Auswirkung von Korrektionen der Alterssichtigkeit auf die muskuläre Belastung des Schulter-Nacken-Bereichs während der Bildschirmarbeit (TRAP PC Studie)

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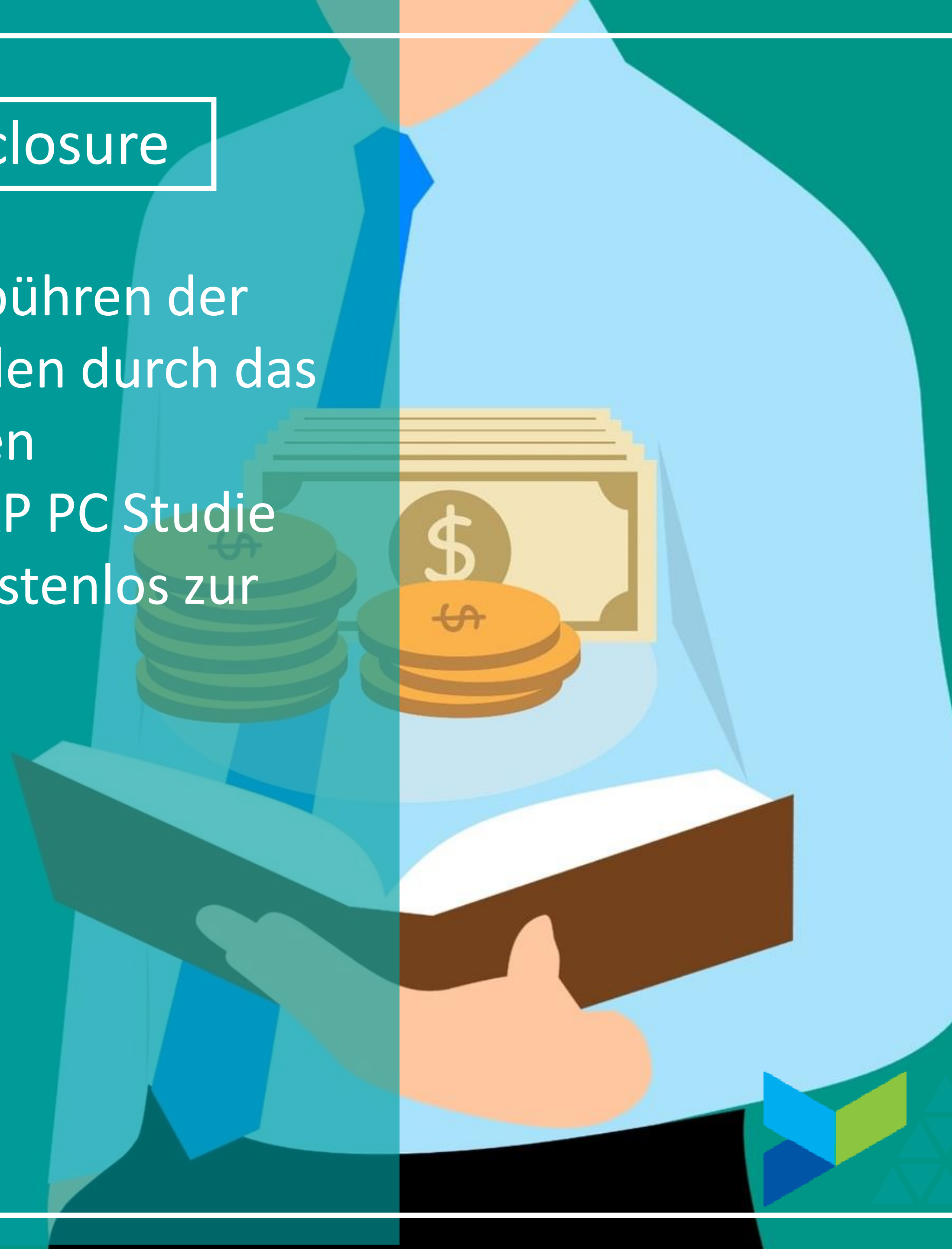
- Brillengläser der TRAP PC Studie wurden von Visall kostenlos zur Verfügung gestellt

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ORIGINAL INVESTIGATION

Surface Electromyography of the Trapezius and Sternocleidomastoid during Computer Work with Presbyopic Corrections

Oliver Kolbe, MEng,[1]* Kathrin Bitterlich, BSc,[1] Johanna Lahne, BSc,[1] Stephan Degle, PhD,[1] and Christoph Anders, PhD[2]

SIGNIFICANCE: During computer work in controlled laboratory conditions, wearing multifocal contact lenses (MFCLs) showed no lower muscle load but increased subjective perception of comfort with equivalent visual quality and comparable tolerance.

PURPOSE: Because musculoskeletal complaints are frequent among computer workers, this study used the muscle electrophysiological activity of shoulder and neck muscles in presbyopic computer workers who received either progressive addition lenses for general purpose (GP-PALs) or MFCLs.

METHODS: For this crossover study, 11 presbyopic computer workers aged 55 ± 4 years (mean ± standard deviation) were equipped with GP-PALs and MFCLs in a randomized order. Surface electromyography signals were recorded bilaterally from shoulder and neck muscles during short-term computer work tasks using an optimally adjusted visual display unit workplace. The amplitude probability distribution function, the number and total duration of EMG gaps, and sustained low-level muscle activity periods of the surface electromyography signals were calculated. Comfort and correction type preferences were assessed. Head inclination was objectively evaluated.

RESULTS: Multifocal contact lenses elicited no significant lower muscle load than GP-PALs. The number of sustained low-level muscle activity periods longer than 60 seconds was similar between visual aids. The total amount

SDC

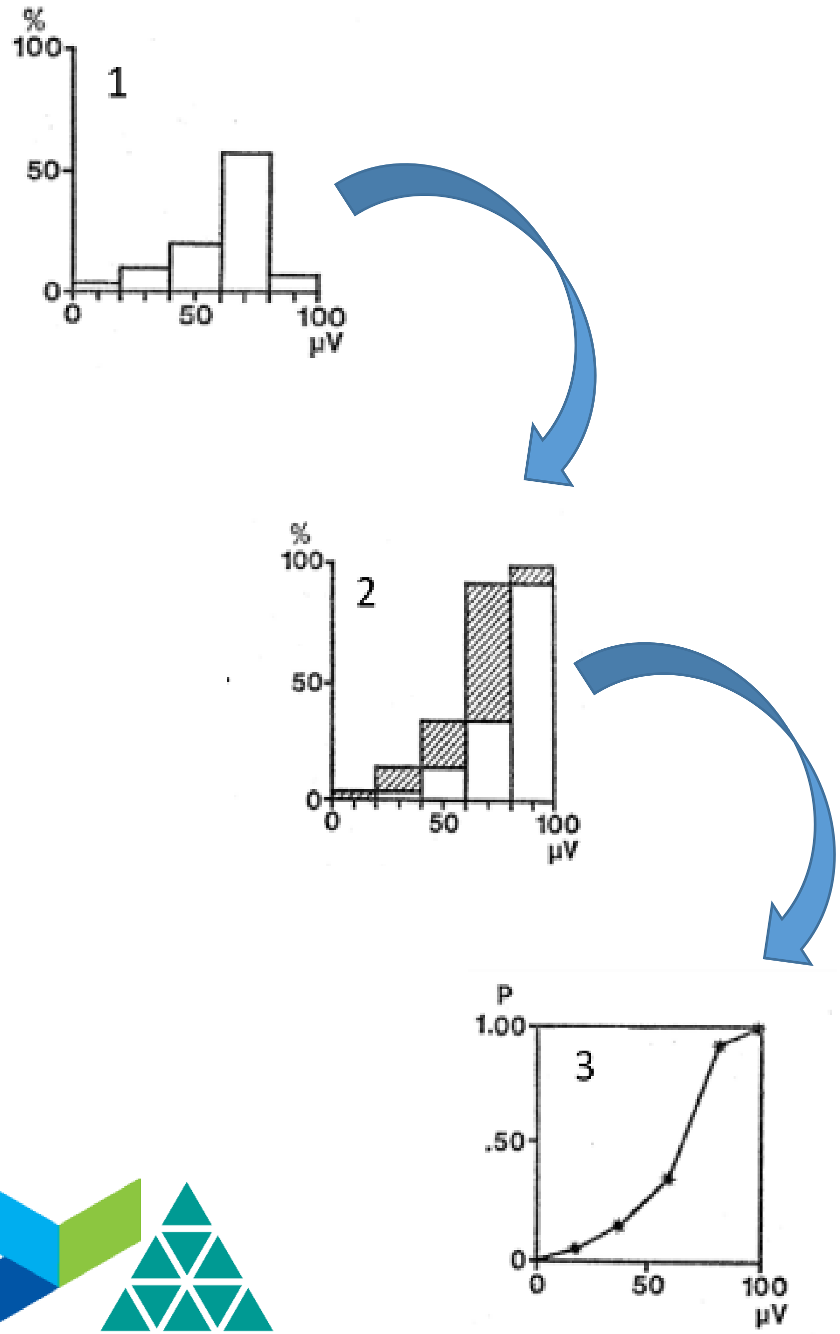
Einfluss der Presbyopie

- Sustained Low-level Muscle Activity (SULMA) evtl. Ursache für Muskel-Skelett-Beschwerden am BAP[1]
- Grund „Cinderella Hypothese“[2]:
- Typ 1 Muskelfasern bleiben von Beginn der Haltearbeit bis zur totalen Muskelentspannung aktiv

Hypothese

- Korrektion der Presbyopie mit Gleitsichtbrille am BAP führt zu SULMA

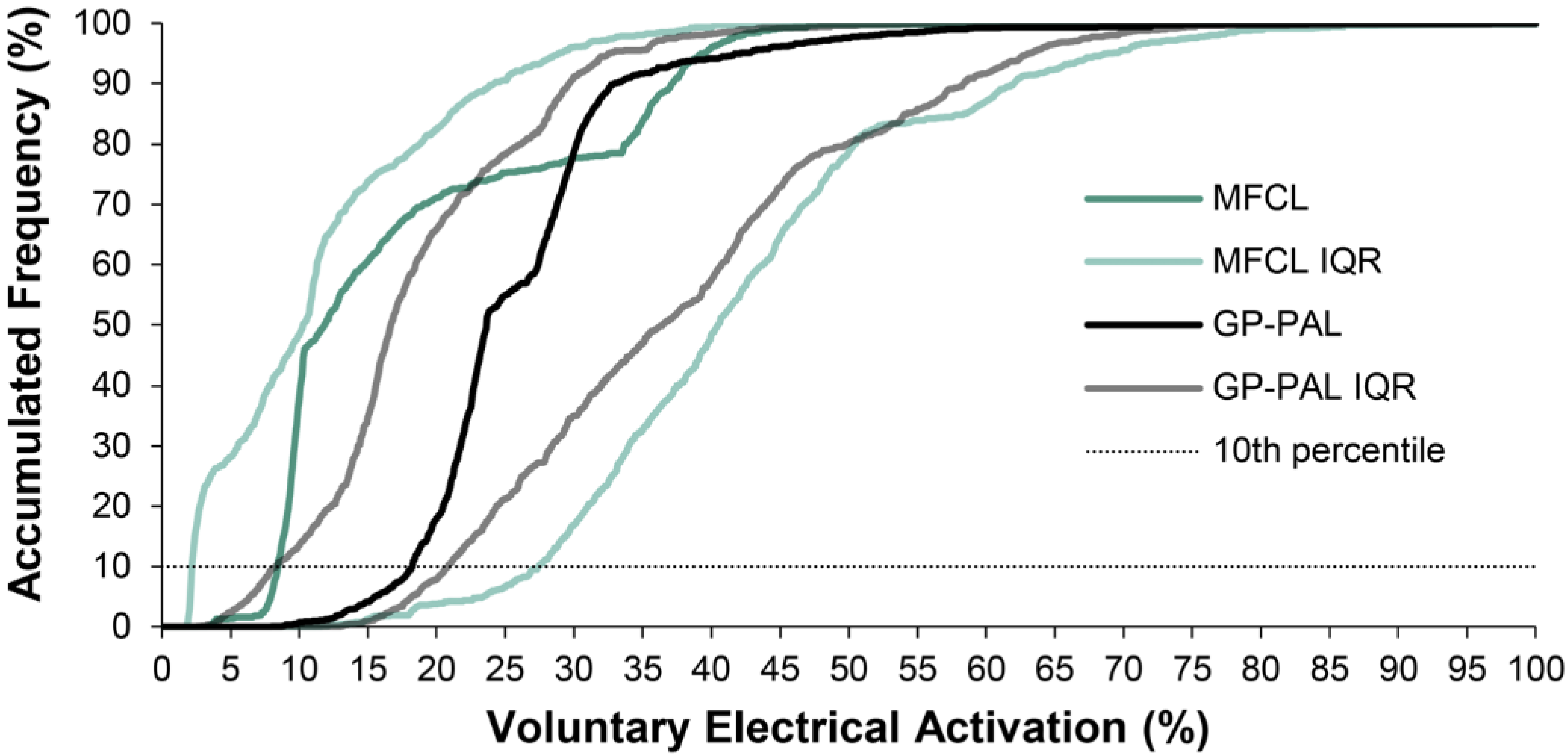
- Grund:
  - Gleitsichtgläser ermöglichen scharfes Sehen in der Ferne bei natürlicher Kopfhaltung
  - Am Bildschirm muss der Kopf um etwa 3-5° angehoben werden um scharf zu sehen[7]



Auswertung

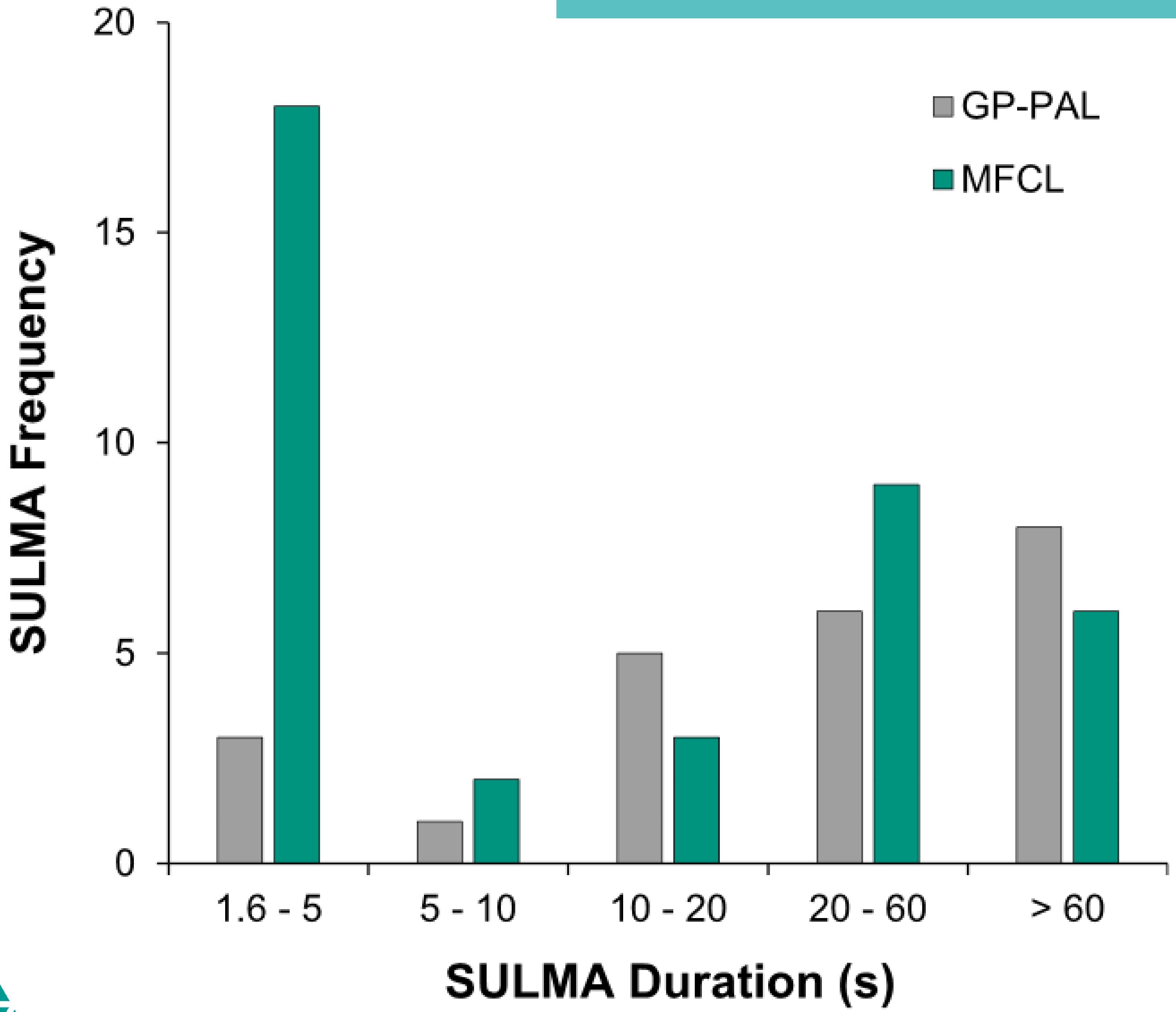
- APDF = kumulative Verteilung der verschiedenen Kontraktionslevel eines Muskels über die gesamte Messzeit im Verhältnis zu einer Referenzaktivität (RVE)
- SULMA = Perioden geringfügiger und dauerhafter Aktivierung des Muskels
- GAPs = spontan auftretende, kurze unbewusste Pausen in der Muskelaktivität, die auch zur Muskelentspannung beitragen

APDF



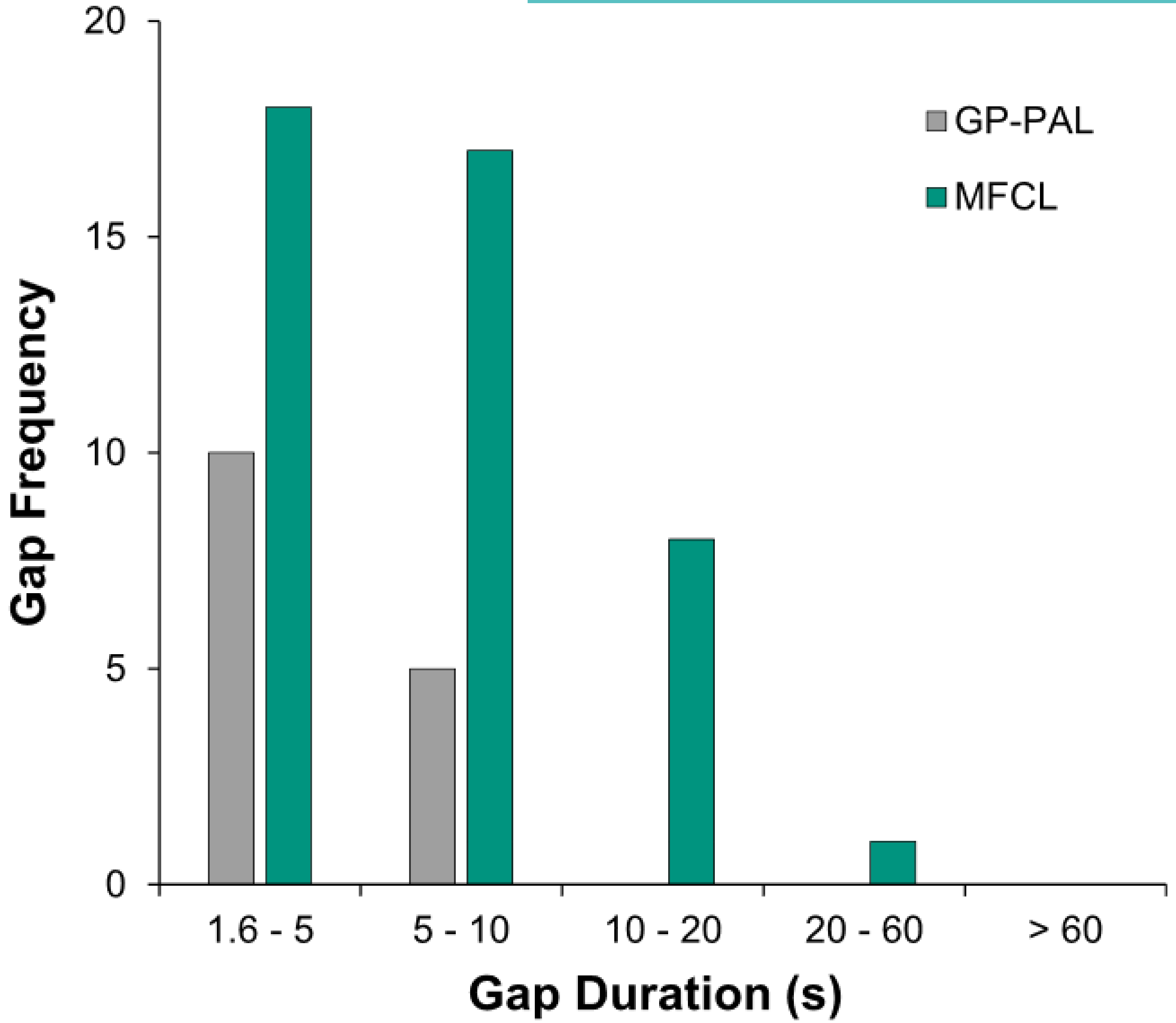
Percentiles	correction	RVE	IQR	test
10th (static level)	MFCLs	8.4	2.2–27.0	$P = .60$
	GP-PALs	18.2	8.0–20.8	
50th (median level)	MFCLs	11.8	10.3–40.4	$P = .43$
	GP-PALs	23.6	16.7–36.5	
90th (peak level)	MFCLs	37.1	24.2–61.8	$P = .38$
	GP-PALs	32.9	29.6–58.4	

SULMA



20
15
10
5
0
SULMA Frequency
GP-PAL
MFCL
1.6 - 5
5 - 10
10 - 20
20 - 60
> 60
SULMA Duration (s)

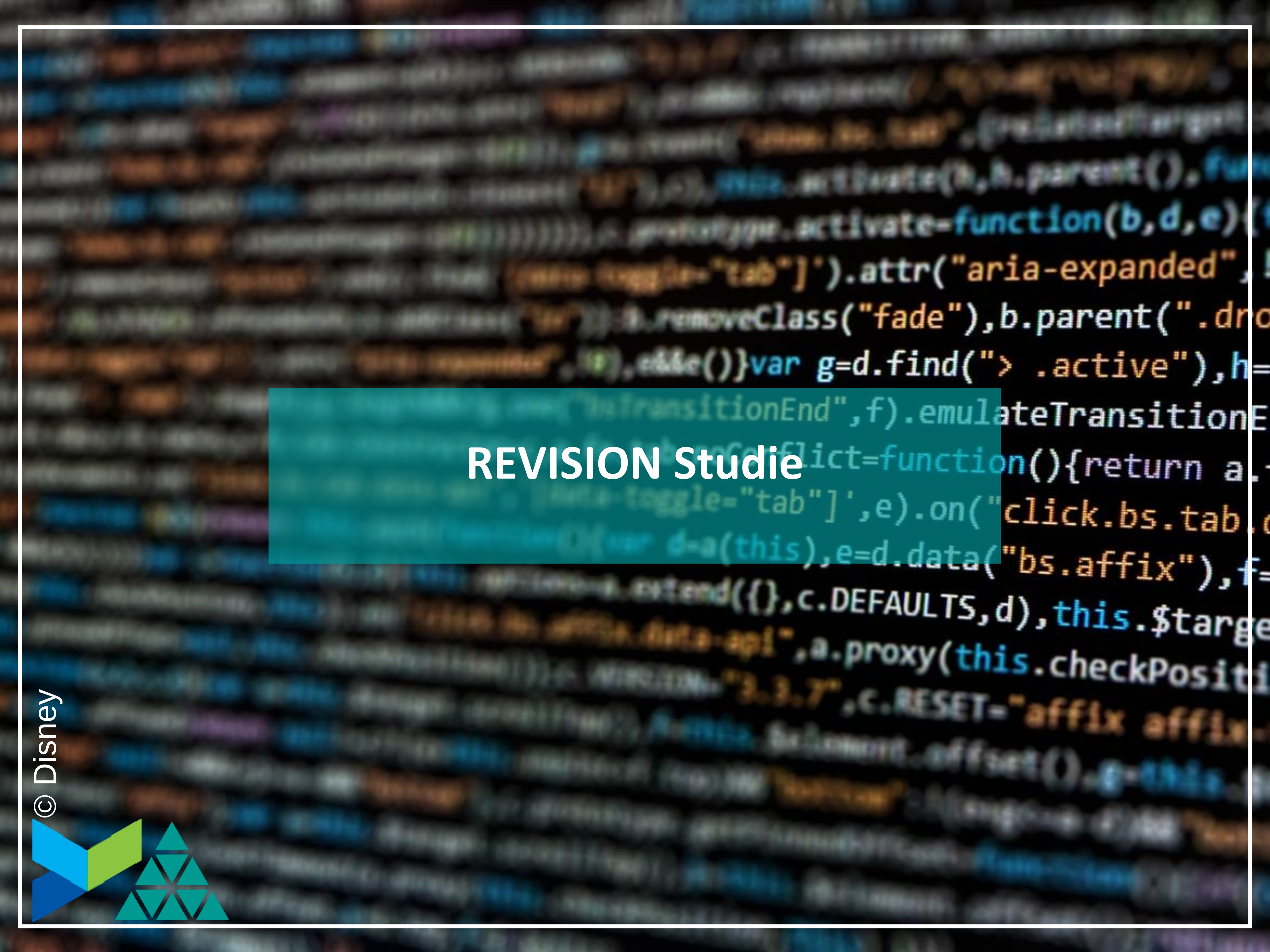
GAPS



20
15
10
5
0
Gap Frequency
GP-PAL
MFCL
1.6 - 5
5 - 10
10 - 20
20 - 60
> 60
Gap Duration (s)

Diskussion

- Unterschiede der SULMA in Studie sehr gering und nicht eindeutig
- Mögliche Ursachen:
  - Probanden waren bereits zu stark an Gleitsichtbrillen gewohnt → Einnehmen von Zwangshaltungen auch während KL Versorgung konnte deutlich beobachtet werden
  - Bildschirmarbeitsplatz ideal eingerichtet (Blicksenkung von ca. 35° ermöglicht)
  - Sehanforderung entsprachen zwar der DGUV aber vermutlich nicht den realen Anforderungen (Schriftgröße 16 auf 24“ Monitor bei 80cm Entfernung) → Aufgabe konnte trotz Unschärfe mit Fernbereich erfüllt werden, Kopfanhebung z.T. nicht nötig
  - Hohe Varianz der „Between Day“-Werte trotz Normierung
  - Zu kurze Belastungsphasen (je 5 Minuten)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OPO THE COLLEGE OF OPTOMETRISTS

ORIGINAL ARTICLE

Analysis of real-world visual ergonomics at the visual display unit

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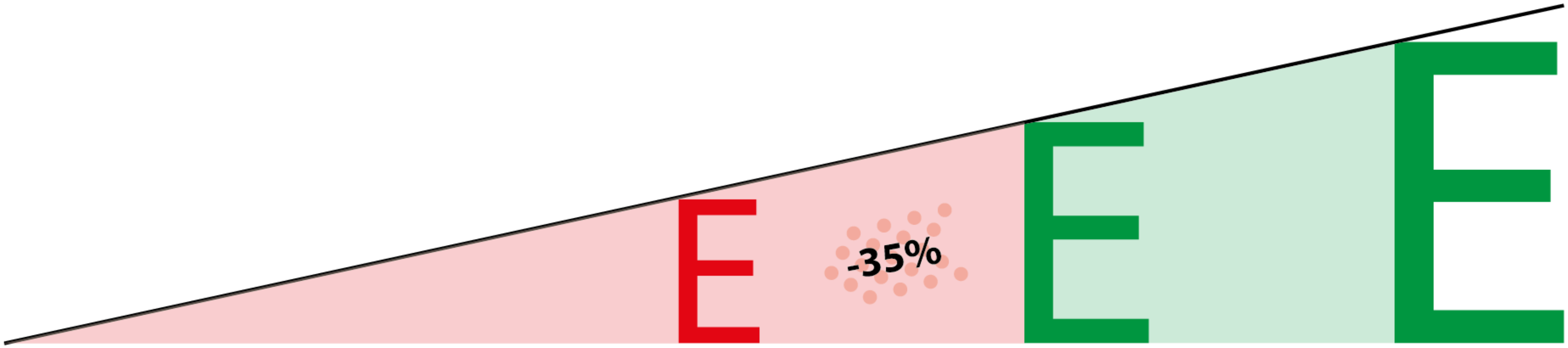
Abstract
Introduction: In this interventional study, the ergonomic workplace set-up and the impact of character size on subjectively estimated working productivity and computer vision syndrome (CVS) were evaluated in the field.
Methods: The number of displays and their size, resolution, surface structure, position in the room and relation to the eye were evaluated for 152 units. CVS was assessed using the CVS-Questionnaire. Habitually used character size for an uppercase E was recorded and compared to the ISO 9241–303:2011, national standards (e.g., ANSI/HFES 100–2007) and national guidelines (e.g., German DGUV Information 215–410). In case of failure to comply with these standards, charac-

Ergebnisse

Durchschnittliche Schriftgröße



Winkelminuten	14,3‘	22‘	30‘
Schriftgröße* (Arial)	11pt	18pt	26pt
Millimeter*	2,9	4,5	6,4

*berechnet für Arbeitsabstand von 70cm (Durschnitt)

Ergebnisse

Ergonomie

Number of displays	
1 Display	32.9%
2 Displays	64.8%
3 Displays	3.3%
Display size (inches)	
19″	16.5%
23–24″	62.5%
27″	12.5%
Other	8.5%
Aspect ratio	
Fullscreen (4:3 or 5:4)	19.0%
Widescreen (16:9 or 16:10)	81.0%
Ultrawide screen (>21:9)	0.0%
Surface	
Glossy	4.6%
Non-glare (anti-reflection coating)	14.5%
Non-glare (matte)	80.9%
Position of the window	
Window in front of the observer	12.7%
Window behind the observer	4.0%
Windows to one side of the observer	80.0%
Other	3.3%

Position relative to the eye	**Mean (SD)**
Viewing distance (primary display)	727.8 mm (97.6)
Viewing distance (secondary display, $N=102$)	780.3 mm (90.0)
Highest presented screen content (above the desk)	391.2 mm (43.8)
Height of eye (above desk)	470.2 mm (50.1)
Head inclination	14.5° (5.7)


TRAP PC Studie
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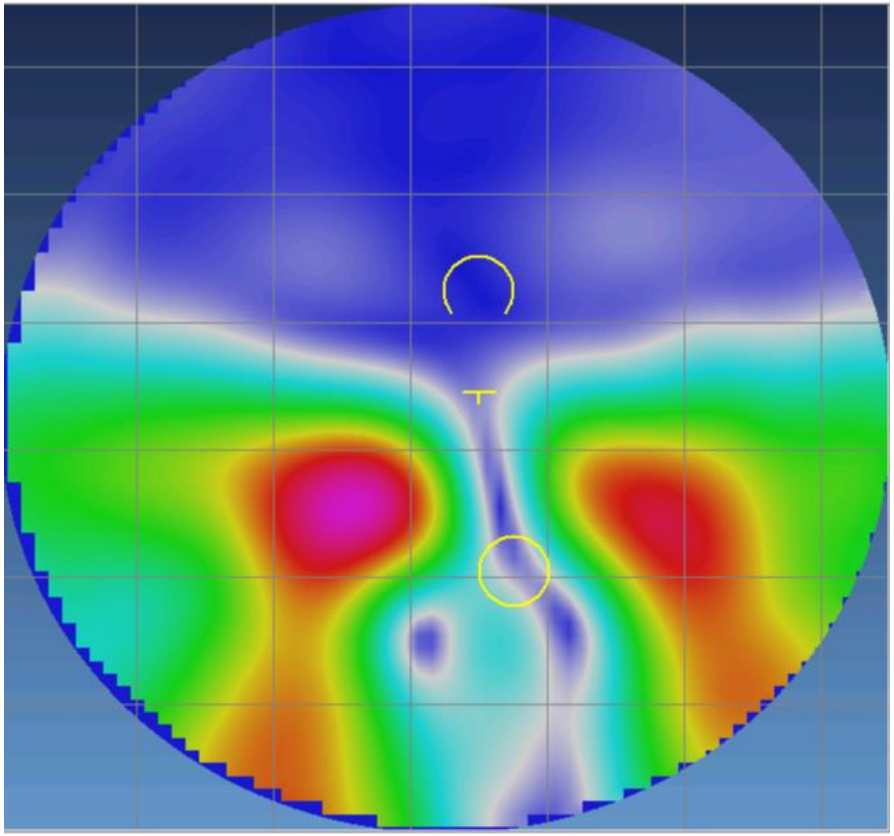
Methode

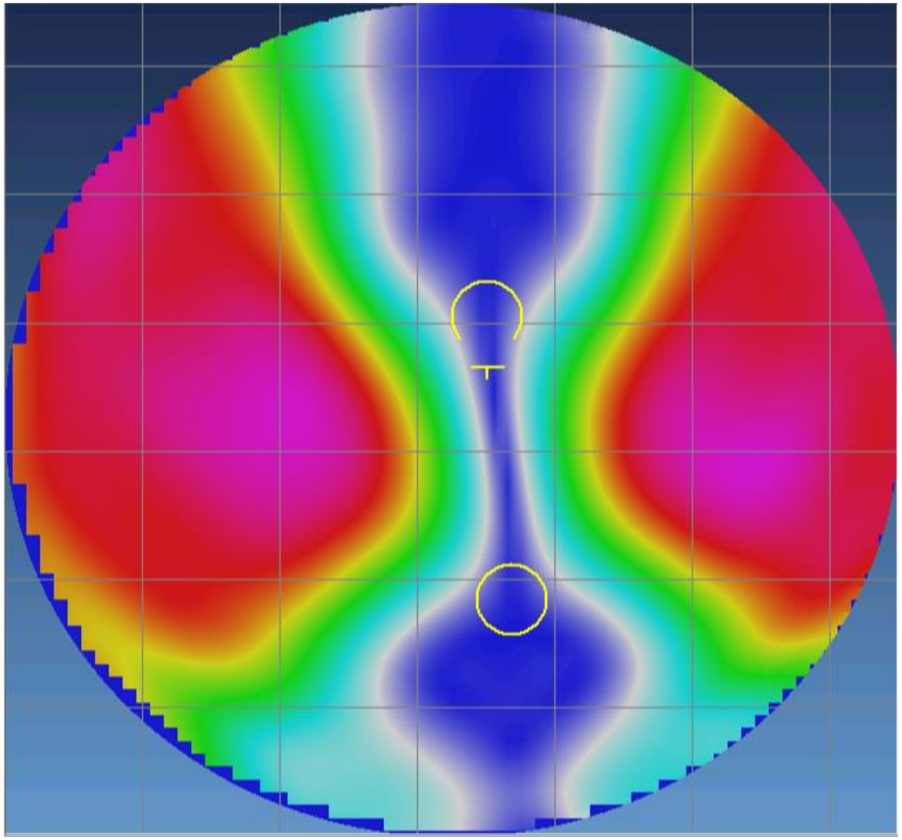
Laborstudie:

- N= 30 Studenten
- OEMG Messungen im Cross-Over Vergleich von Gleitsicht- und Bildschirmgläser während standardisierter Bildschirmarbeit
- Presbyopie künstlich durch Cyclopentolat erzeugt
- Alle Messungen an einem Tag
- Setup (Schriftgröße und Einrichtung) an ReVision Ergebnisse angelehnt

Testitems



Jubile, VISALL



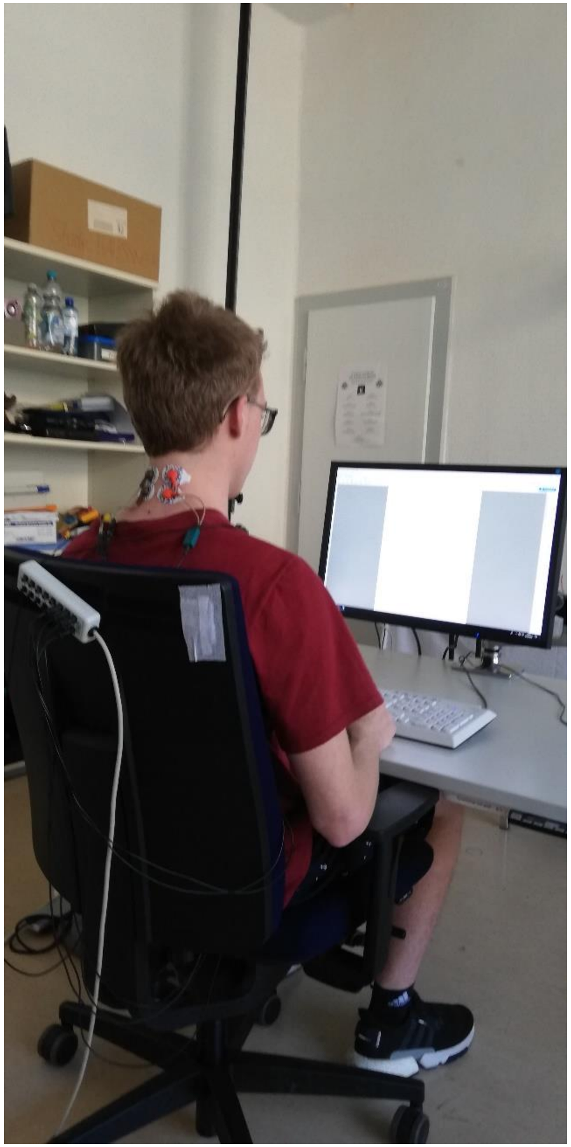
i Work, VISALL

Methode

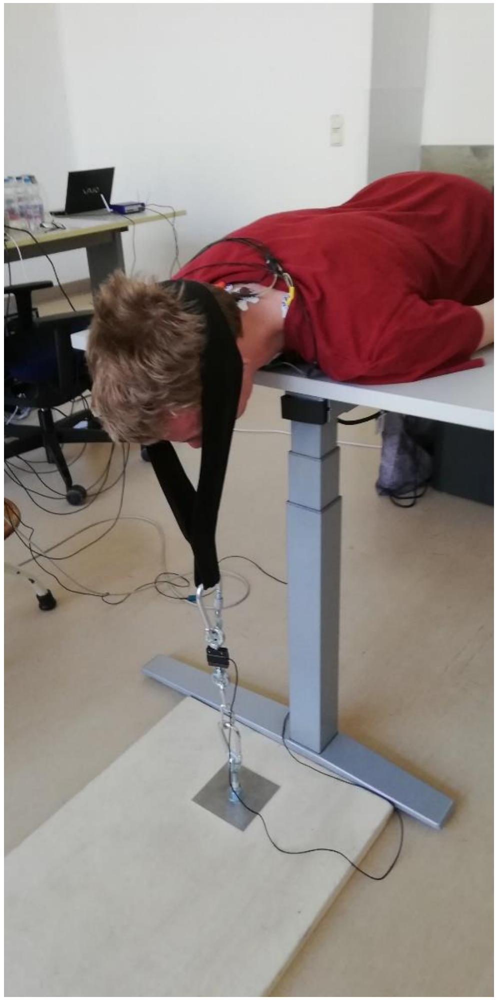
Standardisierte Arbeitsaufgabe:

- 15 Minuten Vorlesen
- 7 Minuten Sortieraufgabe
  - Absätze des Märchens wild durcheinander gemischt
  - Proband muss die Reihnfolge sortieren
- 8 Minuten Aufgabe Markieren
  - Konkrete Wörter aus dem Märchen müssen markiert werden (rot, über Ribbon bei MS Word)

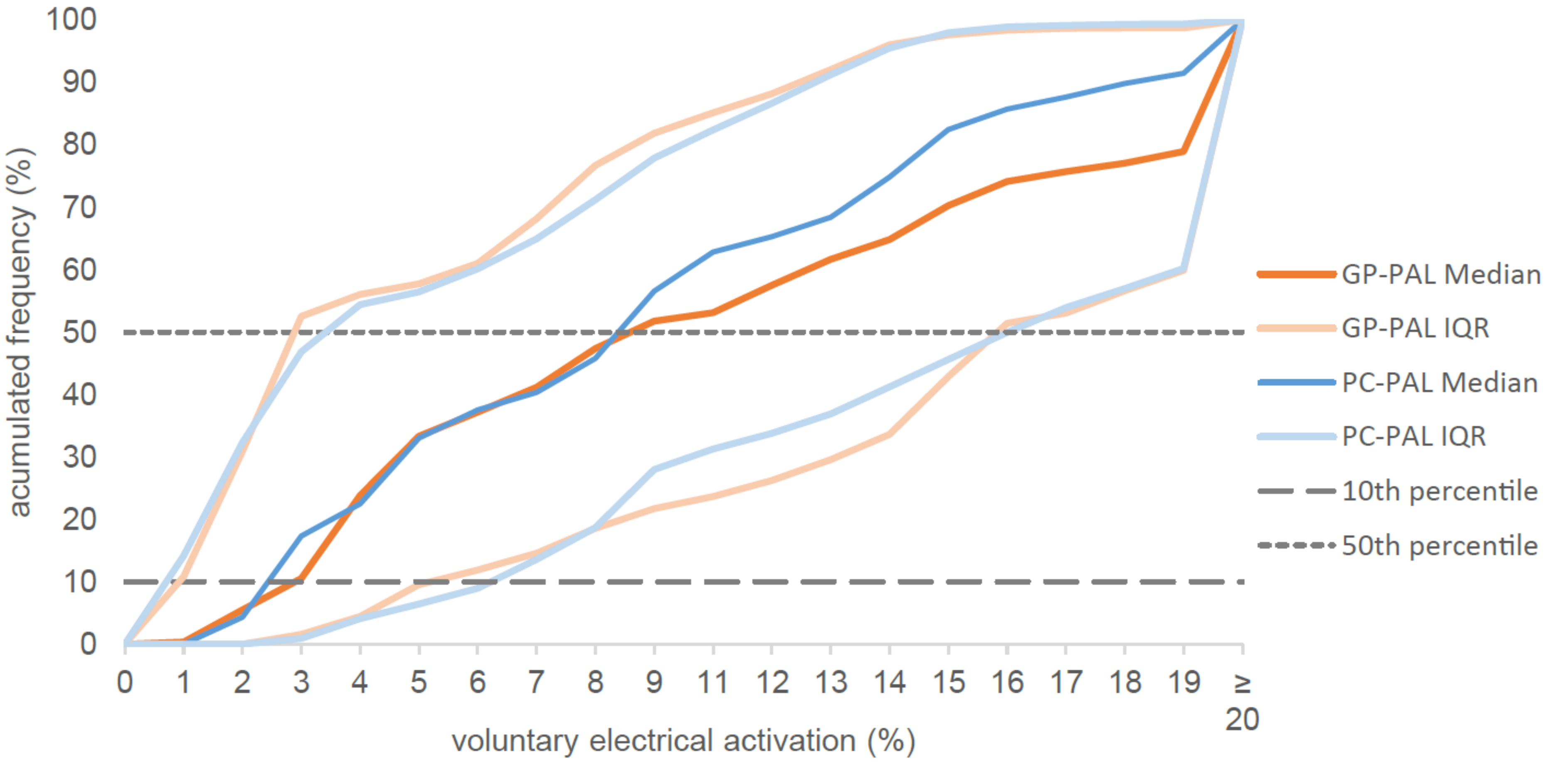
Neues Setup



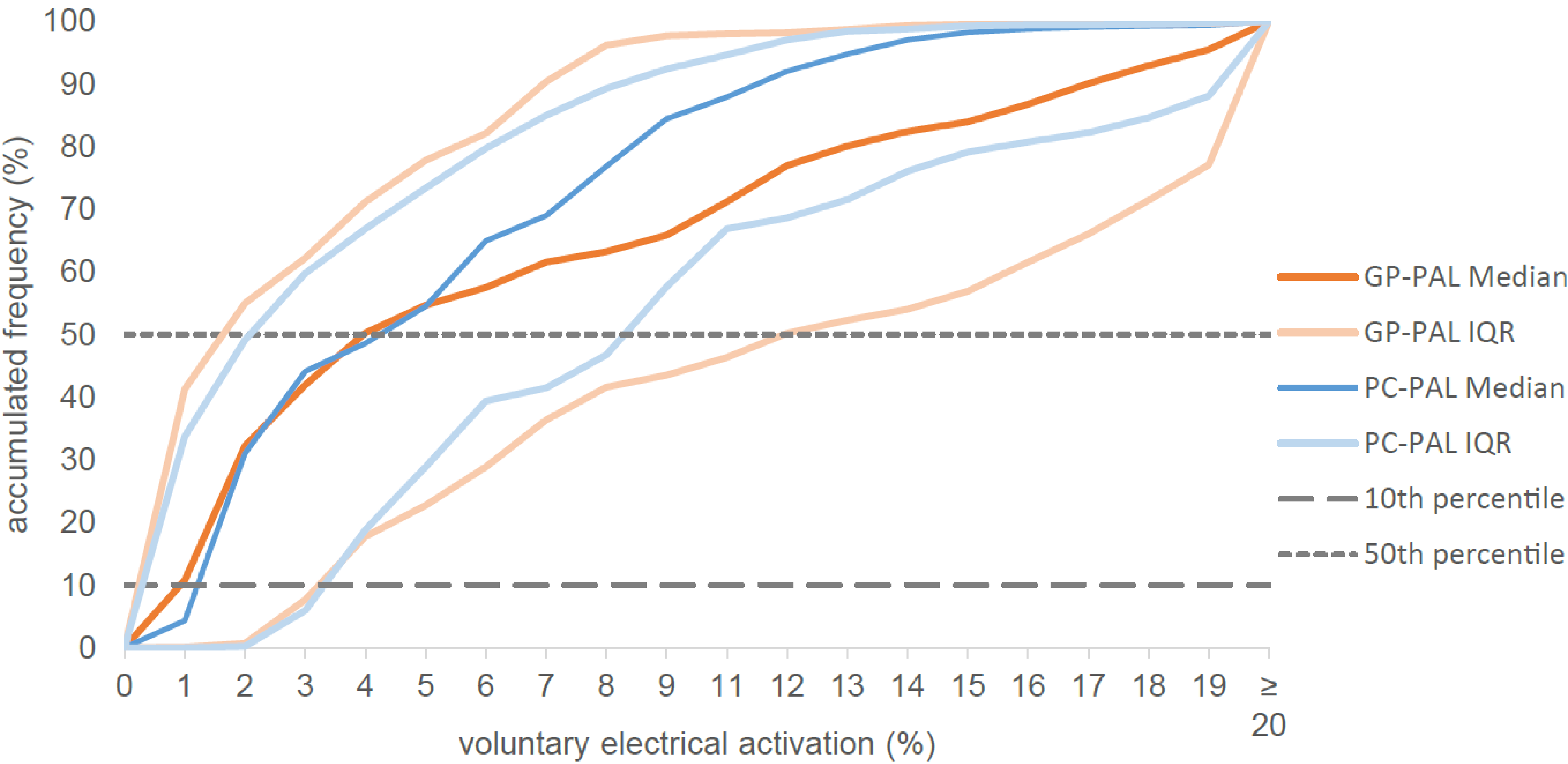
MVC Messung



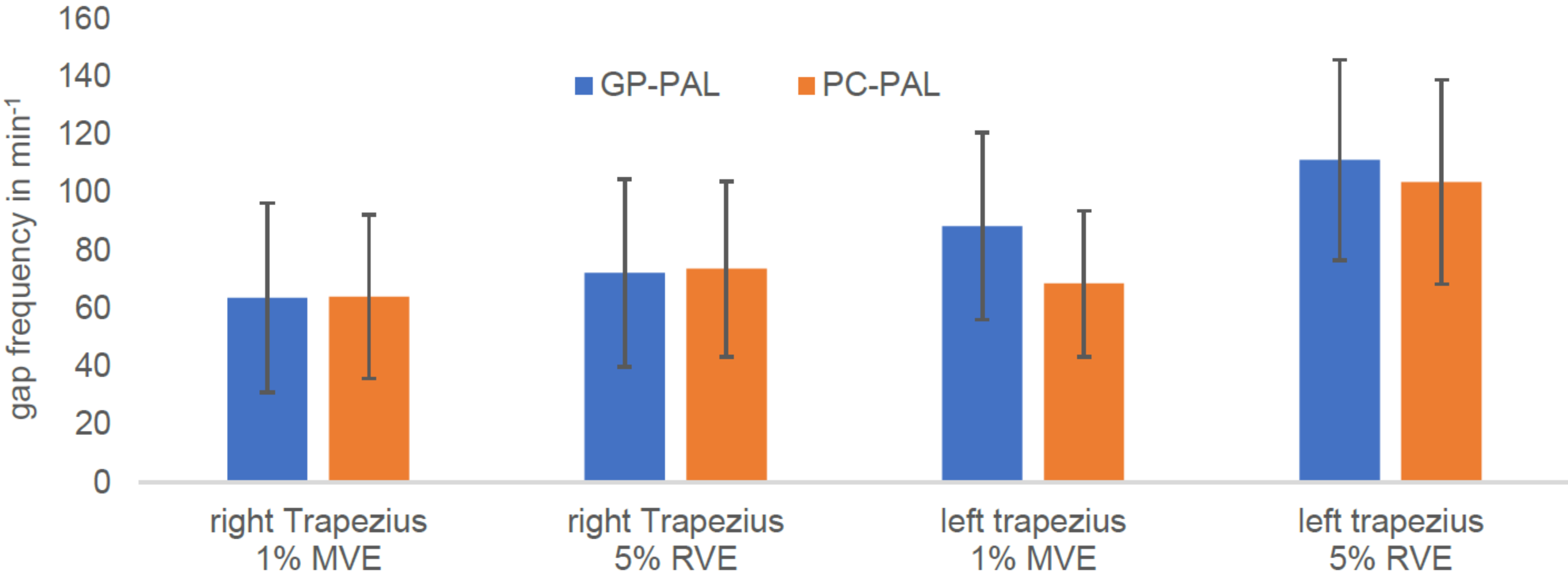
APDF Trapezius Rechts



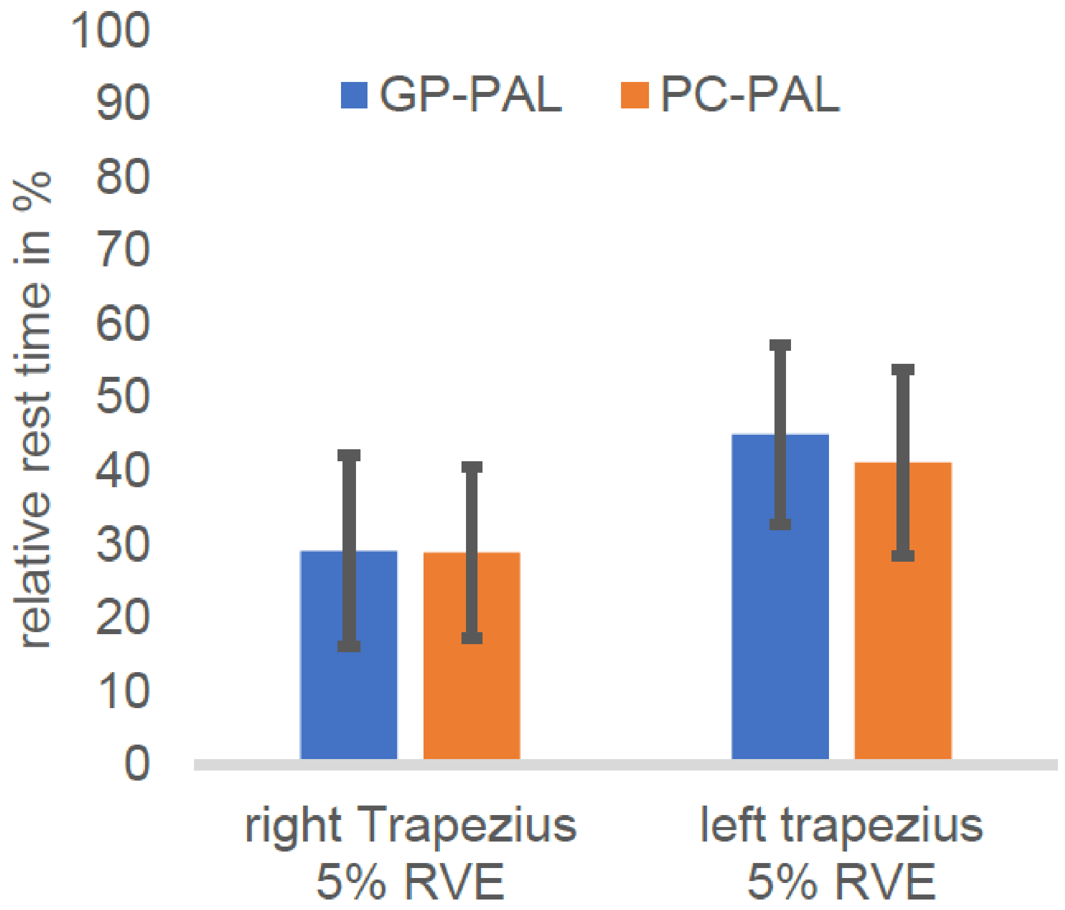
APDF Trapezius links



Gap Frequenz



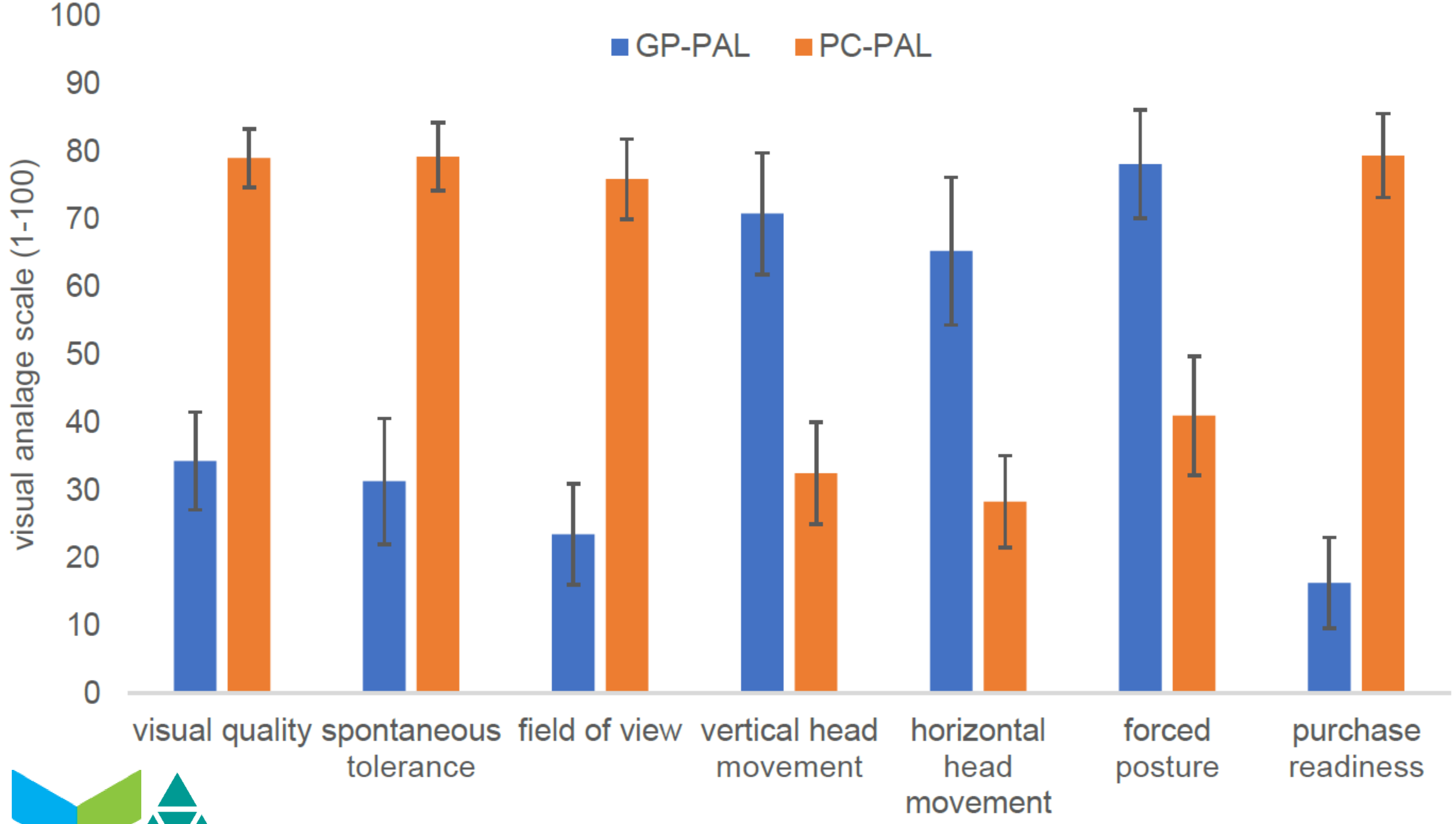
Relative rest time



SULMA

	Media (IQR) SULMA periods GP-PAL	Median (IQR) SULMA periods PC-PAL	Wilcoxon test	
			Z value	P value
1.75 – 5 s	.50 (.00–5.75)	.00 (.00–1.0)	-1.60	.11
5 – 10 s	.00 (.00–2.50)	.00 (.00–.75)	-1.13	.26
10 – 20 s	.00 (.00–2.00)	.00 (.00–.75)	-1.07	.29
20 s – 30 s	.00 (.00–1.00)	.00 (.00–.00)	-1.73	.08
30 s – 1 min	.00 (.00–.75)	.00 (.00–.00)	-1.34	.18
1 min – 3 min	.00 (.00–.75)	.00 (.00–.75)	.00	>.99
3 min – 5 min	.00 (.00–.00)	.00 (.00–.75)	.00	>.99
5 min – 10 min	.00 (.00–1.75)	.00 (.00–.75)	-1.34	.18
10 min – 20 min	.00 (.00–1.00)	.00 (.00–.75)	-1.00	.32
> 20 min	.50 (.00–1.00)	1.00 (.25–1.00)	-1.41	.16

Subjektive Daten



Diskussion

- Unterschiede der muskulären Aktivität nicht existent, kein Trend abzulesen
- Methodik ggf. nicht geeignet, um diese kleinen Unterschiede zu detektieren
- Ggf. ist die Zwangshaltung nicht statisch genug, bzw. sind die kleinen individuellen Kopfbewegungen nicht zu vernachlässig
- Evtl. ist aber auch die Cinderalla Hypothese nicht die geeignete Theorie für die Muskel-Skelett-Beschwerden am Bildschirm
    - Neuere Studien von De Luca et al. [16] und Minerbi and Vulfsons [17] zweifeln den Pathomechanismus von Hägg mittlerweile an

Vielen Dank!

Literatur

[1] Sjogaard G, Lundberg U, Kadefors R. The Role of Muscle Activity and Mental Load in the Development of Pain and Degenerative Processes at the Muscle Cell Level During Computer Work. Eur J Appl Physiol 2000;83:99–105.

[2] Hägg GM. Static work load and occupational myalgia-A new explanation model. In: P. Anderson, D. Hobart and J. Danoff (ed) Electromyographical Kinesiology. Elsevier Science Publishers, Amsterdam 1991; 141-144

[3] FORSMAN, M., R. KADEFORS, Q. ZHANG, L. BIRCH und G. PALMERUD, 1999. Motor-unit recruitment in the trapezius muscle during arm movements and in VDU precision work [online]. International Journal of Industrial Ergonomics, 24(6), 619-630

Literatur

[4] KADEFORS, R., M. FORSMAN, B. ZOÉGA und P. HERBERTS, 1999. Recruitment of low threshold motor-units in the trapezius muscle in different static arm positions [online]. Ergonomics, 42(2), 359-375. ISSN 1366-5847.

[5] SØGAARD, K., 1995. Motor unit recruitment pattern during low-level static and dynamic contractions [online]. Muscle & nerve, 18(3), 292-300. Muscle & nerve.

[6] THORN, S., M. FORSMAN, Q. ZHANG und K. TAODA, 2002. Low-threshold motor unit activity during a 1-h static contraction in the trapezius muscle [online]. International Journal of Industrial Ergonomics, 30(4-5), 225-236. ISSN 01698141.

[7] Jaschinski W, König M, Mekontso TM, et al. Computer Vision Syndrome in Presbyopia and Beginning Presbyopia: Effects of Spectacle Lens Type. Clin Exp Optom 2015;98:228–33.

Literatur

[8] Bababekova et.al, 2011. Font Size and Viewing Distance of Handheld Smart Phones – OVS

[9] Kochurova et.al, 2015. Is the 3x reading rule appropriate for computer users? – DISPLAYS

[10] Rosenfield, 2016. Computer Vision Syndrome (a.k.a. digital eye strain) - Optometry in Practice

[11] Bartha MC, Allie P, Kokot D, Roe CP. Field observations of display placement requirements and character size for presbyopic and pre- presbyopic computer users. Work. 2015;52:329– 42.

[12] Bababekova Y, Rosenfield M, Hue JE, Huang RR. Font size and viewing distance of handheld smart phones. Optom Vis Sci. 2011;88:795–7

Literatur

[13] Legge GE, Pelli DG, Rubin GS, Schleske MM. Psychophysics of reading—I. Normal vision. Vis Res. 1985;25:239–52.

[14] Ko P, Mohapatra A, Bailey IL, Sheedy J, Rempel DM. Effect of font size and glare on computer tasks in young and older adults. Optom Vis Sci. 2014;91:682–9.

[15] Long J, Rosenfield M, Helland M, Anshel J. Visual ergonomics stan-dards for contemporary office environments. Ergonomics Australia.2014;10:1–7.

[16] Westgaard RH and Luca CJ de. Motor unit substitution in long-duration contractions of the human trapezius muscle. J Neurophysiol 1999; 82: 501–504.

[17] Minerbi A and Vulfsons S. Challenging the Cinderella Hypothesis: A New Model for the Role of the Motor Unit Recruitment Pattern in the Pathogenesis of Myofascial Pain Syndrome in Postural Muscles. Rambam Maimonides Med J 2018; 9.