

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

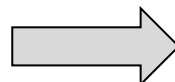
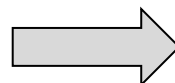


Bild: Robert Keller



Background



M					AE	Wetzikon	R150	PRO	An	Ab	10:11:13
	km	-	+								20.04.20
Home	4.0	10	7	(1315) 1308		Pfäffikon SZ 60 - 100	100	60		09:51:2	SBSP
	1.8	2	7			<i>Hurden</i>	100	60	(09:53:4)		18538
	1.2					km 1.200 F					ADL
Tour	59.3	0	13	(1311)	sms 1-5	Rapperswil 40 80-95	105	95	09:55:5	09:59:1	
						Q→ Zurich via Meilen					-00:01:20
Fahren	60.9	0	12	1303		RW Jona 95	105	95	10:01:1	10:01:4	Manövrieren
	62.4					Block P363					
	63.0					Block P364					
Formulare	65.9	0	12			Rüti ZH 95	115	100	10:05:5	10:06:3	↑
	65.9					<i>Kurve Ausfahrt</i> 95					
Dokumente	68.6	6	12	1301		Bubikon 115 110	110	95	10:09:0	10:09:4	↓
	70.8					Block P370					
	71.9										
Private Dokumente	74.5	11	0	1301		Wetzikon 110 125	125	100	10:14:1	10:15:1	☾
						Q→ Stet via Effretikon					
	75.6					Block P375/Q475					Spalten
	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					
		6	1			Nänikon-Greifensee	125	115	(10:23:1)		

Punctuality display for train drivers?

Supporting information for train drivers increases knowledge,

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

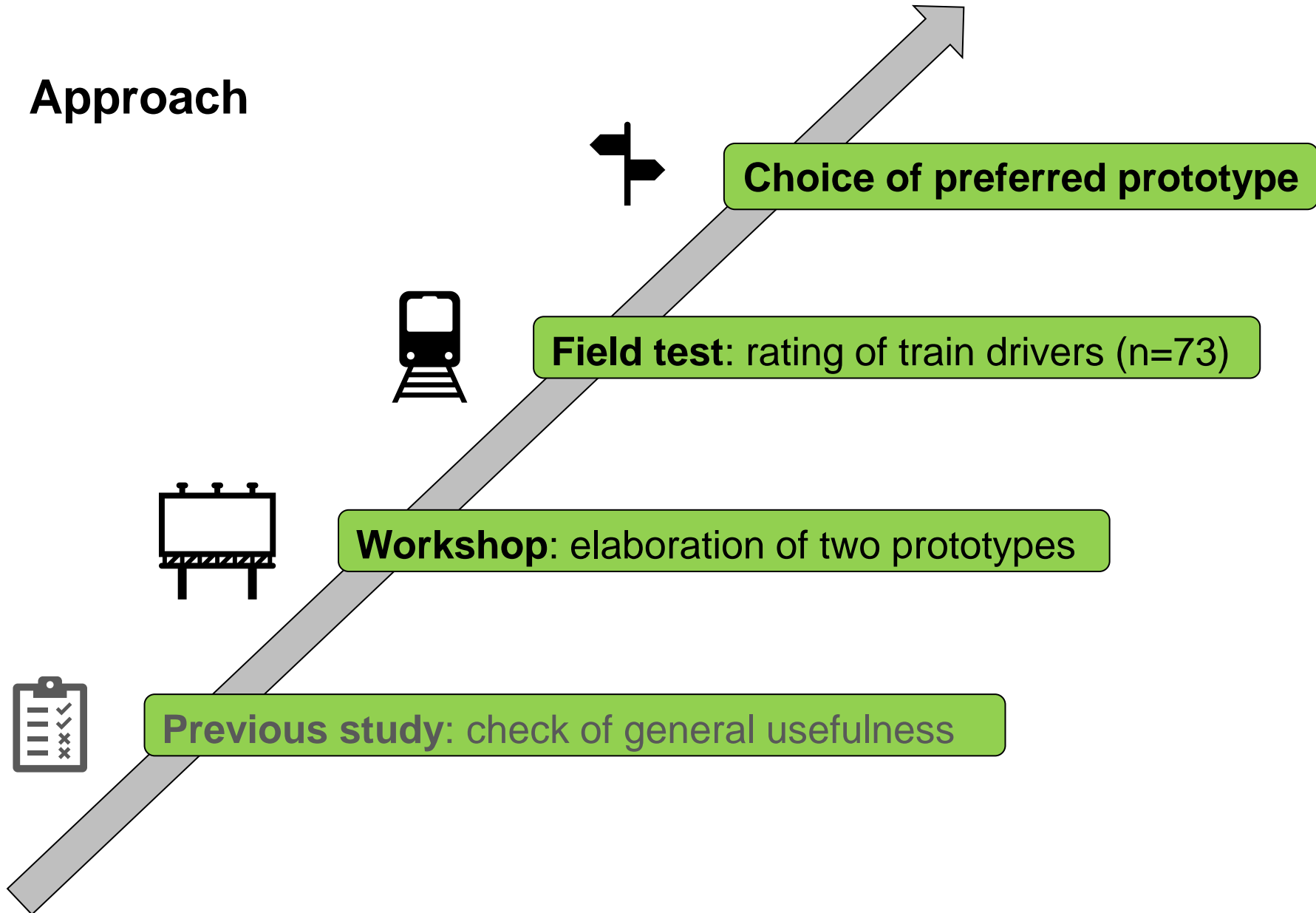
And: Supporting information for train drivers enhances energy safe driving (Graffagnino et al., 2019)

Could such a display also have negative effects?

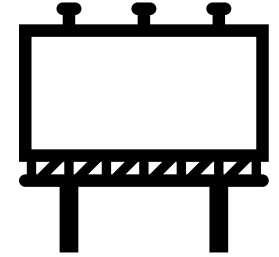
Research questions

- 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







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**

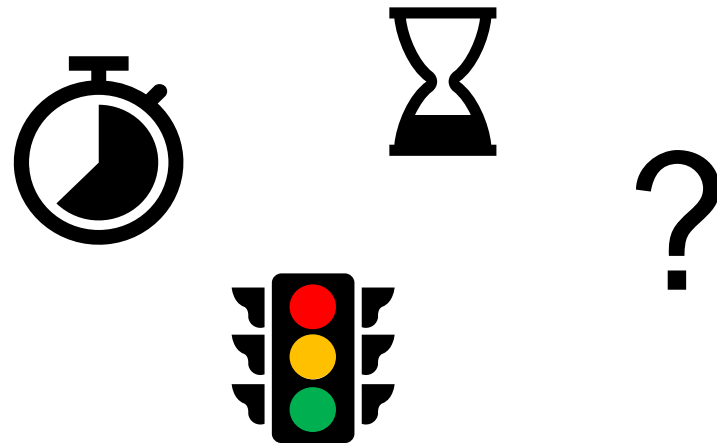
(ISO 9241-110 dialogue principles)

❖ 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			Herrliberg-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			Männedorf		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		

ADL END

2. Psychological principles

A punctuality display should...

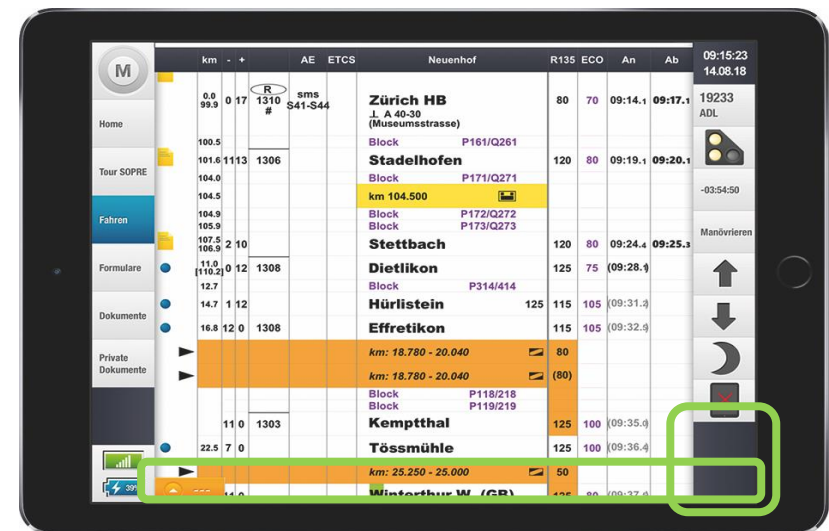
... increase transparency
... increase satisfaction
... increase safe work

A punctuality display must not ...

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

3. Technical limitations

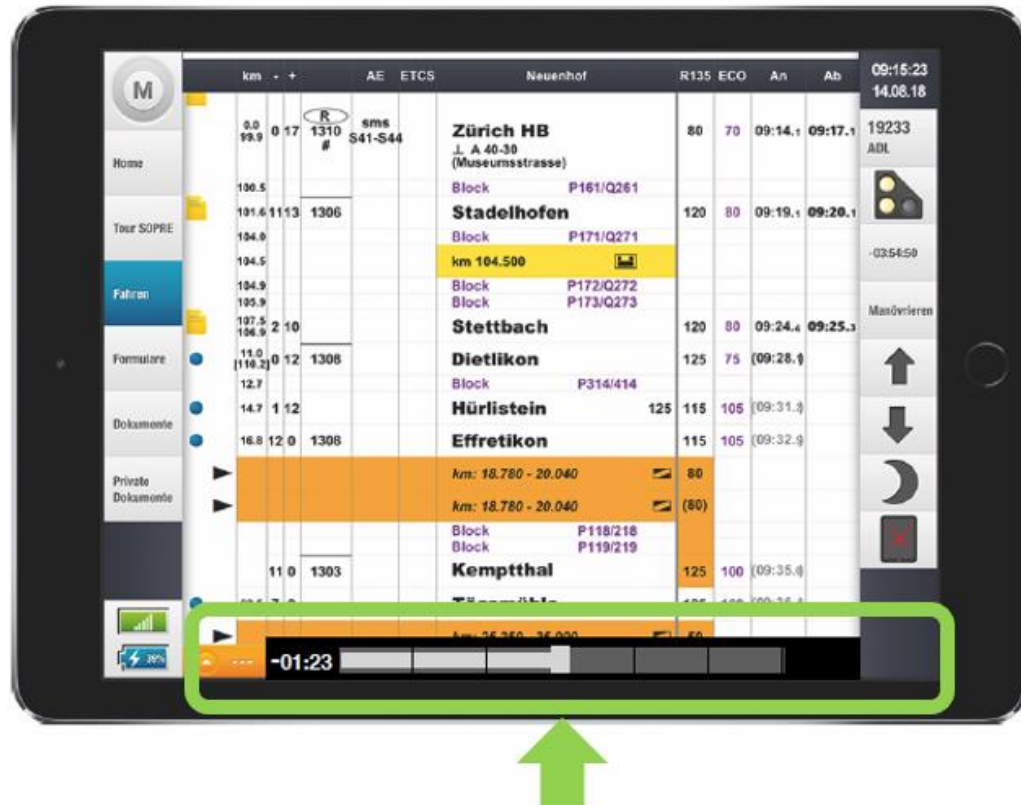
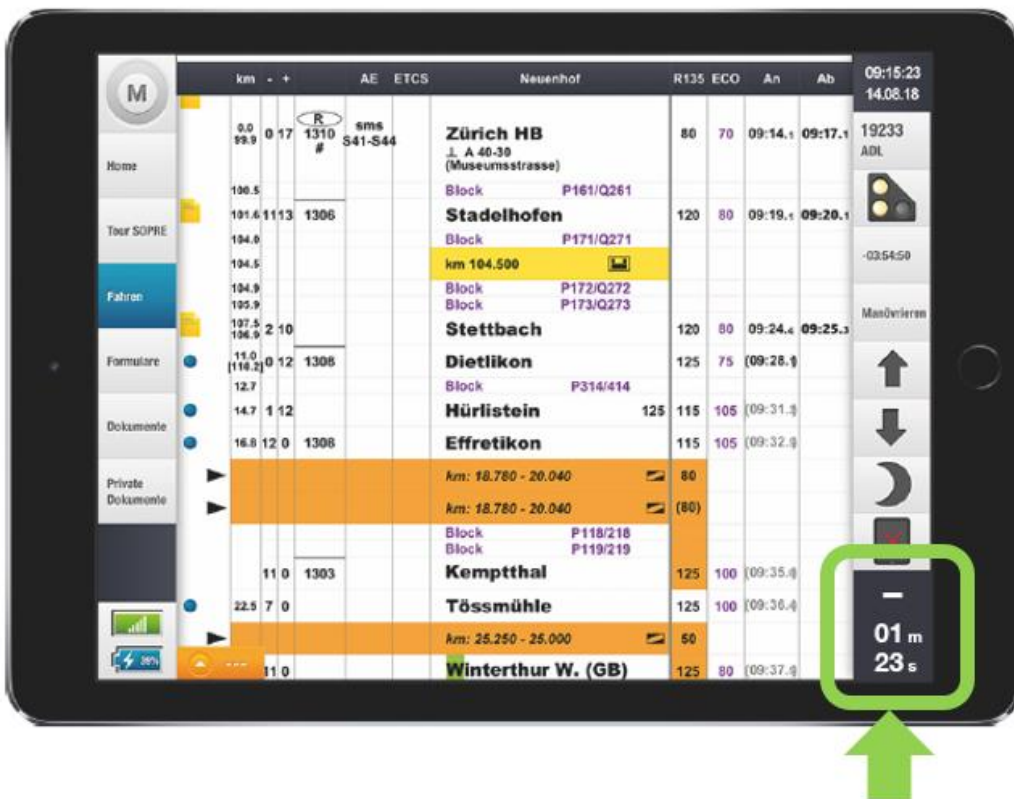
- restrictions on colours
- position / size

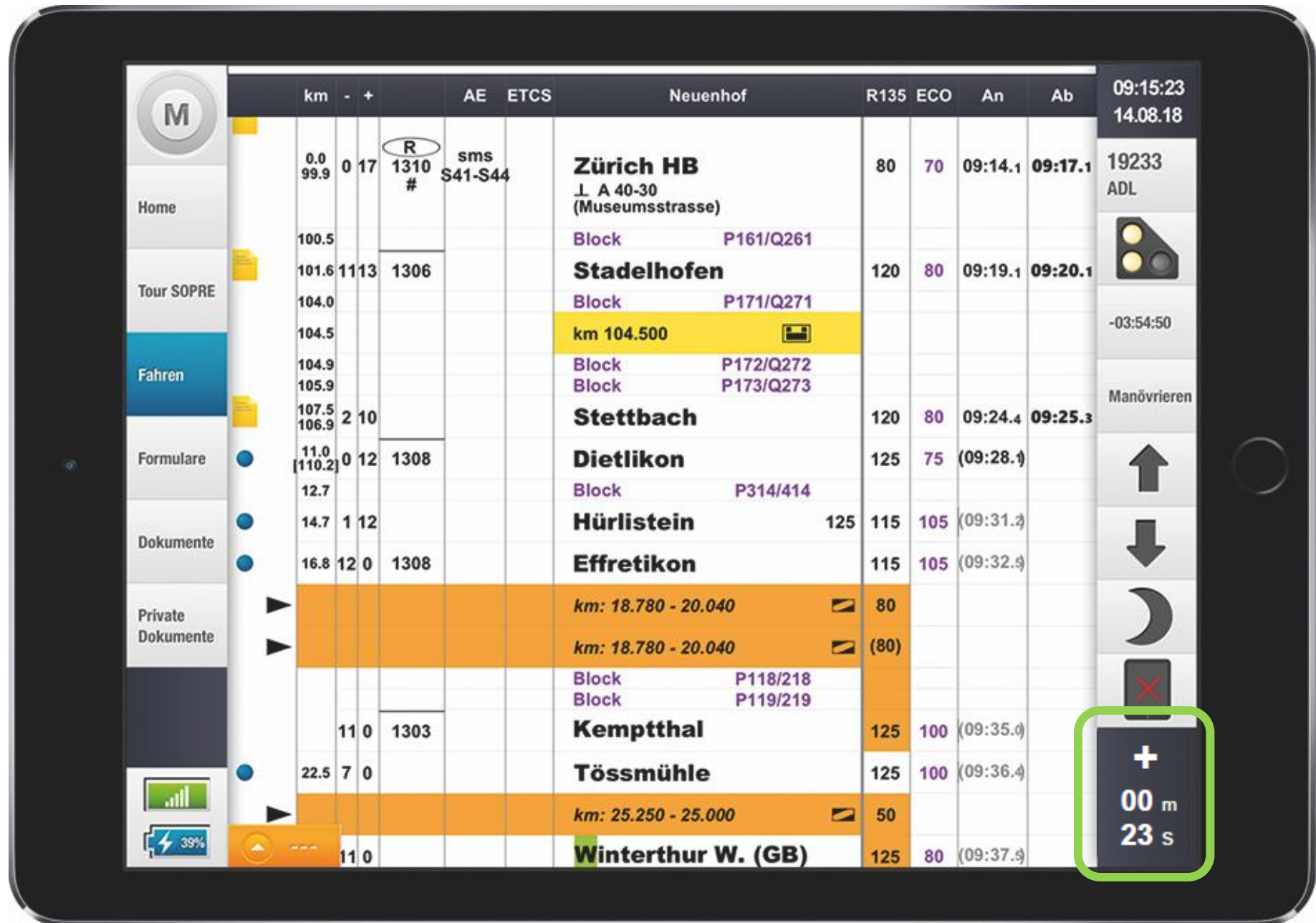


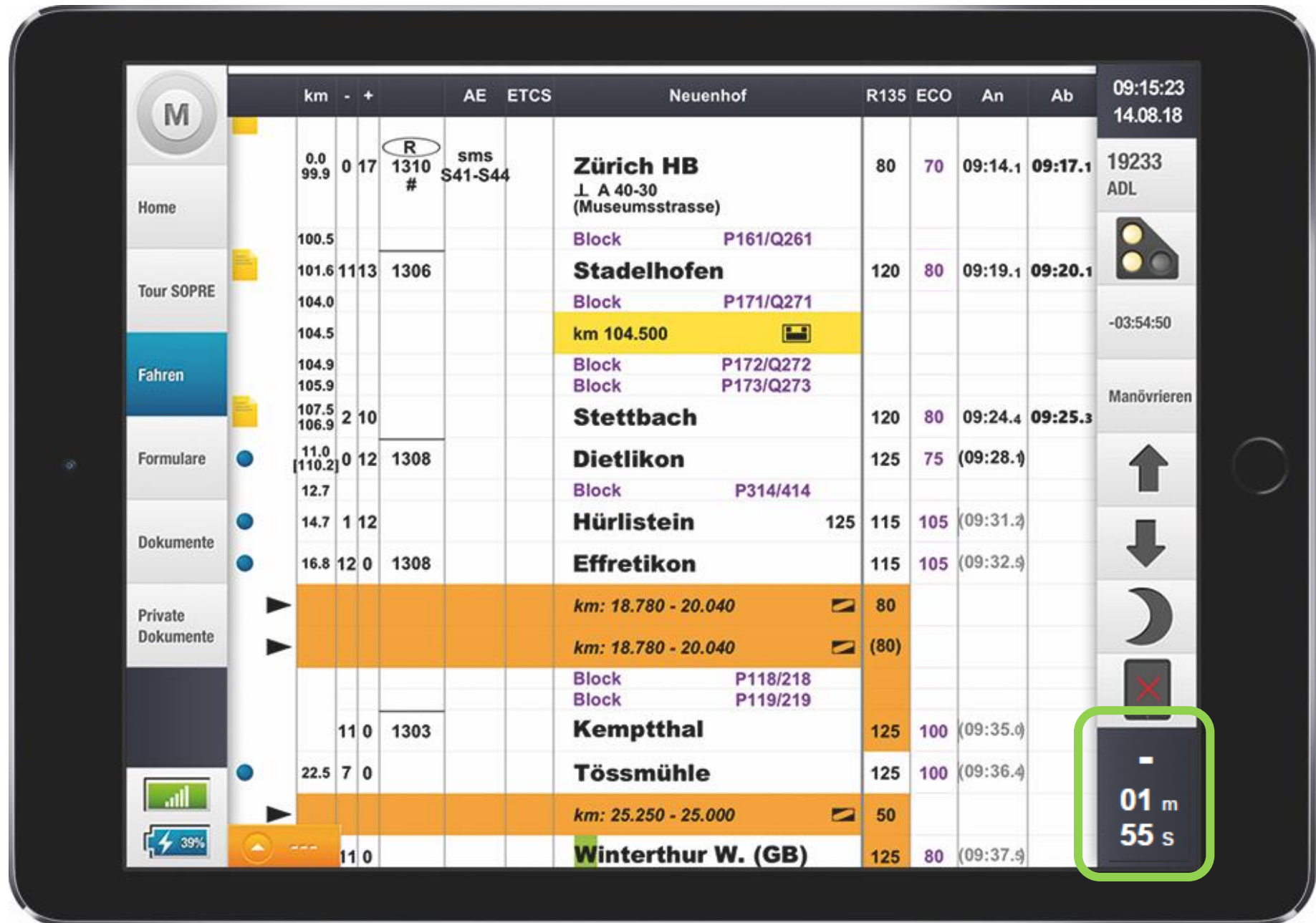
Result of workshop: Two prototypes

Numerical display

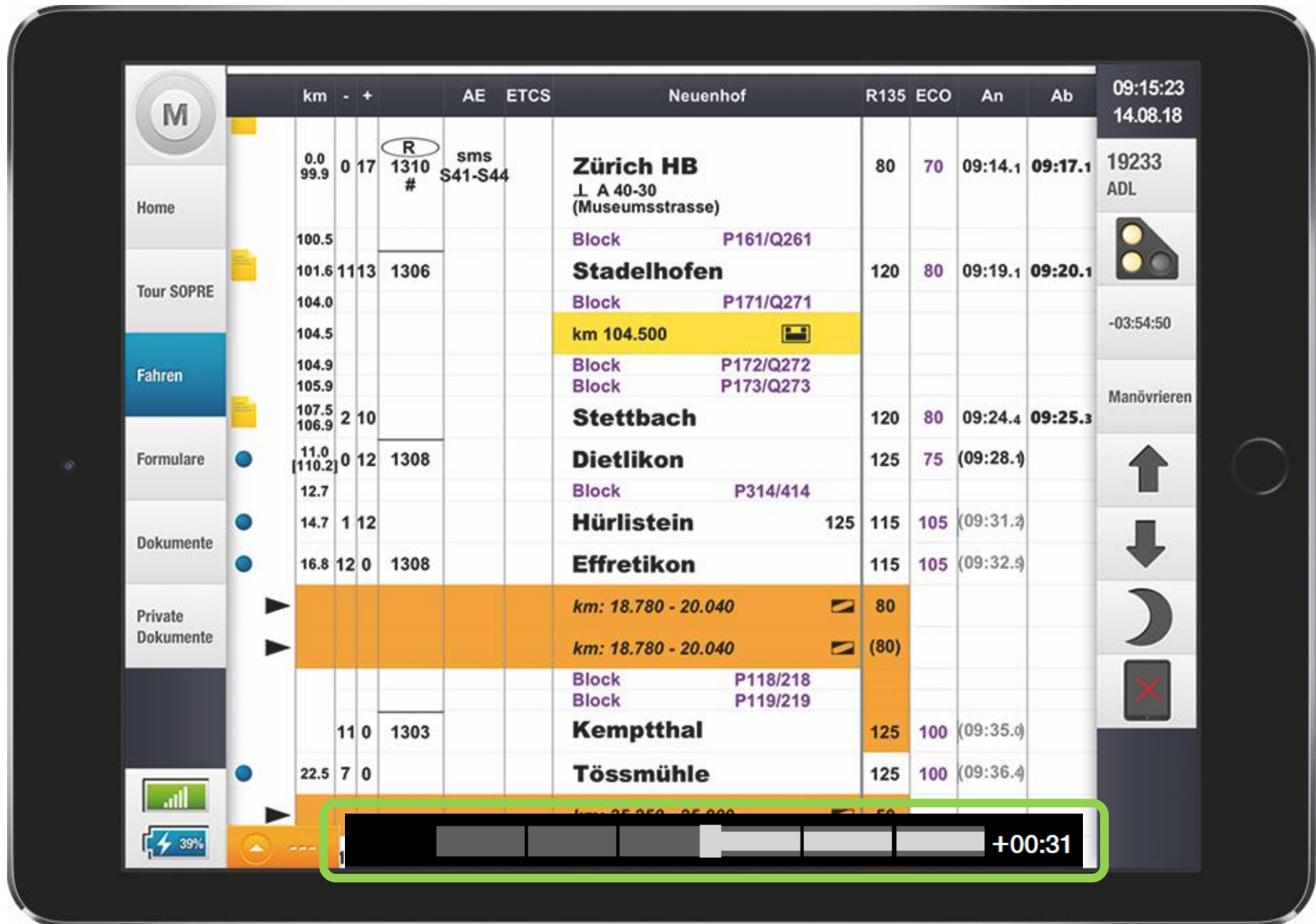
Bar display



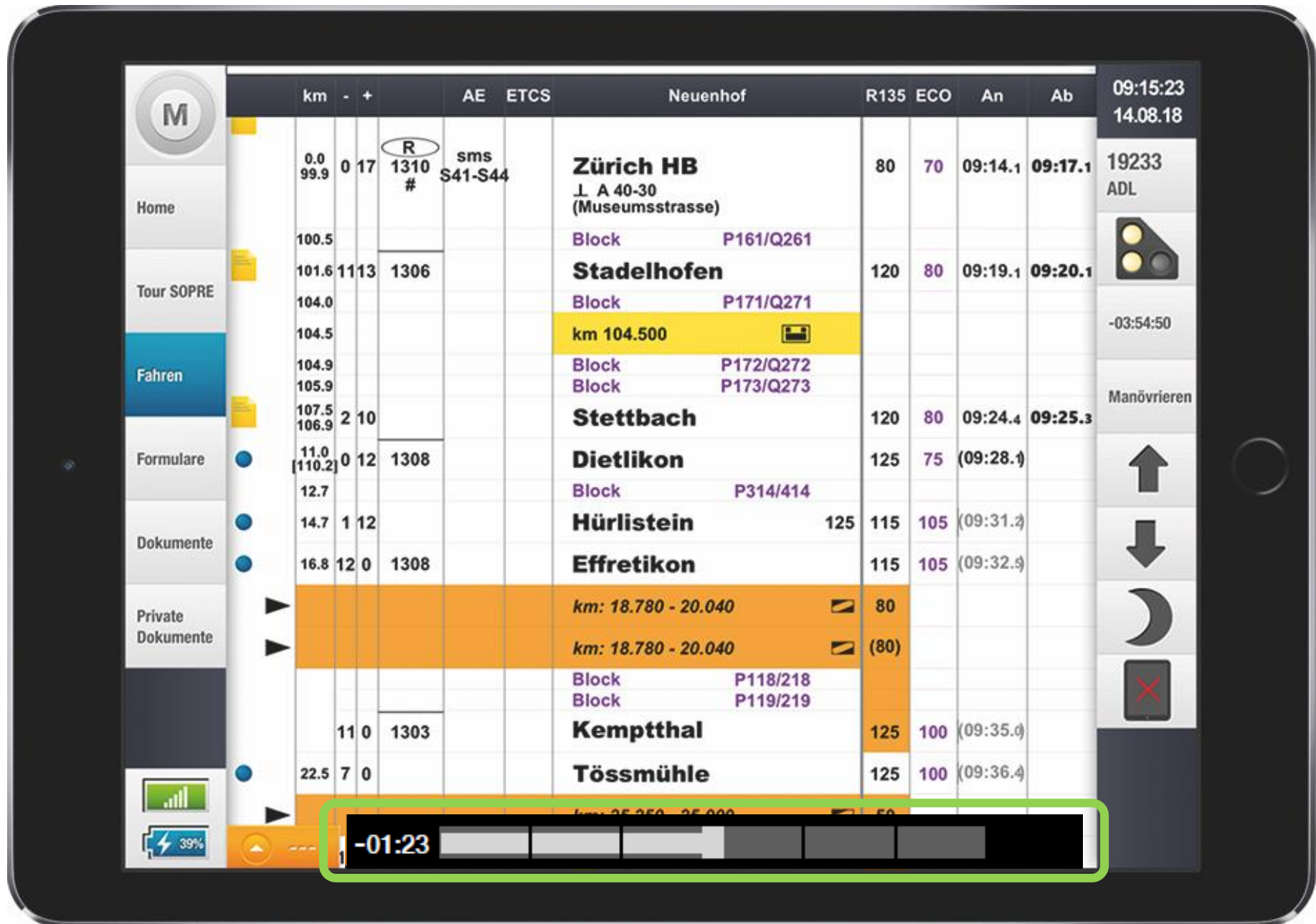


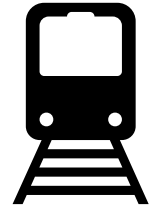






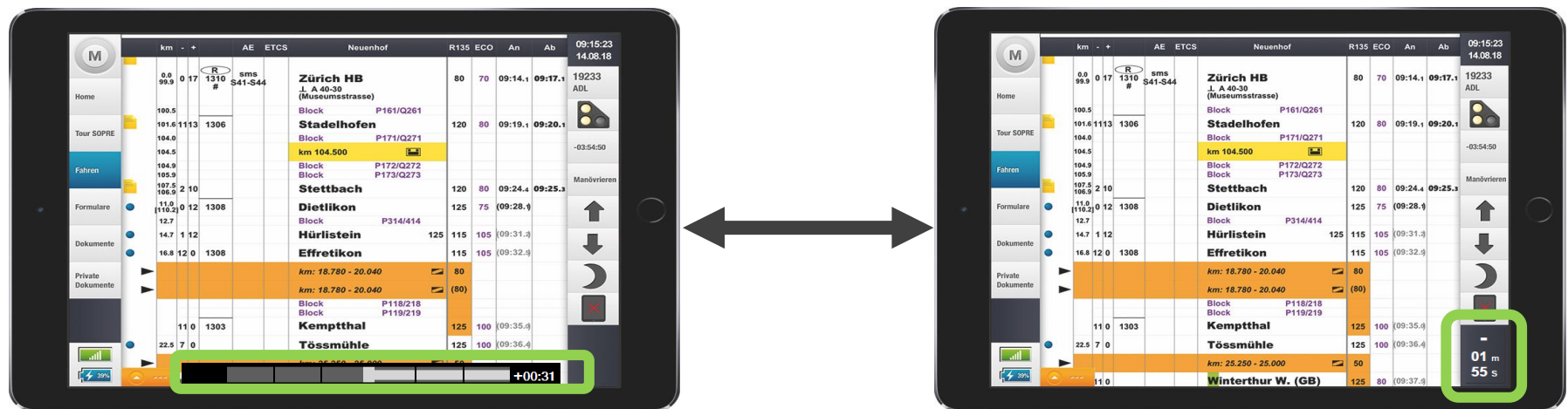


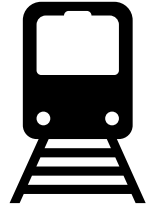




Field test

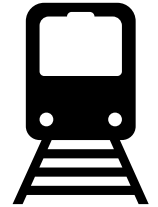
- 73 participants
- Test application and switching between the two displays
- Testing during two shifts
- Evaluation by online questionnaire → 55 valid questionnaires



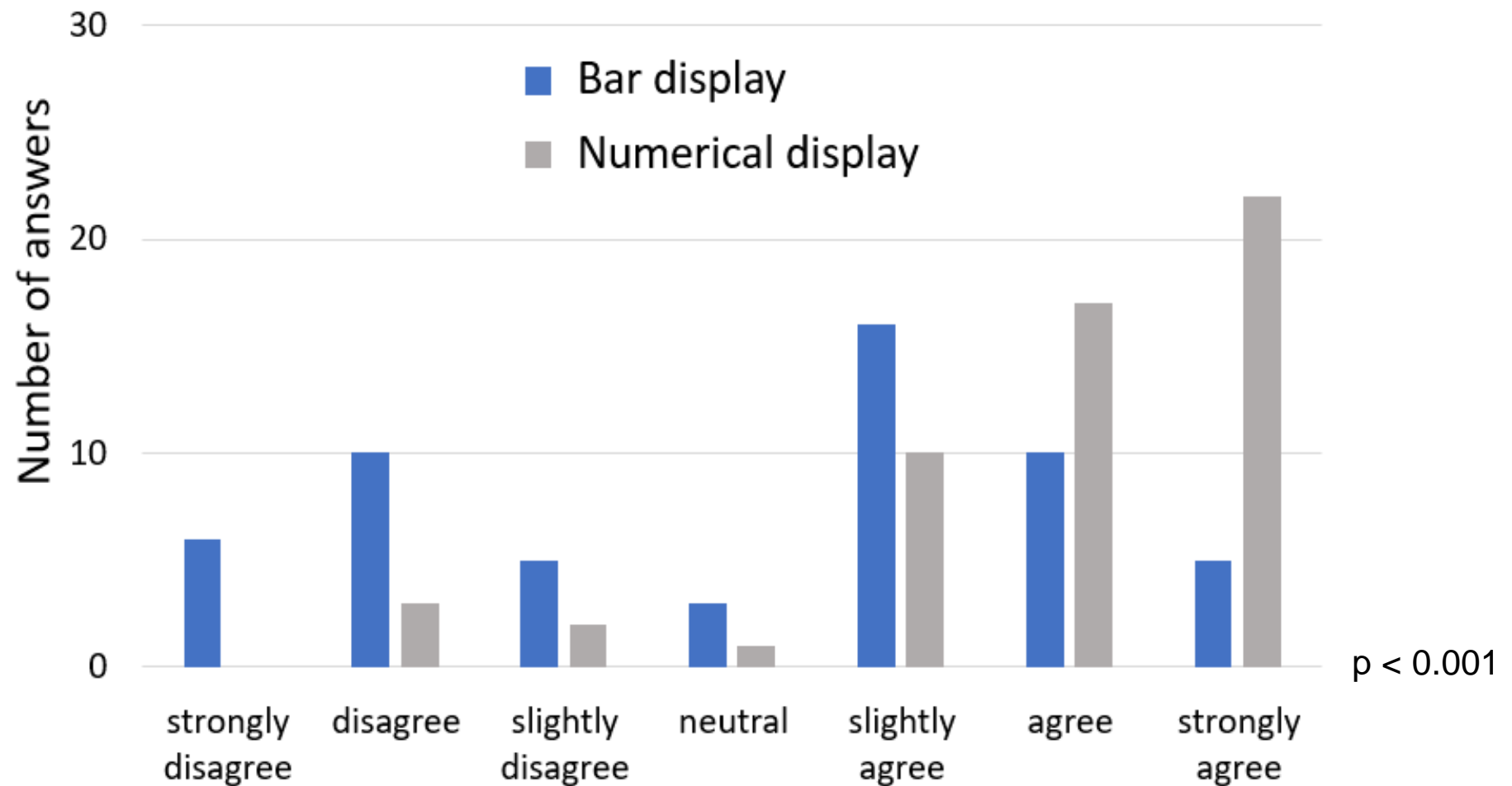


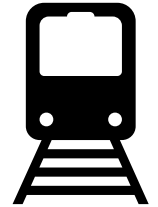
Field test: questionnaire

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

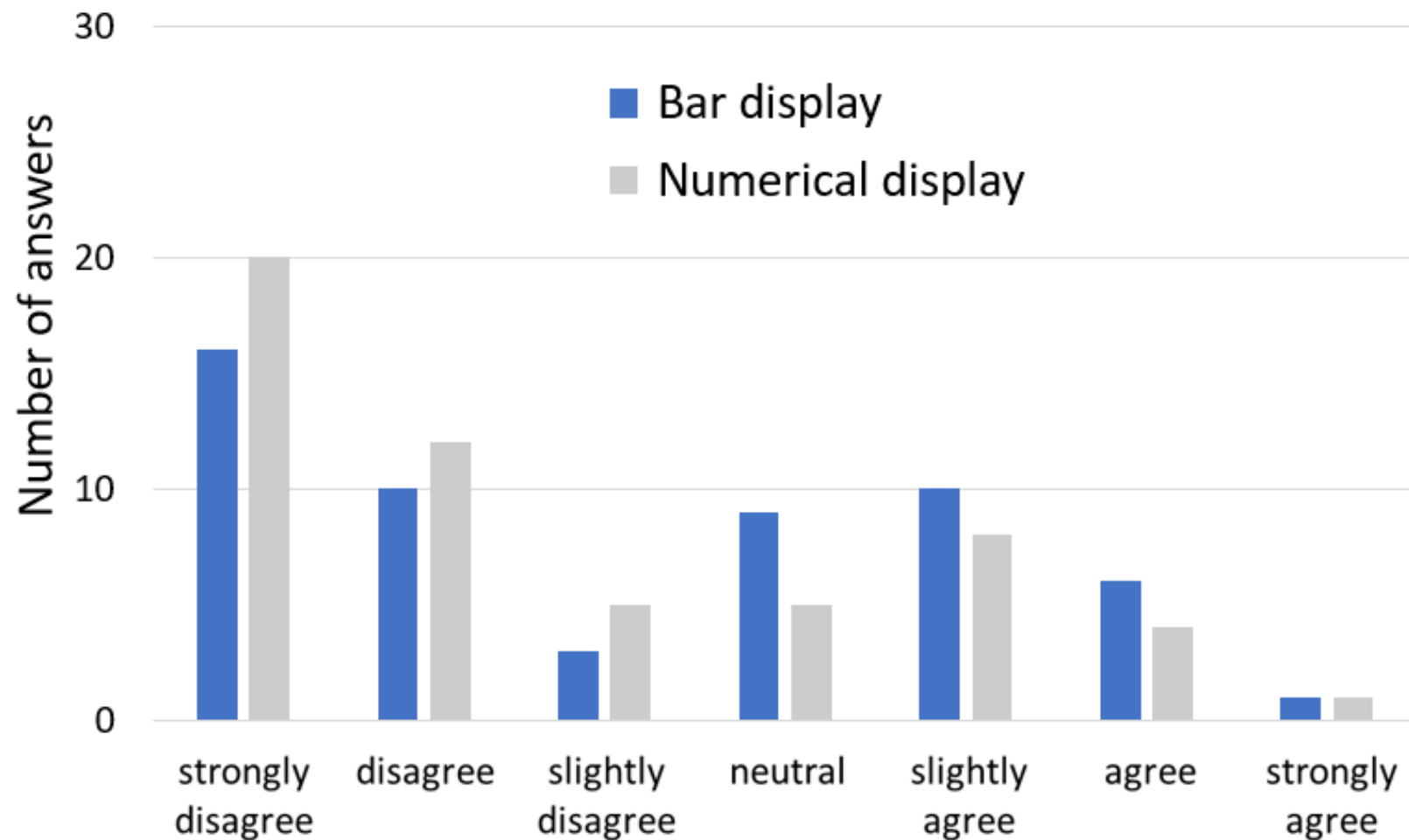


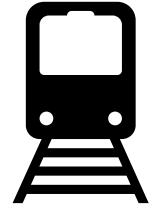
“Was the punctuality display useful to you?”



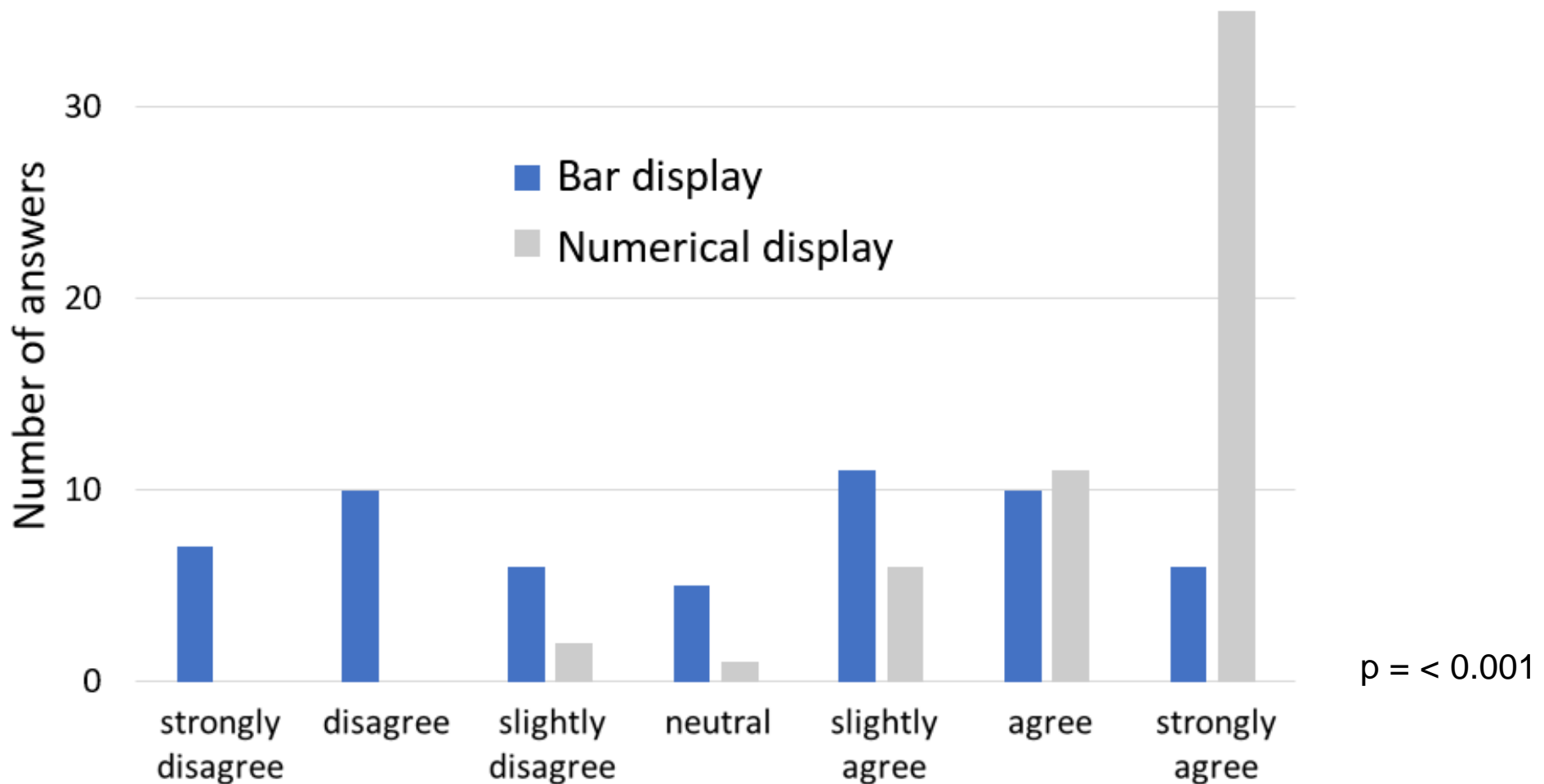


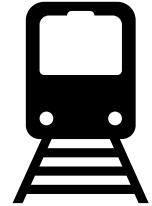
“Did the punctuality display distract you?”









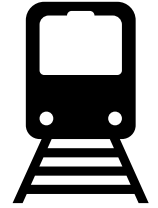
“Could you tell at a glance how much ahead or behind schedule you were at the moment?”



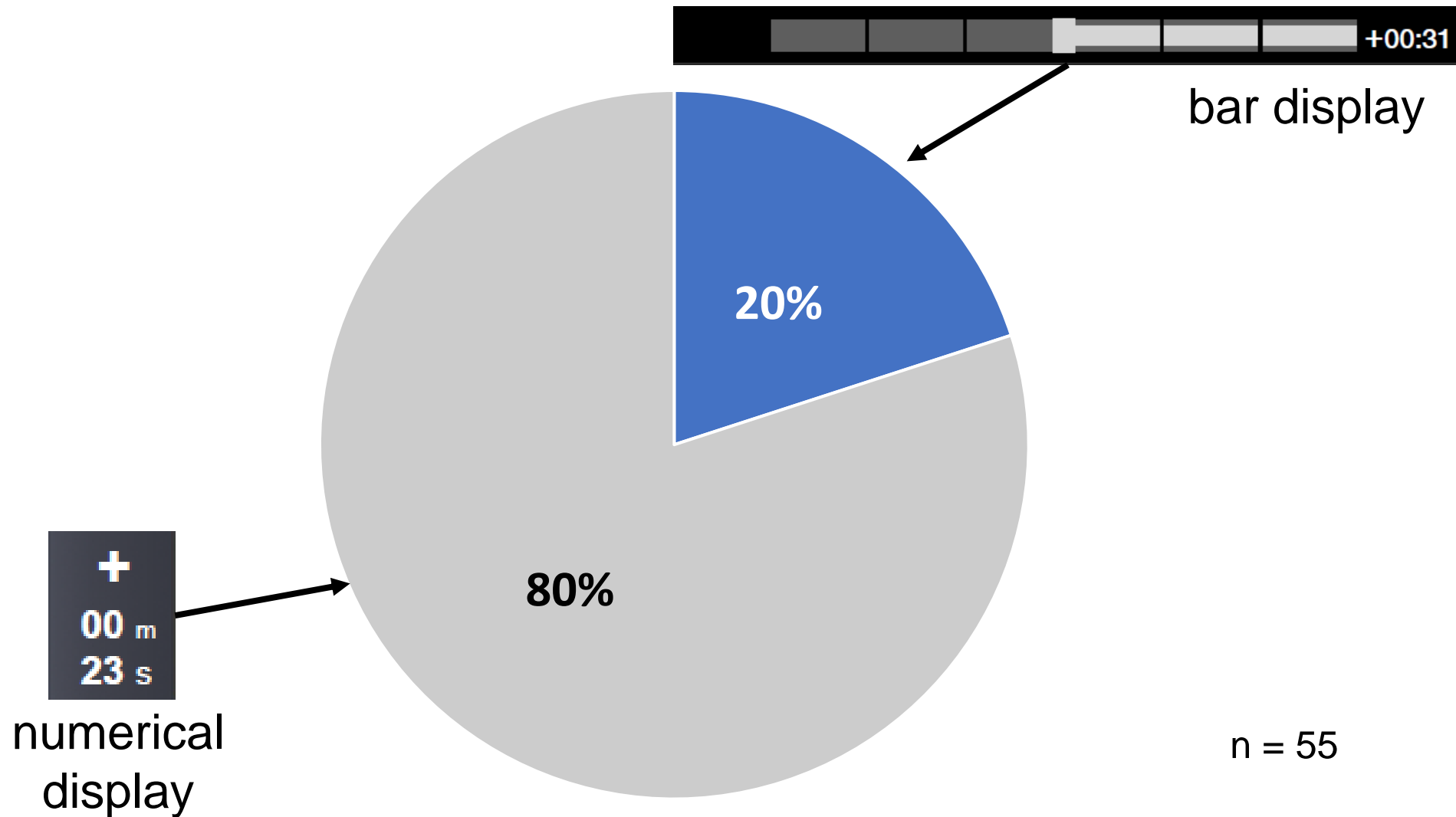


Comments from questionnaire

Type of display		
	<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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