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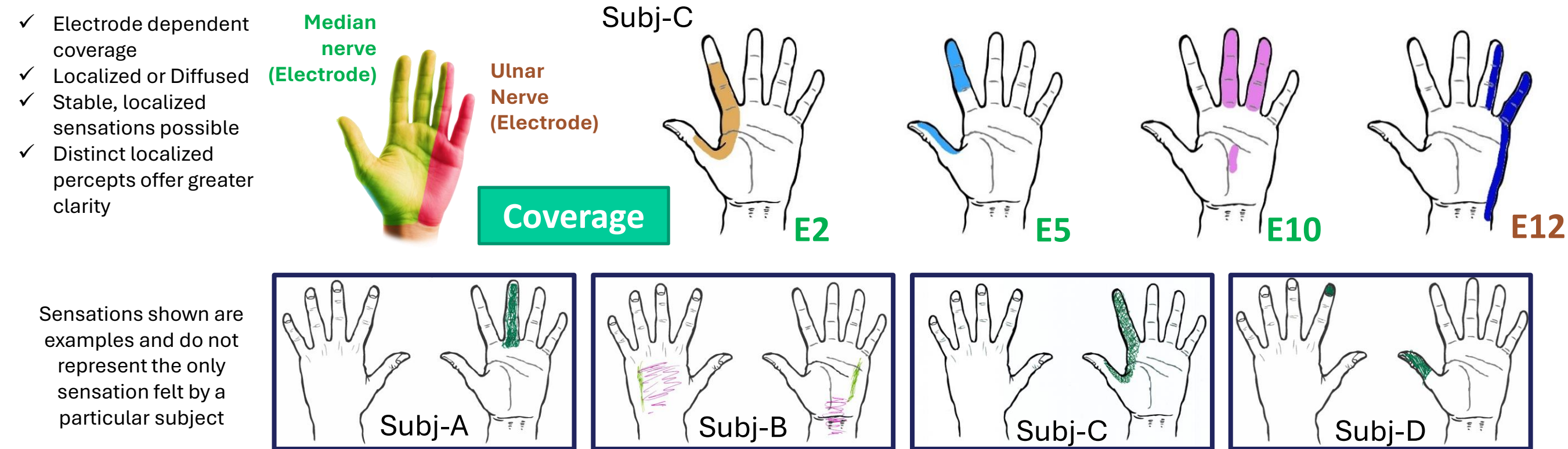
BACKGROUND

- Of the estimated 5.6 million individuals living with limb loss in the U.S., approximately 118,000 are military beneficiaries (~26% upper limb-loss and absence).¹
- Current upper limb prostheses continue to have functional limitations, leading to user dissatisfaction and high rates of device rejection or abandonment.^{3,4}
- Individuals with upper limb loss seek advancements in the function and technology of their daily prostheses.²
- Recent advances in upper limb prosthetics offer potential **sensory restoration**, which have never before been offered for at home use.
- The addition of sensory feedback may help in performing functional tasks/assessments, such as the Activities Measure for Upper Limb Amputees (AM-ULA) and the Southampton Hand Assessment Procedure (SHAP).⁵
- We sought to evaluate whether sensory restoration with the **neural-enabled prosthetic hand (NEPH)** would improve upper limb function.

METHODS

- Two-year multi-site clinical trial of a NEPH system
- Non-diabetic individuals with unilateral transradial amputation or wrist disarticulation.
- Neurostimulator with intrafascicular electrodes implanted to stimulate nerve fibers in median and ulnar nerves in the residual limb.
- Sensors in myoelectric prosthesis utilized to transmit grasp force and hand opening sensory feedback information to the neurostimulator.
- Following attainment of proficiency, participants employed their system in a home-use setting for 18 months.
- Participant surveys/interviews provided subjective feedback regarding changes in function and sensation.
- Functional assessments conducted both with and without sensory feedback at regular time points to capture users' sensory experiences:
 - AM-ULA
 - SHAP

SENSATIONS



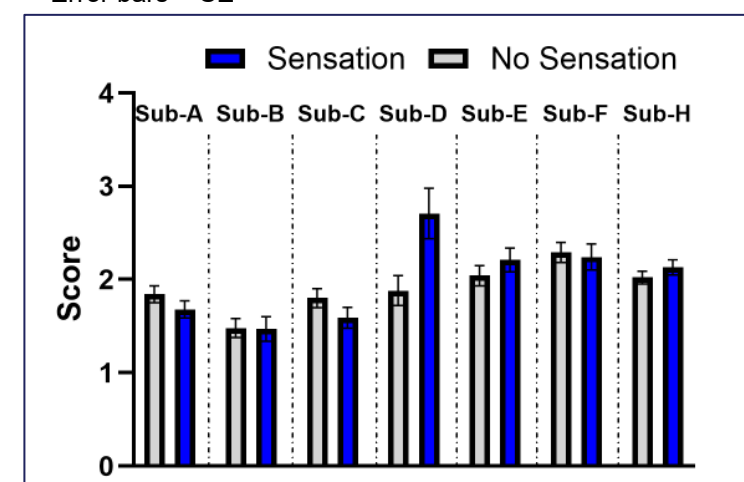
AM-ULA

Activities Measure for Upper Limb Amputees

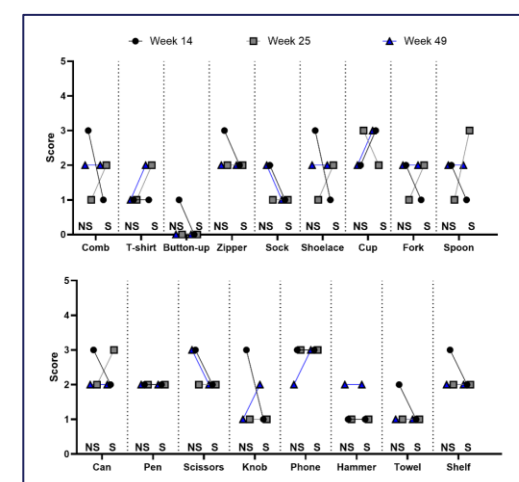


Participant ID	No Sensation M(SD)	Sensation M(SD)	t(df)	p-value	Cohen's d
Subj-A	1.88 (0.80)	1.68 (0.78)	-1.98 (67)	0.052	-0.24
Subj-B	1.31 (0.68)	1.47 (0.90)	1.00 (50)	0.322	0.14
Subj-C	1.80 (0.75)	1.59 (0.78)	-2.04 (50)	0.058	-0.29
Subj-D	2.18 (0.73)	2.71 (1.10)	2.05 (16)	0.031	0.50
Subj-E	1.91 (0.83)	2.21 (0.73)	2.26 (33)	0.865	0.39
Subj-F	2.26 (0.83)	2.24 (0.82)	-0.17 (33)	0.227	-0.03
Subj-H	2.02 (0.65)	2.13 (0.77)	1.22 (84)	0.052	0.13

AM-ULA Performance Across Participants
Error bars = SE



Subj-A AM-ULA Performance



SHAP

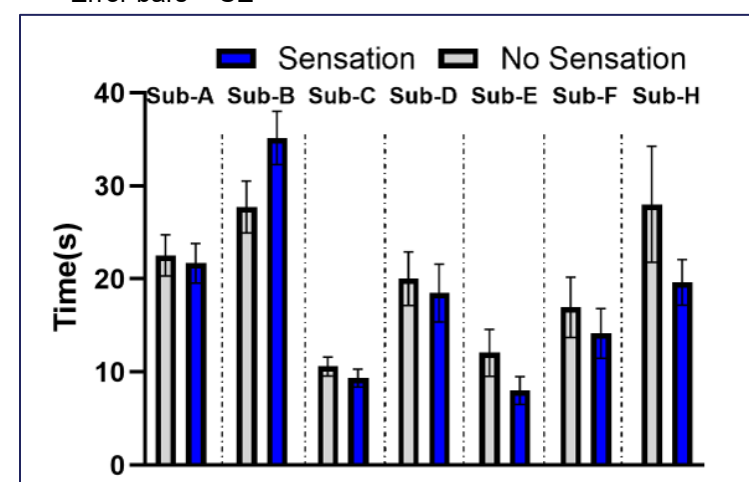
Southampton Hand Assessment Procedure



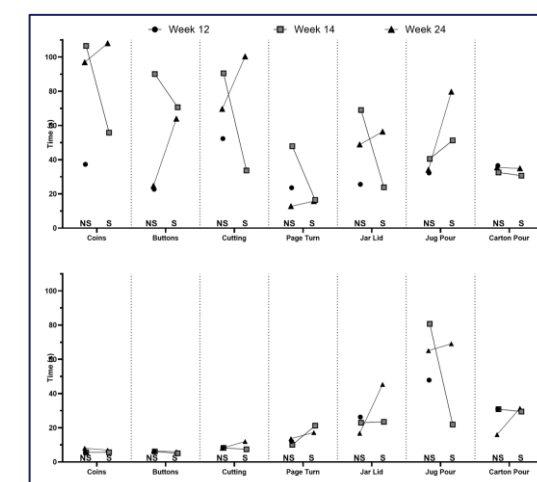
Participant ID	No Sensation M(SD)	Sensation M(SD)	t(df)	p-value	Cohen's d
Subj-A	21.69 (21.78)	22.53 (22.77)	0.49 (103)	0.623	0.05
Subj-B	33.94 (35.28)	27.74 (28.46)	-1.40 (103)	0.164	-0.14
Subj-C	9.35 (8.43)	10.71 (8.98)	1.721 (75)	0.089	0.20
Subj-D	18.49 (22.35)	20.03 (20.67)	0.62 (51)	0.536	0.09
Subj-E	4.82 (6.26)	12.07 (12.86)	2.45 (25)	0.022	0.48
Subj-F	14.15 (13.60)	16.95 (16.40)	0.76 (25)	0.457	0.15
Subj-H	12.84 (12.64)	28.01 (55.06)	2.53 (77)	0.013	0.29

SHAP Performance Across Participants

Error bars = SE



Subj-A SHAP Performance



RESULTS

- Eight participants underwent surgical implantation of the NEPH sensory system, completed functional and sensory based assessments, and utilized the sensory enabled prosthetic arm.
- Participants reported that the sensory feedback provided by the NEPH system:
 - enhanced their ability to perform tasks
 - increased confidence
 - reduced attentional demands
 - relaxed the phantom hand
- Participants demonstrated faster task completion times with activation of the NEPHs for the ADLs tested, including cutting, jug pour, carton pour, empty tin, zipper, screwdriver and door handle.

CONCLUSIONS

- Task-relevant sensory feedback can impact the way users perform activities of everyday life.
- Sensory feedback from prosthetic devices may lead to improvements in prosthesis functionality, potentially improving user acceptance and reducing abandonment.

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