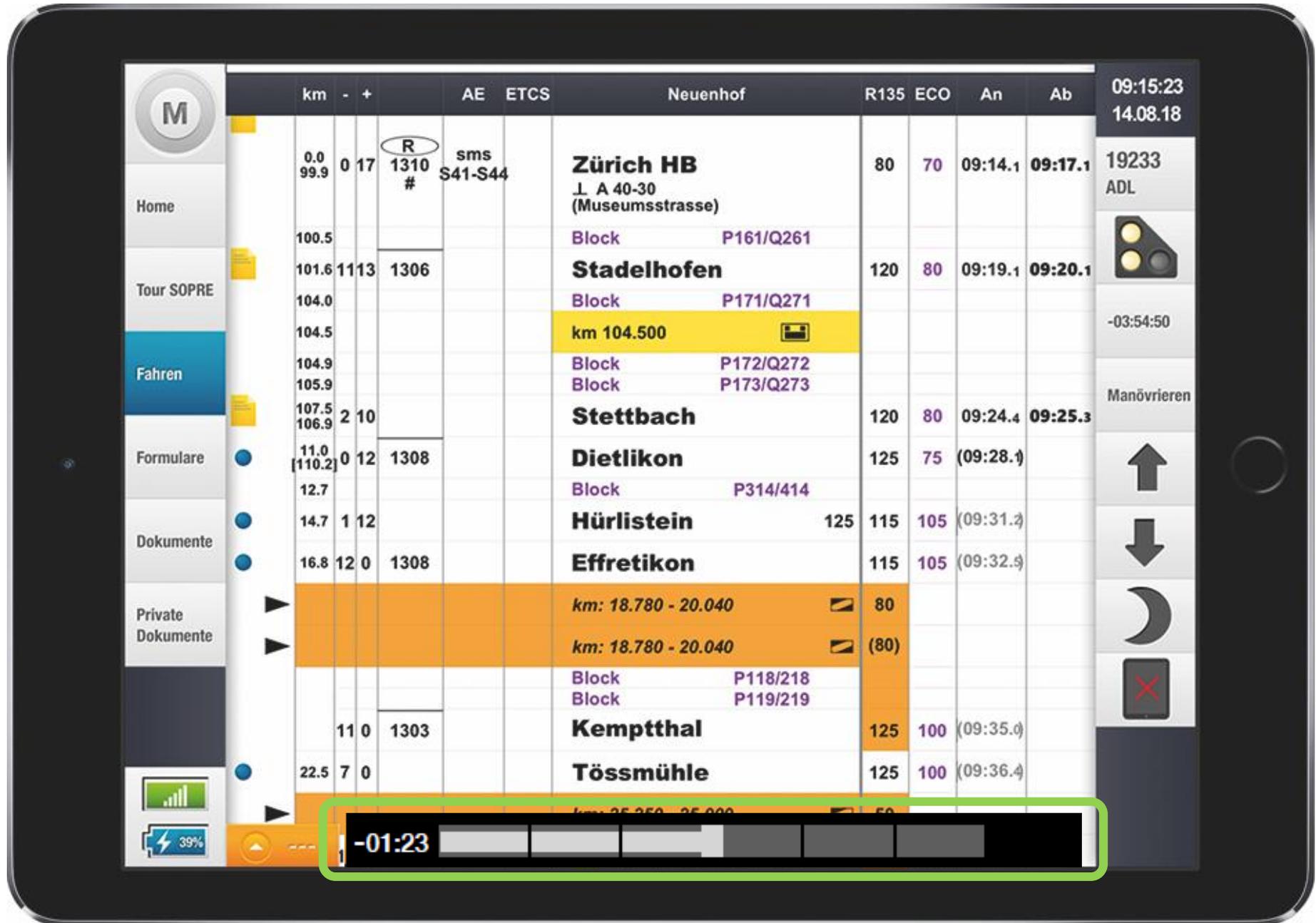
km	-	+	AE	ETCS	Neuenhof	R135	ECO	An	Ab
0.0					Zürich HB J. A 40-30 (Museumsstrasse)	80	70	09:14.1	09:17.1
100.5					Block P161/Q261				
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104.0					Block P171/Q271				
104.5					km 104.500				
104.9					Block P172/Q272				
105.9					Block P173/Q273				
107.5	2	10			Stettbach	120	80	09:24.4	09:25.3
106.9									
11.0	0	12			Dietlikon	125	75	(09:28.1)	
110.2					Block P314/414				
12.7									
14.7	1	12			Hürlistein	125	115	105 (09:31.2)	
16.8	12	0			Effretikon	115	105	(09:32.5)	
					km: 18.780 - 20.040	80			
					km: 18.780 - 20.040	(80)			
					Block P118/218				
					Block P119/219				
	11	0			Kempthal	125	100	(09:35.0)	
22.5	7	0			Tössmühle	125	100	(09:36.4)	
					km: 25.250 - 25.000	50			
	11	0			Winterthur W. (GB)	125	80	(09:37.9)	

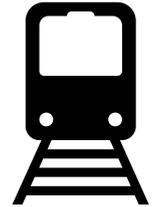






Bar display

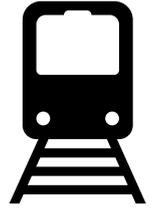




Field test

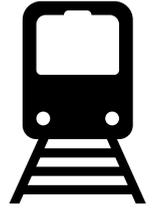
- 73 participants
- Test application and switching between the two displays
- Testing during two shifts
- Evaluation by online questionnaire → 55 valid questionnaires



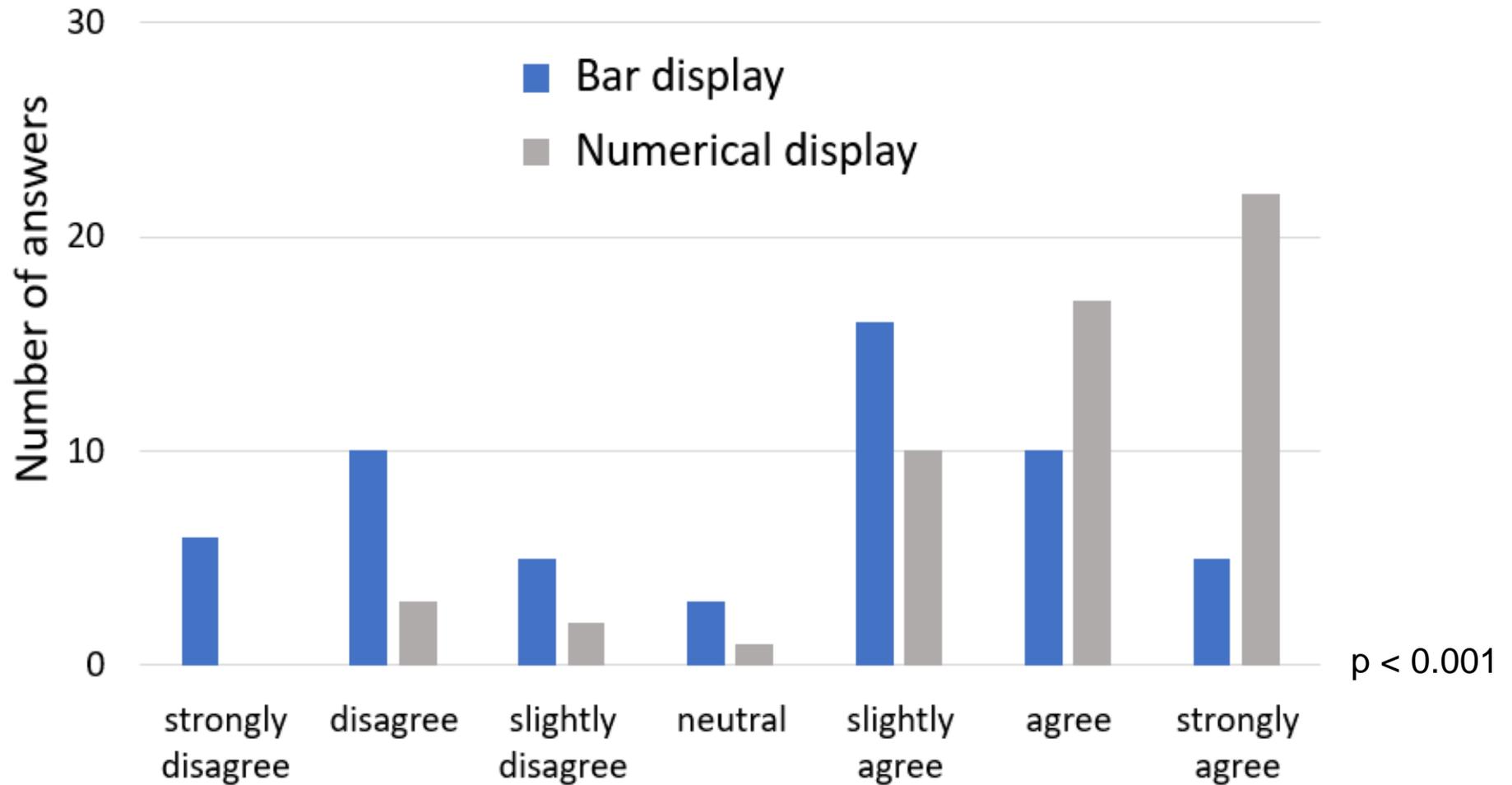


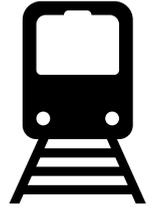
Field test: questionnaire

- usefulness
- potential for distraction
- intuitive understanding
- type preferred

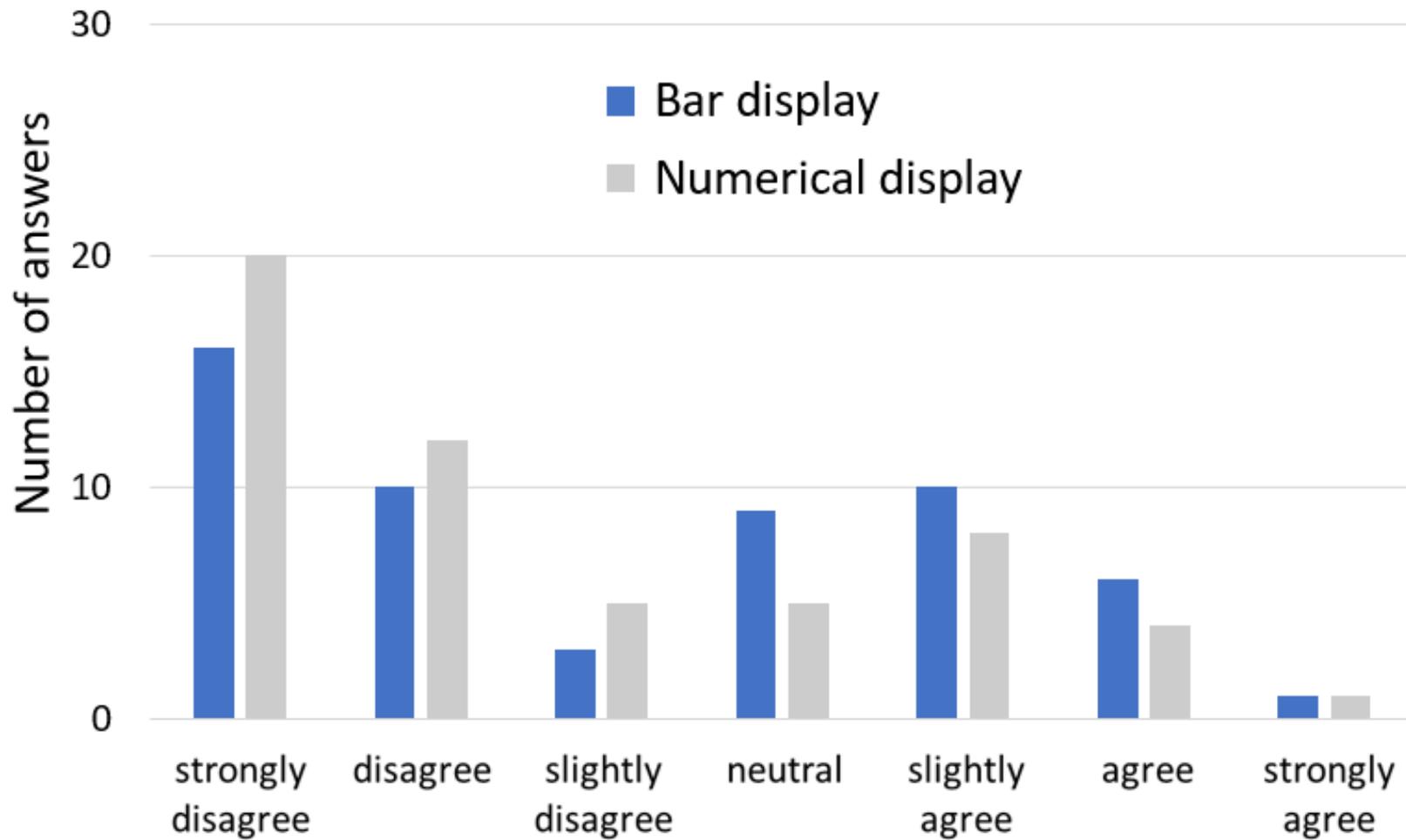


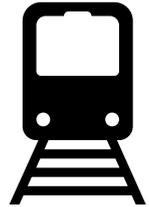
“Was the punctuality display useful to you?”



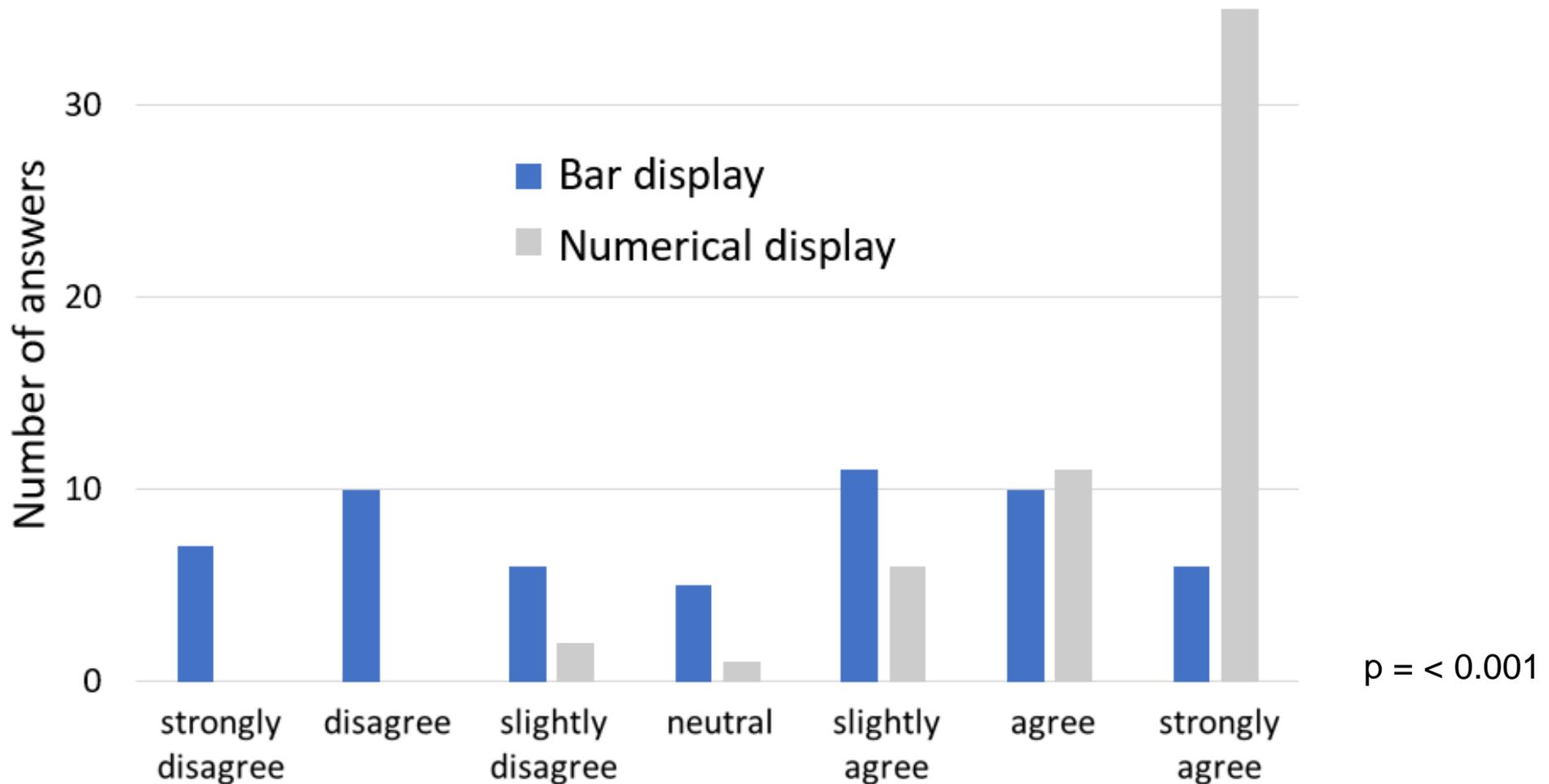


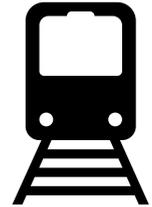
“Did the punctuality display distract you?”





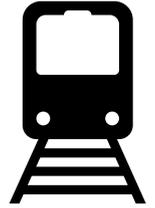
“Could you tell at a glance how much ahead or behind schedule you were at the moment?”



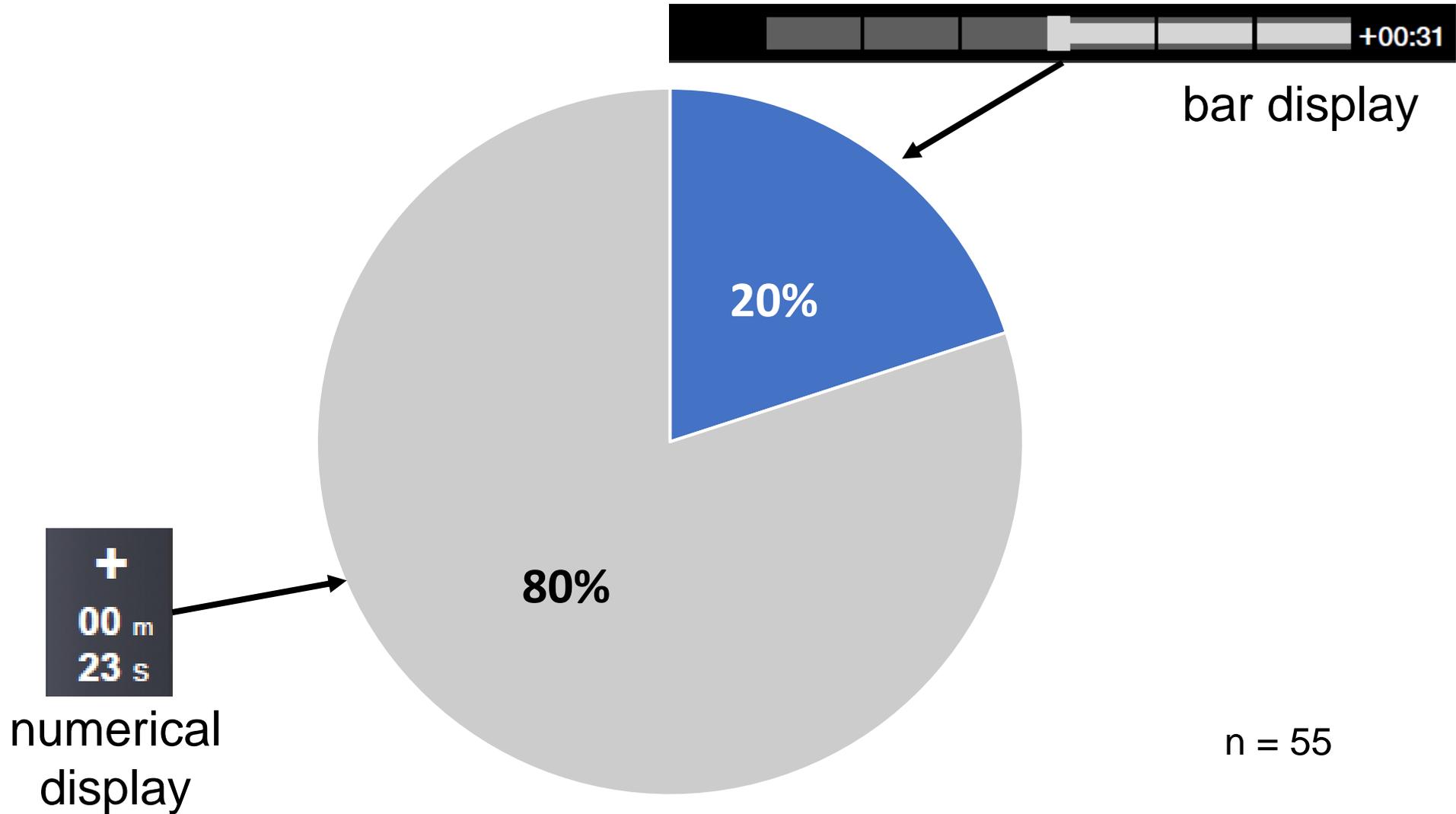


Comments from questionnaire

<p>Type of display</p>		
	<p>“Indication in seconds is much more conclusive.”</p> <p>“You can see at a glance how many seconds you are ahead or behind.”</p> <p>“The display is perfect. It should be placed exactly where it was in the test...”</p>	<p>“Above all, the bar graph shows me with a quick sideways glance how I am in terms of time.”</p>
	<p>“... leads to an overload of numbers on the screen.”</p>	<p>“I didn't know if I was early or late now.”</p> <p>“... less clearly understandable.”</p> <p>“...tied up too much attention without numbers.”</p>

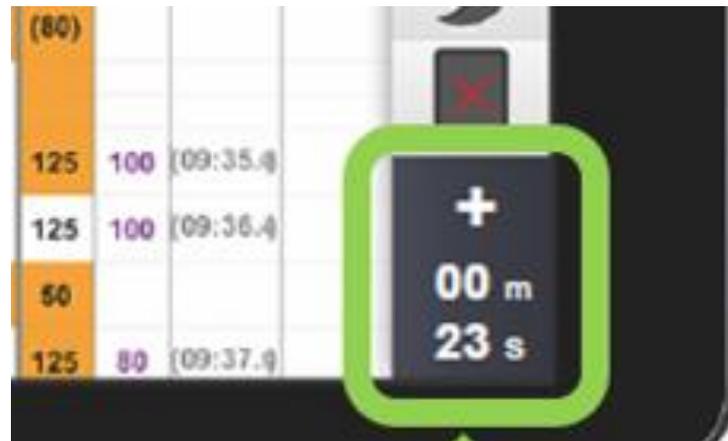


“What type do you prefer?”



Conclusion

- Train drivers appreciate this additional support
- **Numerical display is clearly preferred**
- For both types the potential for stress and distraction is low
- But: Small potential for distraction?



Further research topics

- Usability criteria must be considered also on holistic levels (application, cab)
- Further testing for special situations (network interruption, diversion etc.)
- Objective measure for distraction



Thank you very much!

Sources

- Deutsches Institut für Normung e.V. EN ISO 9241-110 (DIN EN ISO 9241-110). (2008). Ergonomie der Mensch-System-Interaktion - Teil 110: Grundsätze der Dialoggestaltung [Ergonomics of human-system interaction - Part 110: Dialogue design principles] (ISO 9241-110:2006). Berlin: Beuth Verlag GmbH.
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