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# Influence of individual factors and acclimatization on the perception of noise reduction settings

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## INTRODUCTION

- Speech understanding in noise (SiN) is important but demanding for hearing-impaired persons
- Amplification and noise reduction (NR) are supposed to help, but hearing aid (HA) users can respond very differently to them
- The relation between preference for and performance with NR algorithms is not clear (e.g. Neher 2014; Serman et al. 2016), nor is the influence of auditory acclimatization and HA experience on these outcomes
- We investigated these aspects in novice and experienced users over time, i.e. initially ('t1'), after 6 weeks ('t2'), and after 12 weeks ('t3') of HA use

## MATERIAL & METHODS

### Participants, HA settings and setup

Tab 1: Means and ranges for age, PTA4 and HA experience for three experimental groups.

Experimental group	Novices (N = 21, 9♀)			Experienced users (N = 20, 6♀)			Controls (N = 10, 5♀)		
	μ	min	max	μ	min	max	μ	min	max
Age [yrs]	70	56	79	69	53	76	72	63	80
PTA4 [dB HL]	37	27	52	48	34	61	47	36	56
HA experience [yrs]	-	-	-	8	0.5	38	9	0.5	34

- Novices and experienced users fitted bilaterally with Signia Pure 7px devices according to NAL-NL1 – 3 dB at t0. Controls continued using their own HAs
- Additional subdivision according to preferred NR strength (assessed at t1): *Strong* NR (N = 24) vs. *weak* NR (N = 9) vs. *indifferent* (N = 8); no differences in terms of age, PTA4 or HA experience among these groups
- KEMAR recordings made with HAs in the experimental setups; stimulus presentation via equalized Sennheiser HDA200 headphones

Tab 2: Tested HA settings (P1-P4) with corresponding SNR improvements in dB relative to P1.

HA condition		SNR improvement [dB]	
		unweighted	speech-weighted
P1	Omni-directional	-	-
P2	Single-channel noise reduction (NR)	6.4	4.6
P3	Directional microphone (DIR)	4.0	3.3
P4	Combination of NR and DIR	9.5	7.7

### Preference and performance assessments

- Spatially dynamic SiN task** (after Getzmann et al. 2015)
  - Three concurrent sentences from 0° and ±45° (at 71 dB SPL each) in spatially diffuse cafeteria noise (at 65 dB SPL)

- Female target (German, Wagener et al. 1999) and male distractors (Russian and Spanish, Hochmuth et al. 2015) from Oldenburg sentence material; Target and distractors switched spatial positions from trial to trial.
- Performance measure: No. of correctly repeated digits (one digit per trial)
- Preference measure: number of wins in a complete paired comparison task (four repetitions per comparison)
- Listening span test** (LST; after Neher et al. 2018)
  - Sentences from "Basler Satztest" (Tschopp & Züst 1994), similar to Speech Perception in Noise Test (SPIN, Kalikow et al. 1977), presented from 0° at +12 dB SNR in spatially diffuse cafeteria noise (65 dB SPL)
  - Performance measure: No. of correctly recalled final sentence words (recognition rate at ceiling throughout)

## RESULTS

### Influence of HA experience and acclimatization (Novices, Experienced users, Controls for Visit t1 to t3)

- Spatially dynamic SiN task, performance: Visit × group,  $F_{(1,4)} = 2.6, p < .05$  (Fig. 1).

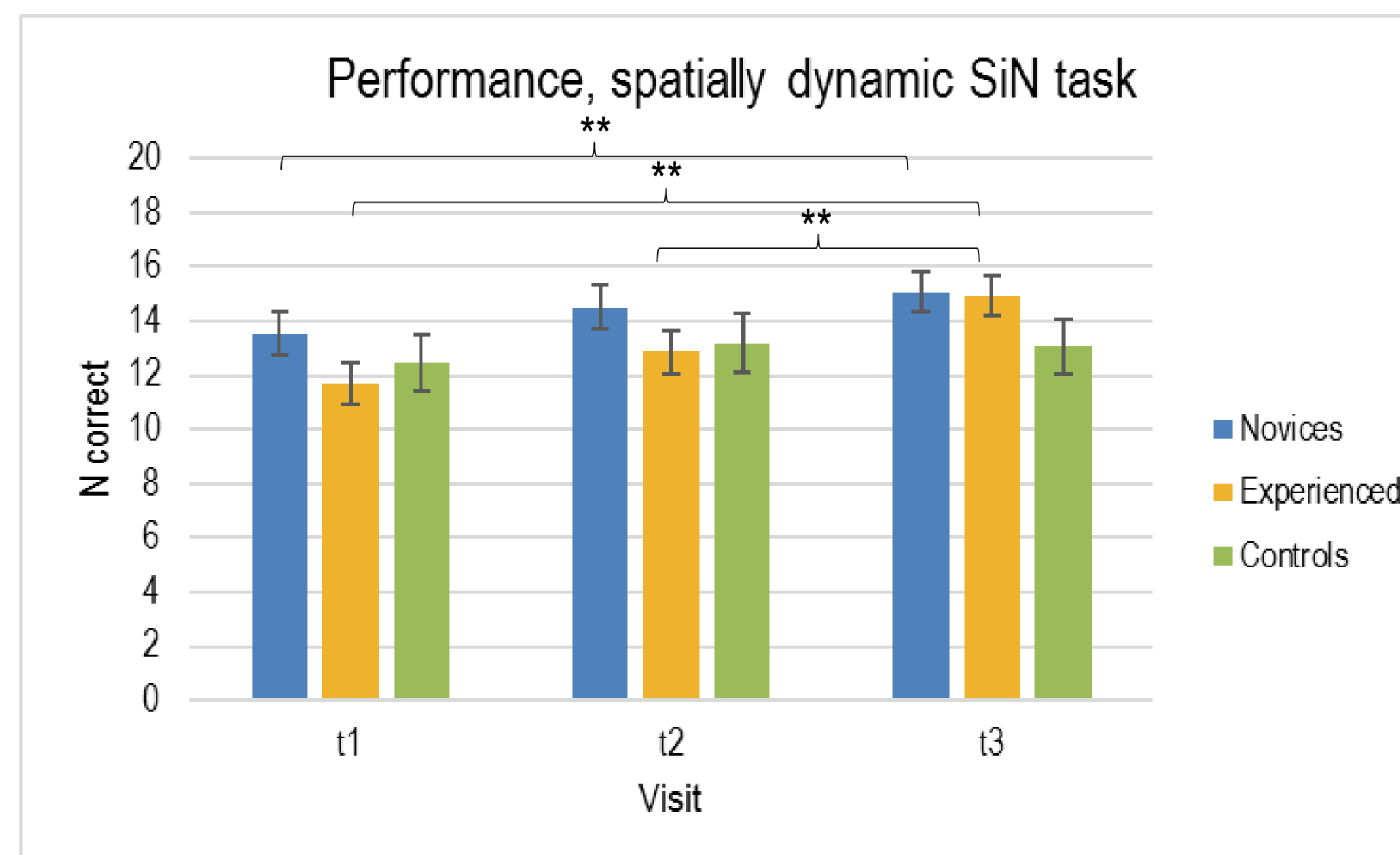


Fig. 1: Means and standard errors of spatially dynamic SiN task performance for the three groups and visits. \*\* indicating differences between visits are statistically significant with  $p < .01$ .

- Spatially dynamic SiN task, preference: Visit × HA condition,  $F_{(1,6)} = 2.5, p < .05$
- LST recall: All  $p > .05$
- PTA4 as covariate:  $p < .05$  for all performance measures

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### Influence of initial NR preference and acclimatization (Groups Strong NR, Weak NR, Indifferent for Visit t1 to t3)

- Spatially dynamic SiN task, preference: HA condition × pref. group,  $F_{(1,6)} = 11.5, p < .001$ ; Visit × HA condition × pref. group,  $F_{(1,12)} = 3.9, p < .001$  (Fig. 2)

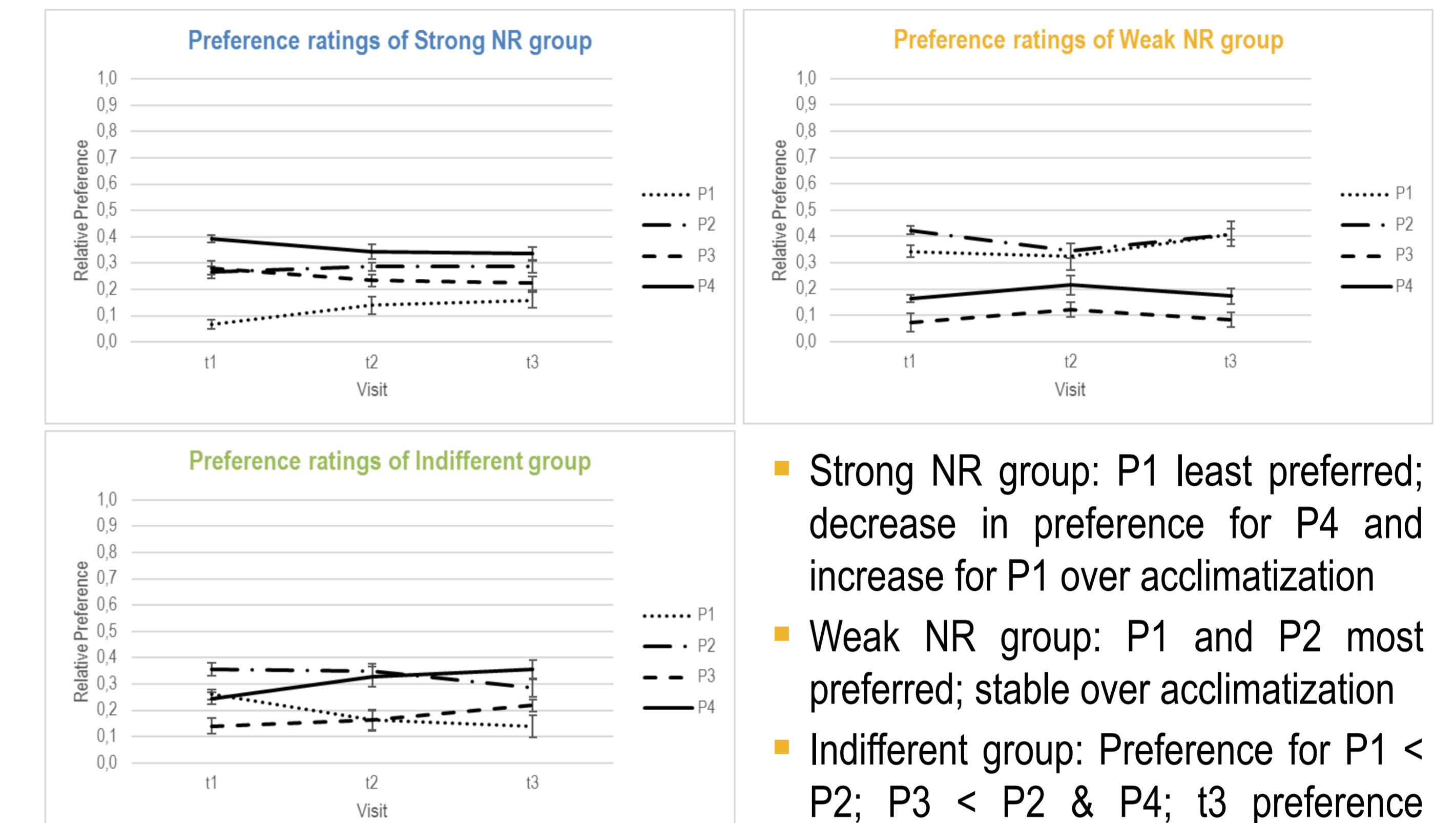


Fig. 2: Means and standard errors for preference scores of the three groups as a function of visit.

- Strong NR group: P1 least preferred; decrease in preference for P4 and increase for P1 over acclimatization
- Weak NR group: P1 and P2 most preferred; stable over acclimatization
- Indifferent group: Preference for P1 < P2; P3 < P2 & P4; t3 preference pattern similar to Strong NR group

## CONCLUSIONS

- Spatially dynamic SiN task, performance: All  $p > .05$
- LST recall: All  $p > .05$
- PTA4 as covariate:  $p < .05$  for all performance measures
- Influence of HA acclimatization and experience on performance with HAs
  - Novices and (re-fitted) experienced users improved on spatially dynamic SiN task, while Controls remained at the initial performance level
  - Experienced users seem to be able to compensate for their worse PTA compared to novices after 12 weeks of HA use
- Change vs. stability of initial NR preference during HA acclimatization: different treatments might be indicated
  - Users with initial preference for strong NR potentially show loudness normalization (slightly increased preference for weak NR (P1) and decreased preference for strong NR (P4)); decrease of NR strength
  - Weak NR group show stable preference pattern; keep parameterization

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