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These are the slides for the talk presented at CHI 2024 by Romain Nith.

All the links in this PDF are clickable and lead you to YouTube videos, paper, etc.

You can watch the talk [here: https://www.youtube.com/watch?v=YcZj1XKZe4M](https://www.youtube.com/watch?v=YcZj1XKZe4M)

You can watch the video [here: https://www.youtube.com/watch?v=J4tJ1FZ-QoA](https://www.youtube.com/watch?v=J4tJ1FZ-QoA)

If you need a PPTX/editable version for your class, email us hci@uchicago.edu

More information on this paper (or others of our lab) at: <https://lab.plopes.org/#SplitBody>



SplitBody: Reducing Mental Workload while Multitasking via Muscle Stimulation

Romain Nith, Yun Ho, Pedro Lopes. In Proc. [CHI'24](#) (full paper)

CHI best paper award (top 1%)

Electrical muscle stimulation (EMS) offers promise in assisting physical tasks by automating movements (e.g., shake a spray can that the user is using). However, these systems improve the performance of a task that users are *already* focusing on (e.g., users are already focused the spray can). Instead, we investigate whether these muscle stimulation offer benefits when they automate a task that happens in the *background* of the user's focus. We found that automating a repetitive movement via EMS can reduce mental workload while users perform parallel tasks (e.g., focusing on writing an essay while EMS stirs a pot of soup).



[CHI'24 paper](#)



[video](#)



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human computer integration lab



SplitBody

romain nith, yun ho, pedro lopes

Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>



Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>



Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>



Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>

A woman with dark hair tied back, wearing a black sleeveless top and a gold necklace, is in a kitchen. She is holding a wooden spoon over a pot on a stovetop. On her upper left arm, she is applying a white rectangular device with black wires, which is an electrical muscle stimulation (EMS) unit. The kitchen has white cabinets, a grey countertop, and a stainless steel sink. A dish rack and a toaster oven are visible in the background.

let's try again, but this time using
electrical muscle stimulation (EMS)

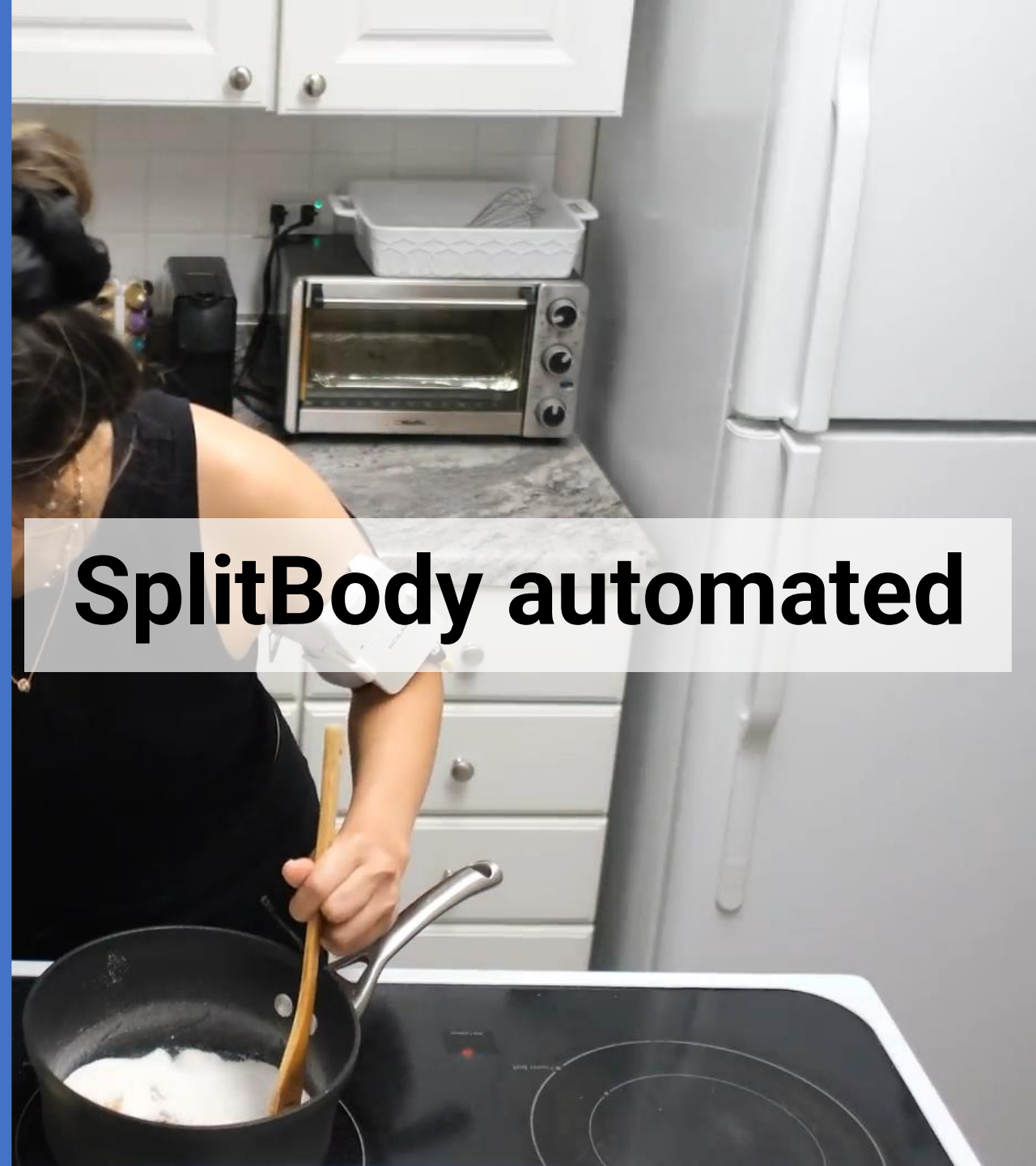
Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>

A woman with brown hair tied in a bun with a black scrunchie is in a kitchen. She is wearing a black sleeveless top and a gold necklace. On her left upper arm, she has a white medical device with a black strap. She is holding a black marker in her right hand and writing on a white piece of paper on the countertop. With her left hand, she holds a wooden spoon and stirs a black frying pan on an induction cooktop. The kitchen has white cabinets, a grey granite countertop, and a stainless steel sink. A dish rack, a blue soap dispenser, and a white sponge are on the left side of the sink. On the right side of the countertop, there is a silver toaster oven and a white storage basket. A white refrigerator is visible on the far right.

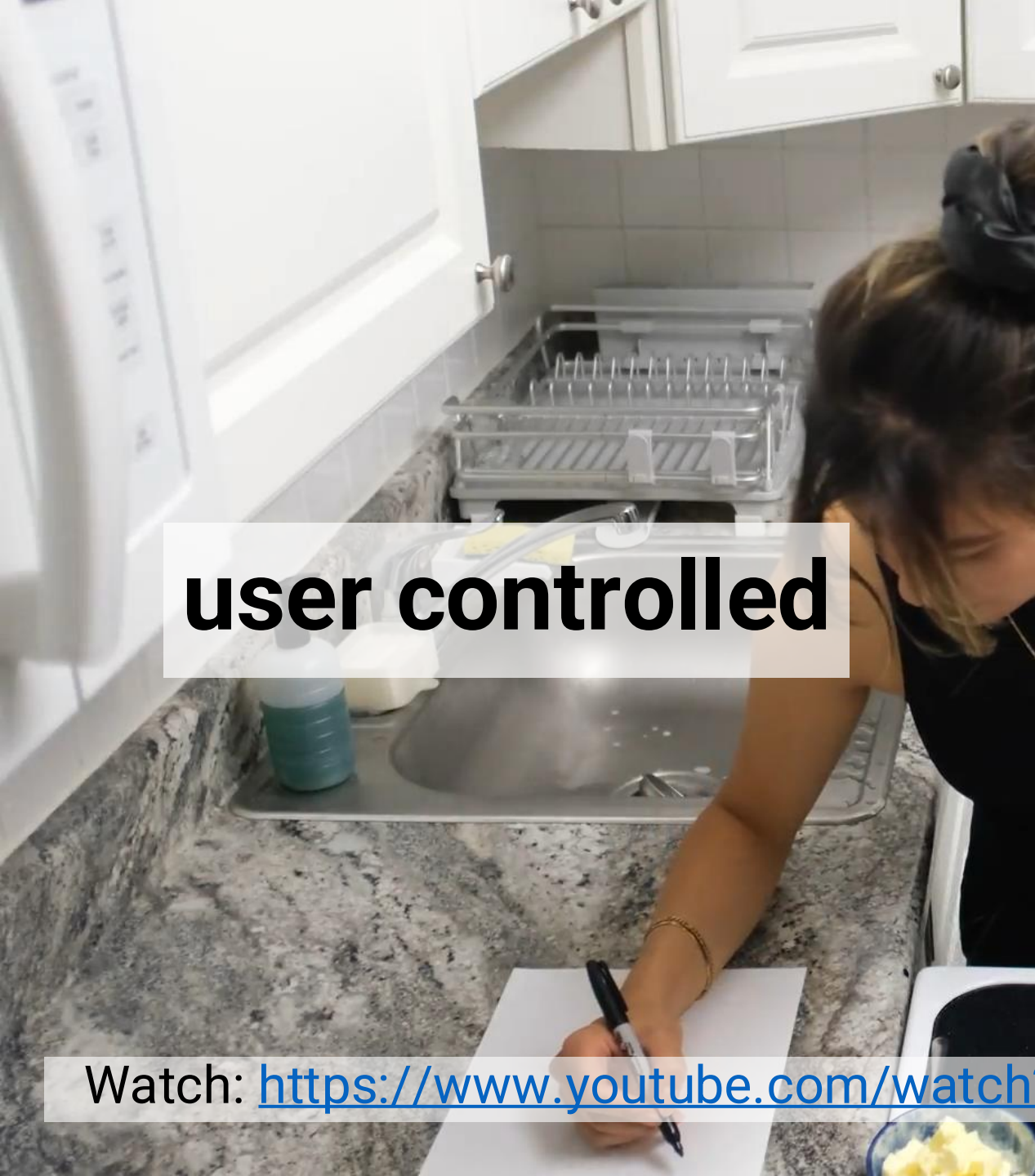
Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>



Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>

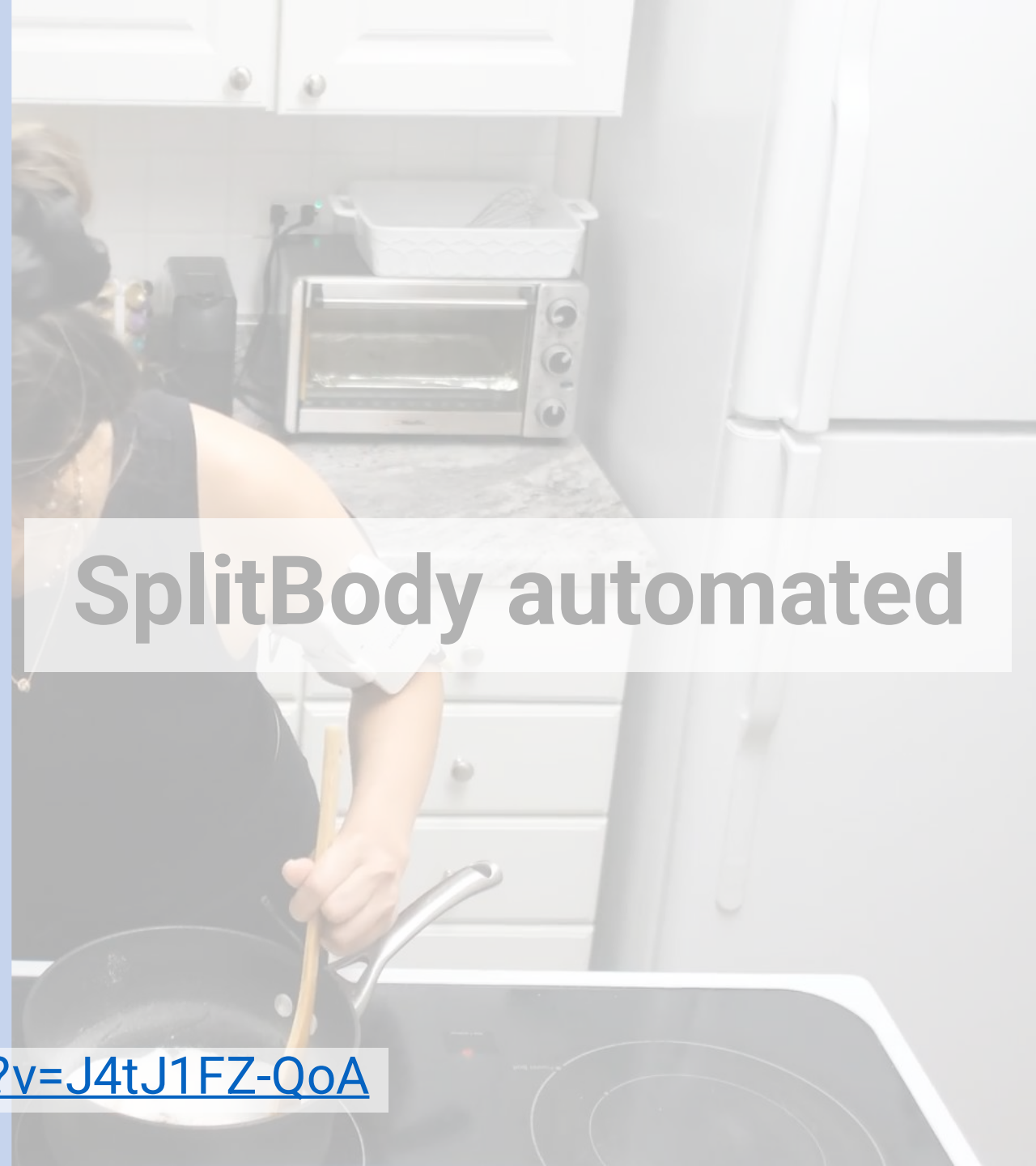


SplitBody automated

A woman with dark hair tied back is standing at a kitchen counter. She is wearing a black sleeveless top and a gold bracelet. She is holding a black marker and writing on a white notepad. In the background, there is a stainless steel sink with a dish rack, a blue bottle of dish soap, and a white cabinet. The text "user controlled" is overlaid in a white box.

user controlled

Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>

A woman is standing at a kitchen counter, cooking. She is wearing a black sleeveless top and a gold bracelet. She is holding a wooden spoon and stirring a pot on a stovetop. In the background, there is a white cabinet, a microwave, and a white refrigerator. The text "SplitBody automated" is overlaid in a white box.

SplitBody automated

A woman with brown hair tied in a bun with a black scrunchie is in a kitchen. She is wearing a black sleeveless top and a gold necklace. On her left upper arm, she has a white medical device with a black strap. She is holding a black marker in her right hand and writing on a white piece of paper on the countertop. With her left hand, she holds a wooden spoon and stirs a black frying pan on an induction cooktop. The kitchen has white cabinets, a grey granite countertop, and a stainless steel sink. A dish rack, a blue soap dispenser, and a white sponge are on the left side of the sink. On the right side of the countertop, there is a silver toaster oven and a white storage basket. A white refrigerator is visible on the far right.

Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>

A woman with dark hair tied in a bun, wearing a black sleeveless top and a necklace, is cooking in a kitchen. She is stirring a pot on a black induction cooktop with a wooden spoon. The kitchen has white cabinets, a granite countertop, and a stainless steel sink. A dish rack is visible in the background. In the foreground, there is a white notepad with a pen and a small blue bowl.

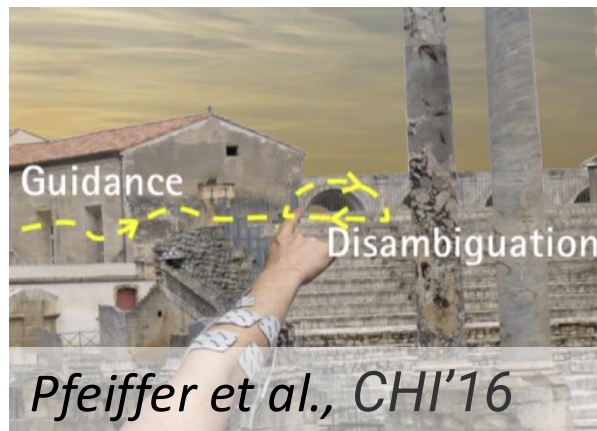
Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>

x50

related work



Takahashi et al., CHI'21



Pfeiffer et al., CHI'16



Lopes et al., CHI'15



Hassan et al., IMWUT'17



Ebisu et al., SA'16



Nith et al., UIST'21



Colley et al., TEI'18



Faltaous et al., it'21



Tamaki et al., CHI'11



Lopes et al., CHI'16



Tanaka et al., CHI'22



Kasahara et al., CHI'19



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Tamaki et al., CHI'11



Lopes et al., CHI'16



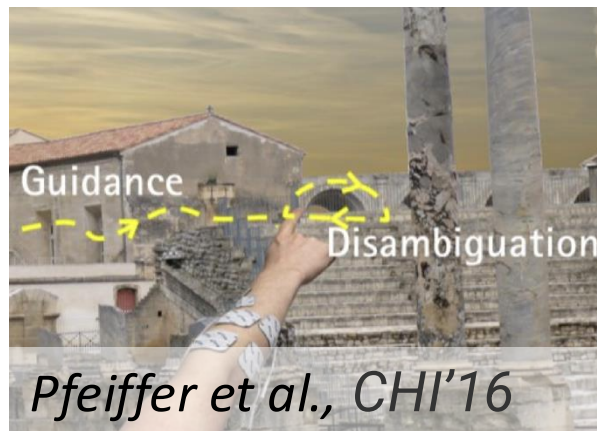
Tanaka et al., CHI'22



Kasahara et al., CHI'19



Takahashi et al., CHI'21



Pfeiffer et al., CHI'16



Lopes et al., CHI'15



Hassan et al., IMWUT'17



Ebisu et al., SA'16



Nith et al., UIST'21



Colley et al., TEI'18



Faltaous et al., it'21



Tamaki et al., CHI'11



Lopes et al., CHI'16



Tanaka et al., CHI'22



Kasahara et al., CHI'19



Takahashi et al., CHI'21



Pfeiffer et al., CHI'16



Lopes et al., CHI'15



Hassan et al., IMWUT'17



Ebisu et al., SA'16



Nith et al., UIST'21



Colley et al., TEI'18



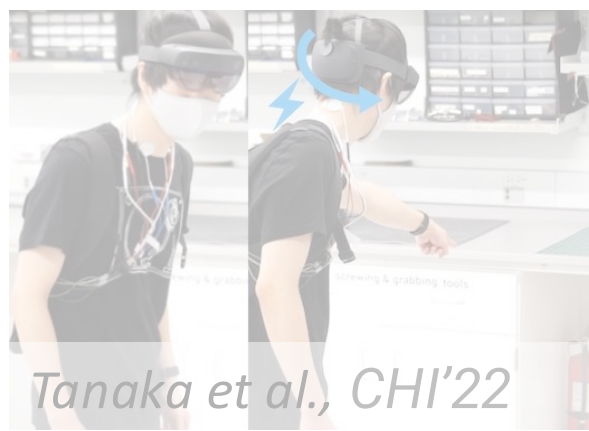
Faltaous et al., it'21



Tamaki et al., CHI'11



Lopes et al., CHI'16



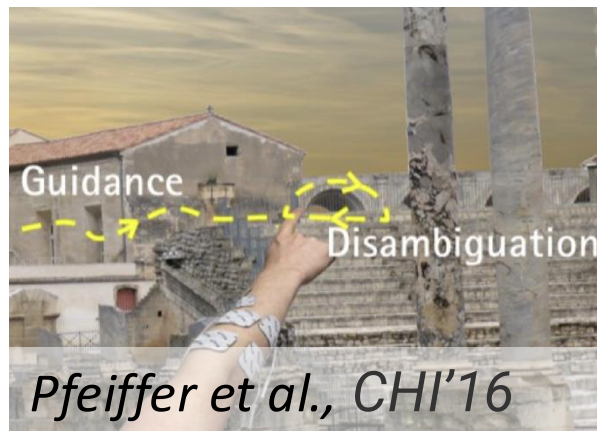
Tanaka et al., CHI'22



Kasahara et al., CHI'19



Takahashi et al., CHI'21



Pfeiffer et al., CHI'16



Lopes et al., CHI'15



Hassan et al., IMWUT'17



Ebisu et al., SA'16



Nith et al., UIST'21



Colley et al., TEI'18



Faltaous et al., it'21



Tamaki et al., CHI'11



Lopes et al., CHI'16



Tanaka et al., CHI'22



Kasahara et al., CHI'19



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Pfeiffer et al., CHI'16



Lopes et al., CHI'15



Hassan et al., IMWUT'17



Ebisu et al., SA'16



Nith et al., UIST'21



Colley et al., TEI'18



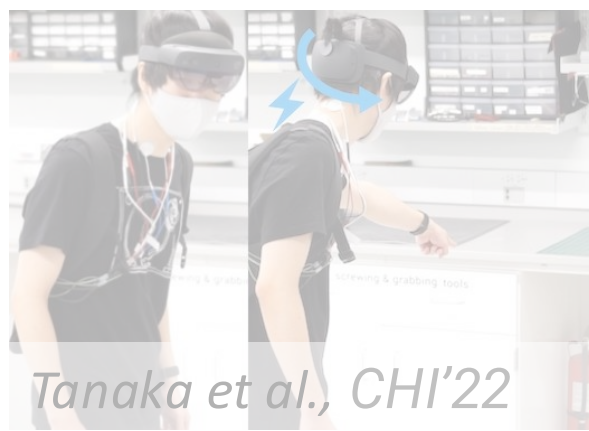
Faltaous et al., it'21



Tamaki et al., CHI'11



Lopes et al., CHI'16



Tanaka et al., CHI'22

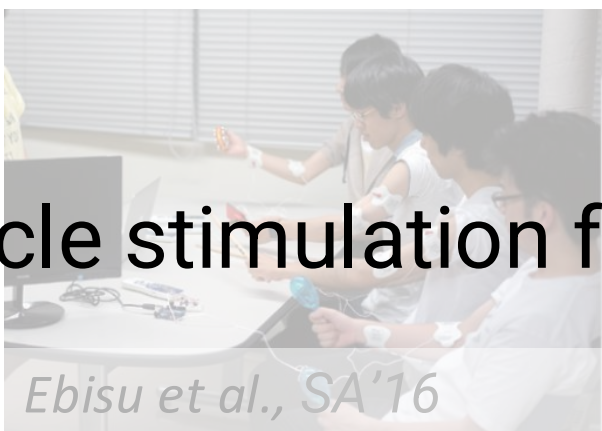


Kasahara et al., CHI'19

muscle stimulation for foreground tasks



muscle stimulation for foreground tasks





Takahashi et al., CHI'21



Pfeiffer et al., CHI'16



Hassan et al., IMWUT'17



Ebisu et al., SA'16



Nith et al., UIST'21



Faltaous et al., it'21



Nith et al., CHI'24



Tamaki et al., CHI'11



Lopes et al., CHI'16



Kasahara et al., CHI'19

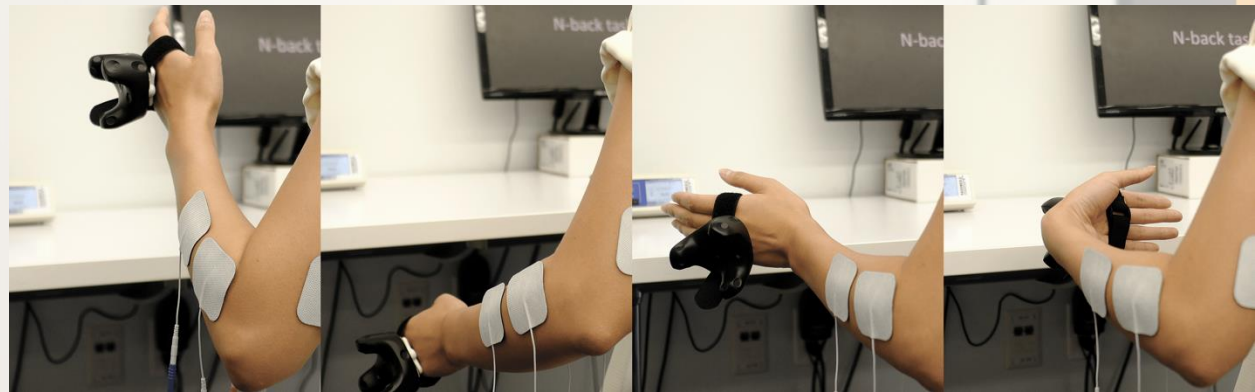
... will EMS help with multitasking?

user study



Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>

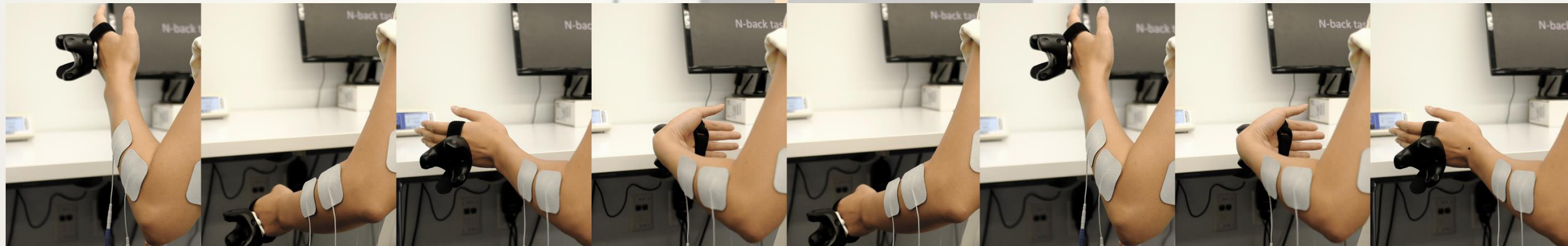
movement task



up → down → left → right →



movement task



up → down → left → right → down → up → right → left

movement task



cognitive task (2-back)



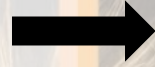
Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>

movement task

A



B



cognitive task (2-back)

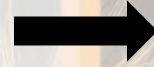
H

movement task

A



B



C

cognitive task (2-back)

H

movement task

cognitive task (2-back)

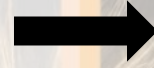


movement task

A



B



C



B

cognitive task (2-back)

H

movement task

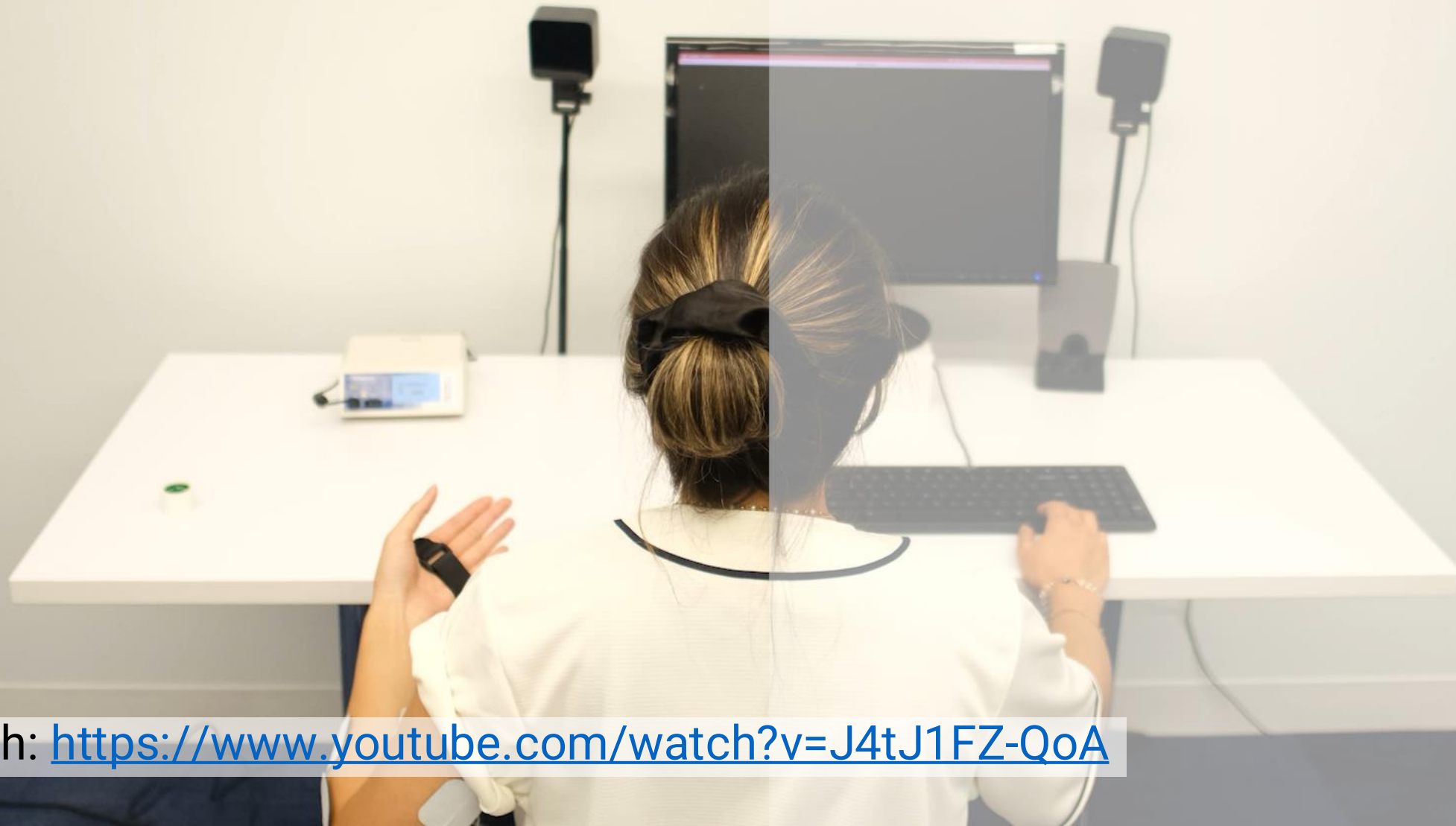
cognitive task (2-back)

A → **B** → **C** → **B**



this is a 2-back

in two conditions

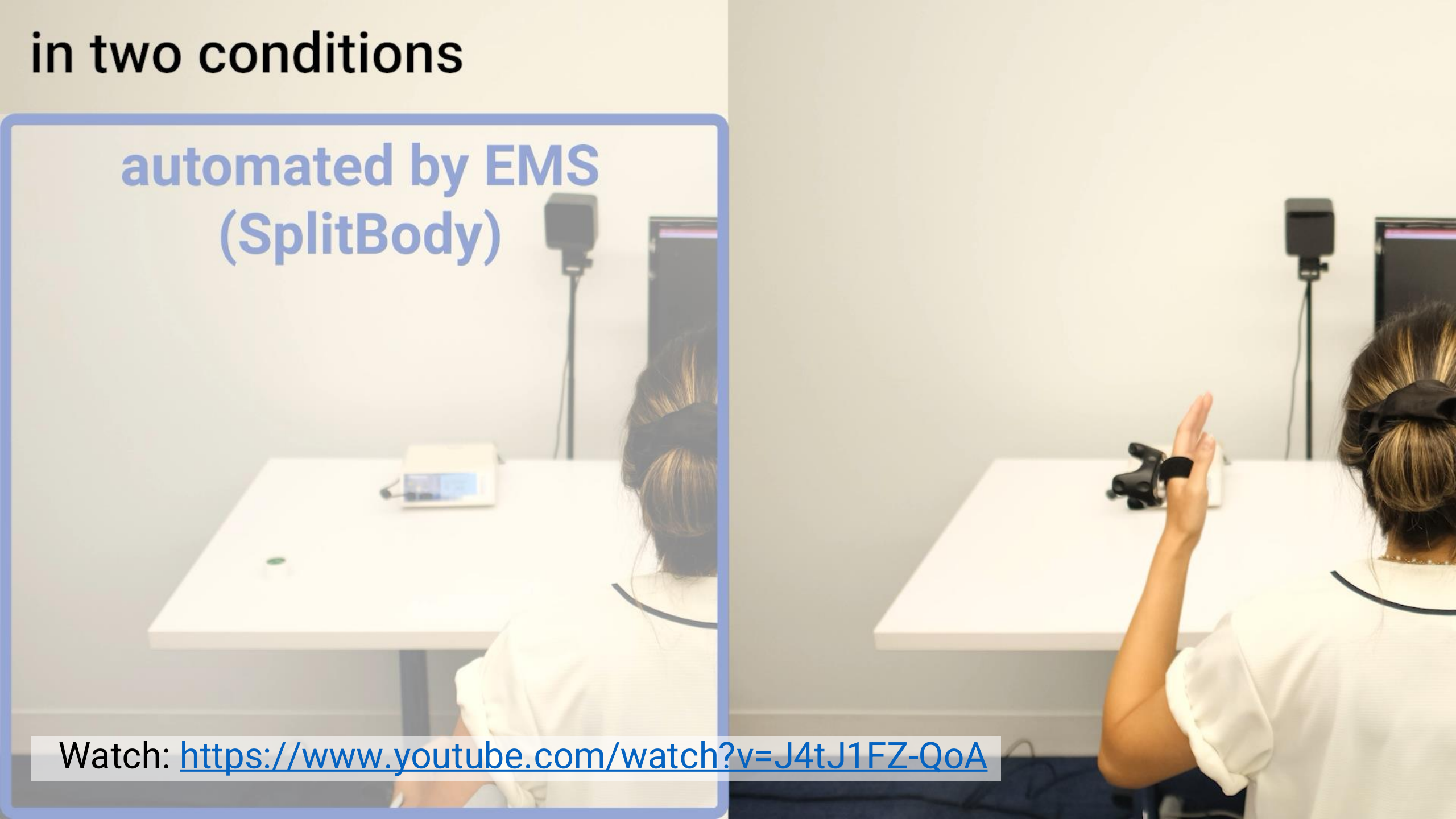


Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>

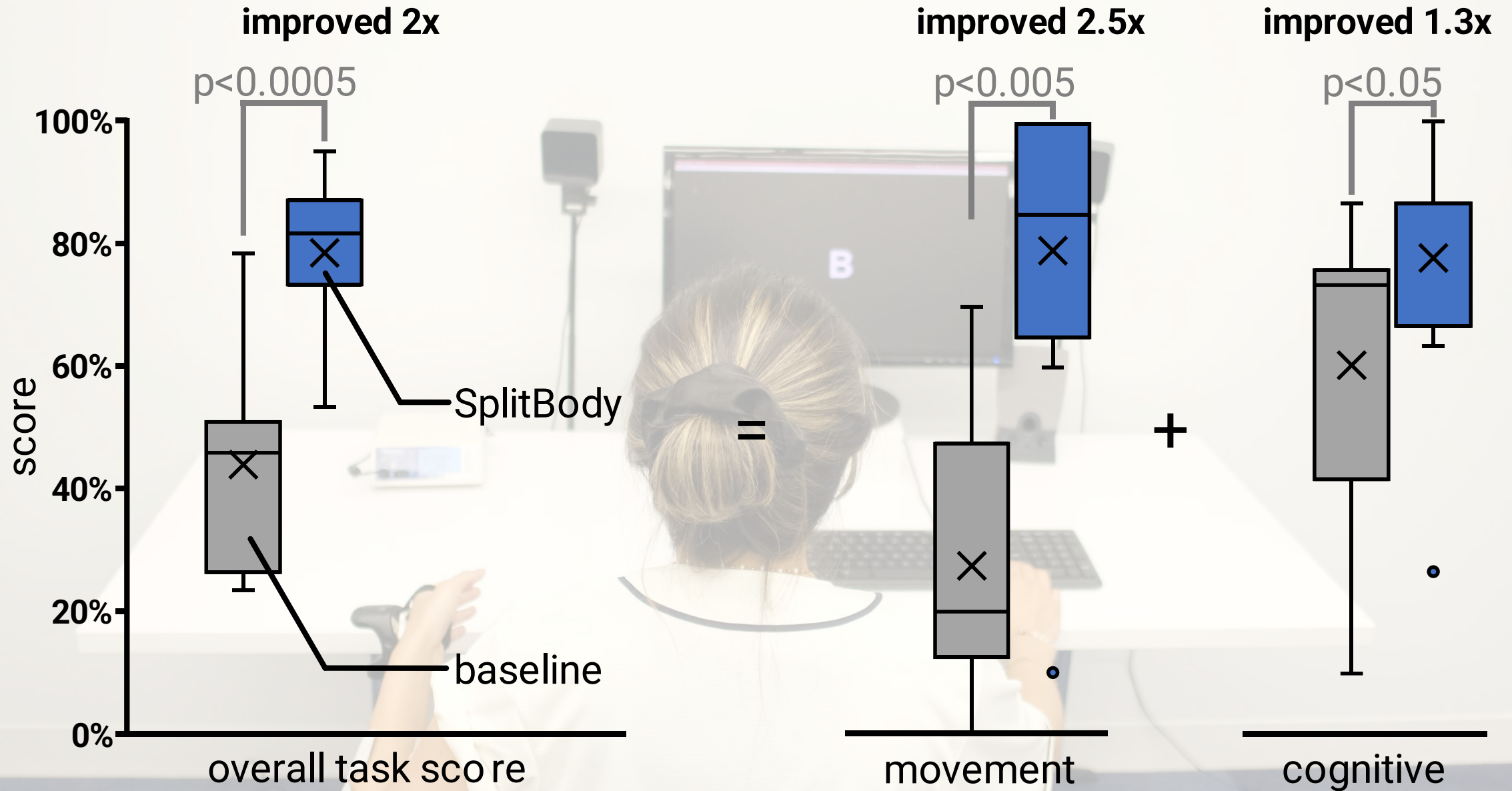
in two conditions

automated by EMS
(SplitBody)

Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>

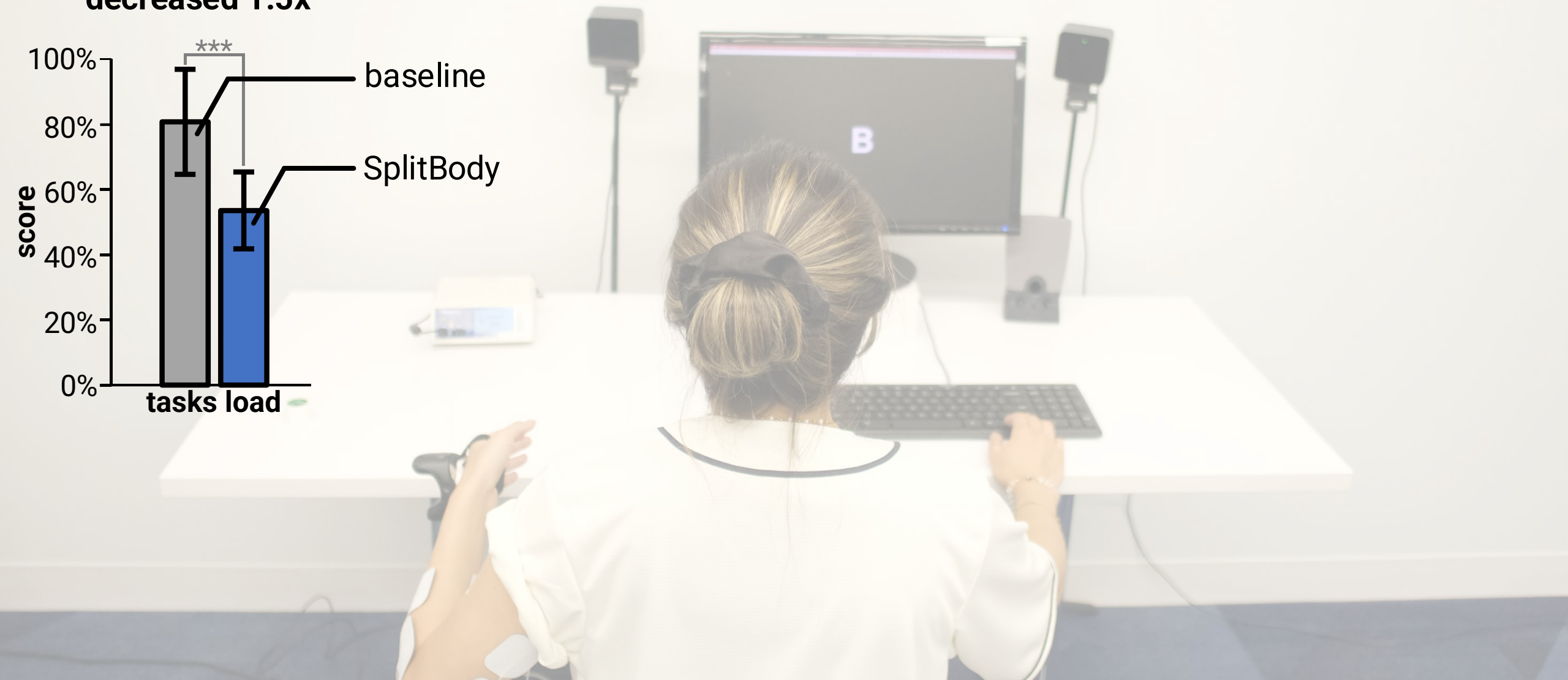
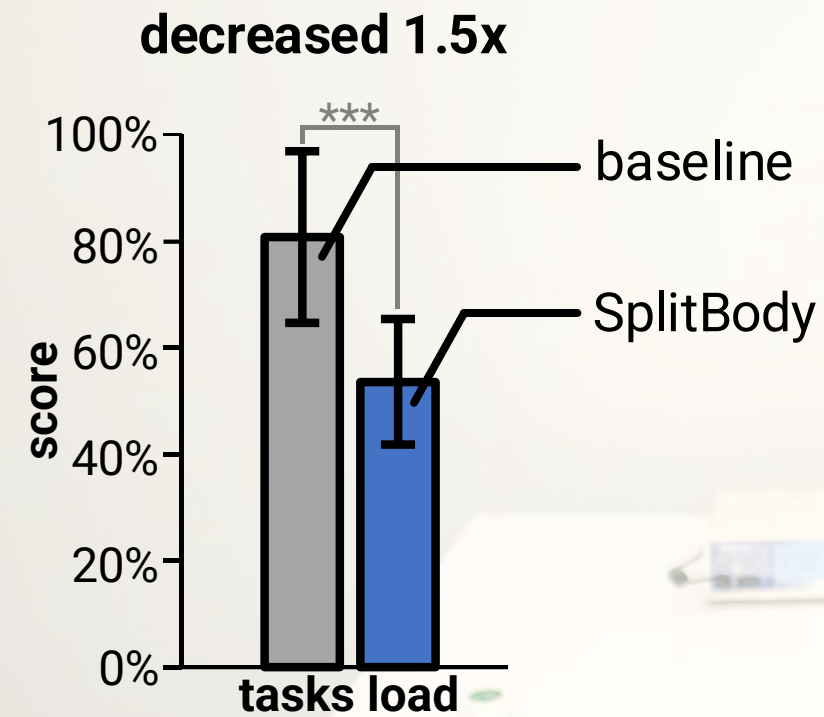


task score

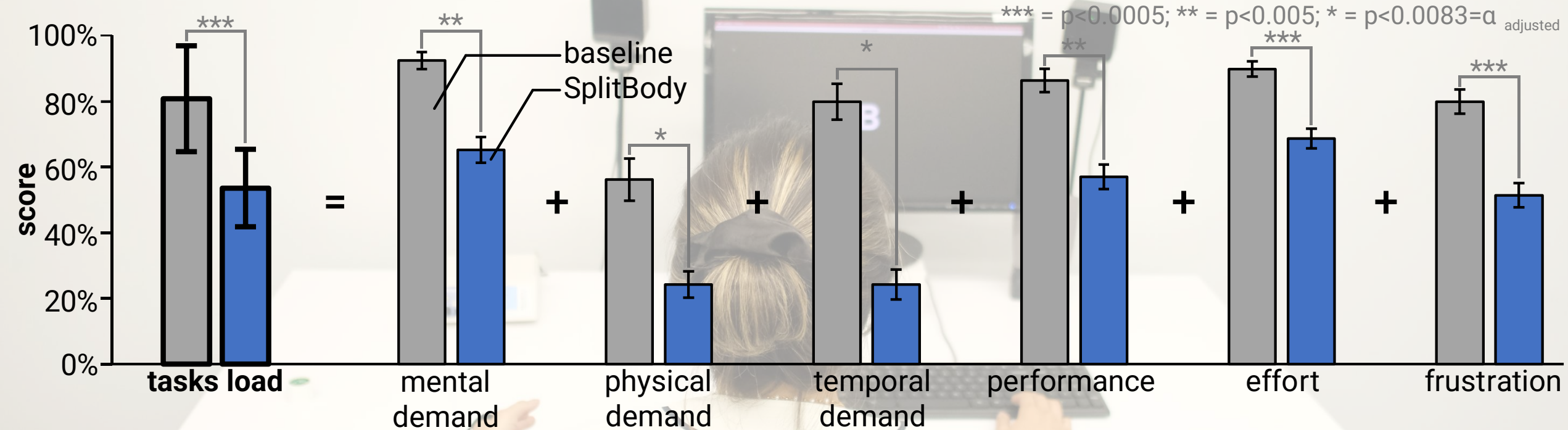


Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>

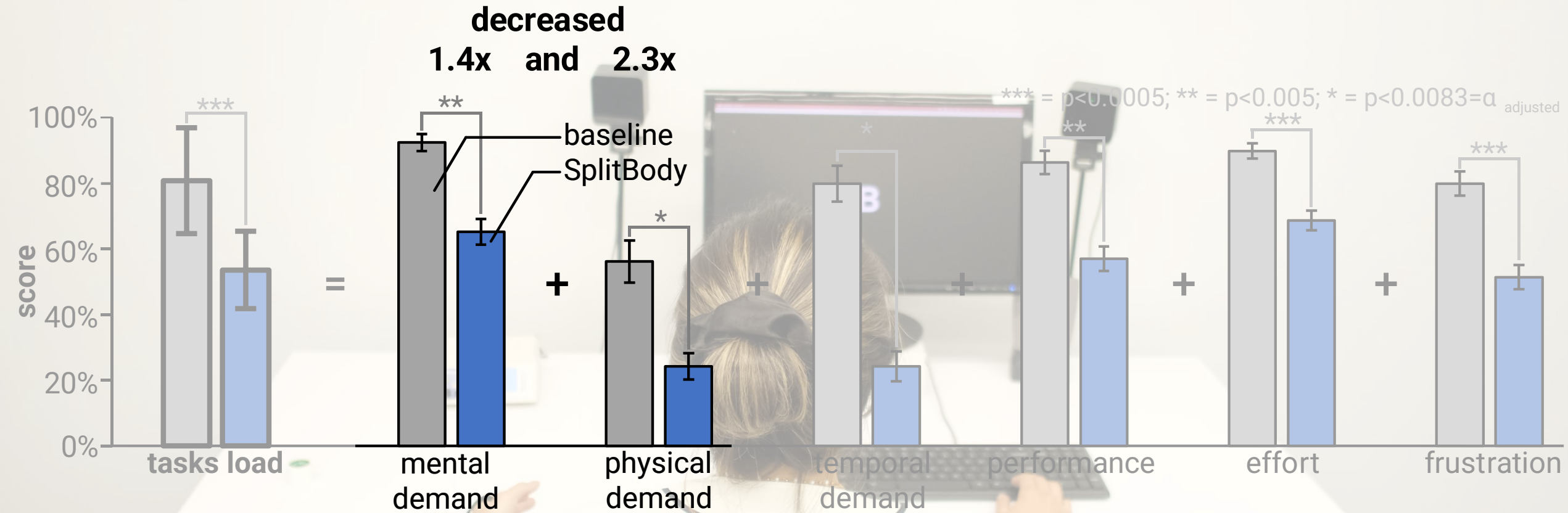
NASA Task Load Index



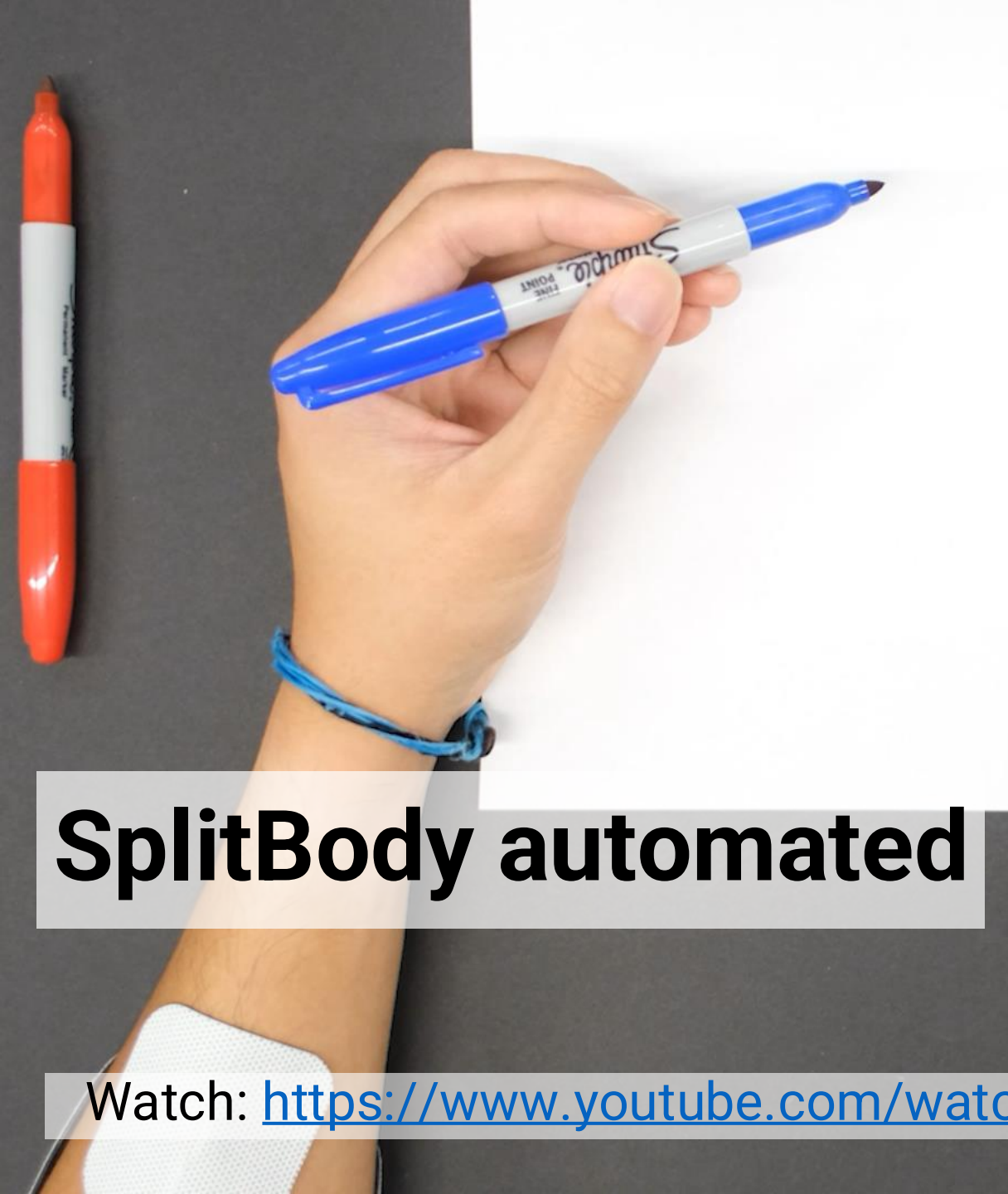
NASA Task Load Index



NASA Task Load Index



further applications



SplitBody automated

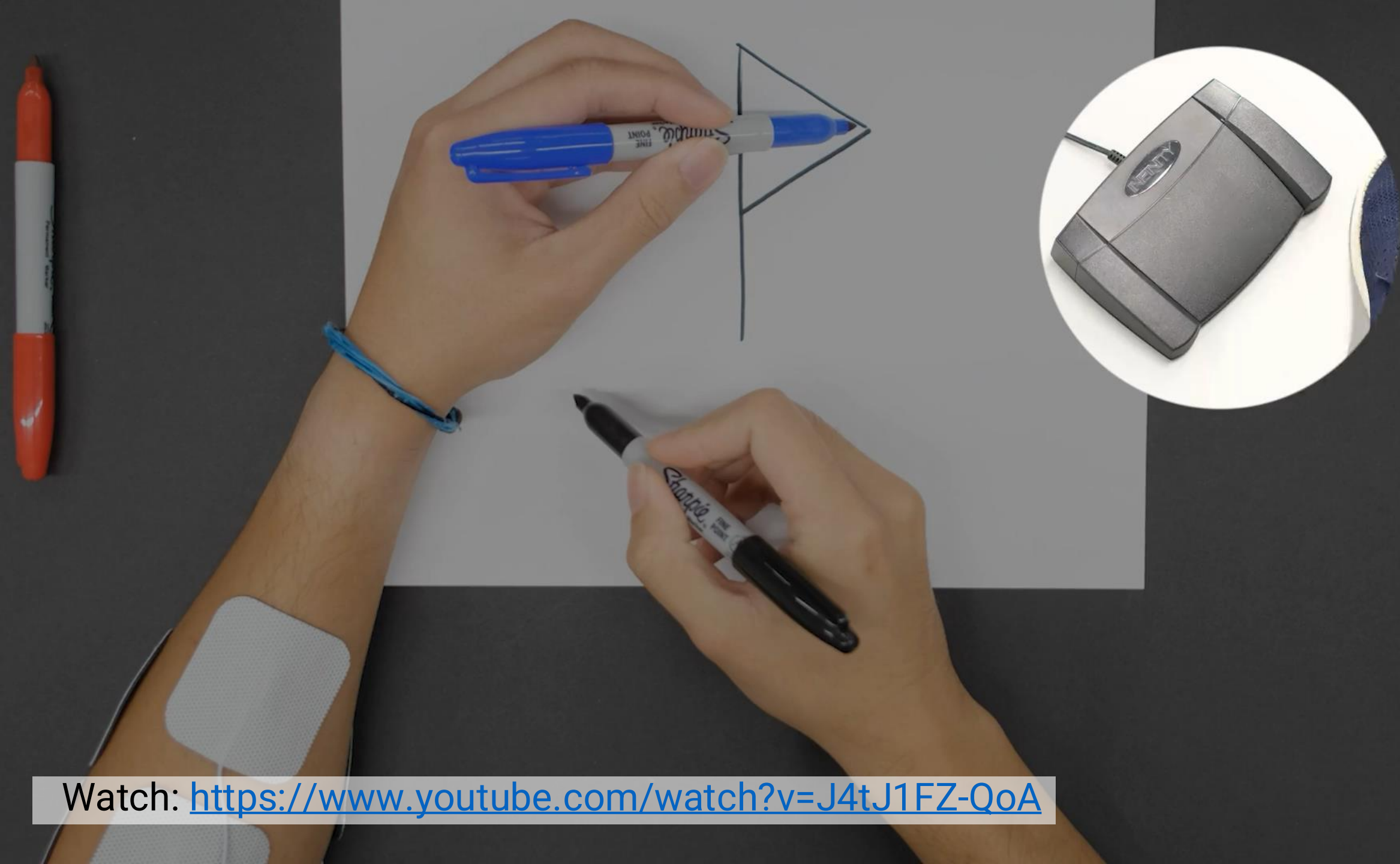


user controlled

Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>



Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>



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user controlled

SplitBody automated

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Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>



Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>

A young man with dark hair, wearing a light blue polo shirt and light-colored trousers, is seated and playing a drum set. He has several white motion capture sensors attached to his body: two on his upper right arm, two on his right thigh, and one on his right ankle. He is holding drumsticks and playing a snare drum. To his left is a large wooden bass drum. In front of him is a black music stand. To his right is a cymbal stand with a cymbal. A large blue diagonal line runs from the top right towards the bottom left, separating the image into two halves. The background is a plain, light-colored wall.

SplitBody automated

user controlled

Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>



Watch: <https://www.youtube.com/watch?v=J4tJ1FZ-QoA>

conclusion



I also have another dog named J.A.
He is a small white malt-poodle.
Unlike Oliver, he doesn't care about
food at all, but
he would, even if it meant possibly
hunger.



user controlled



SplitBody automated

methods of assisting user

muscle stimulation



methods of assisting user

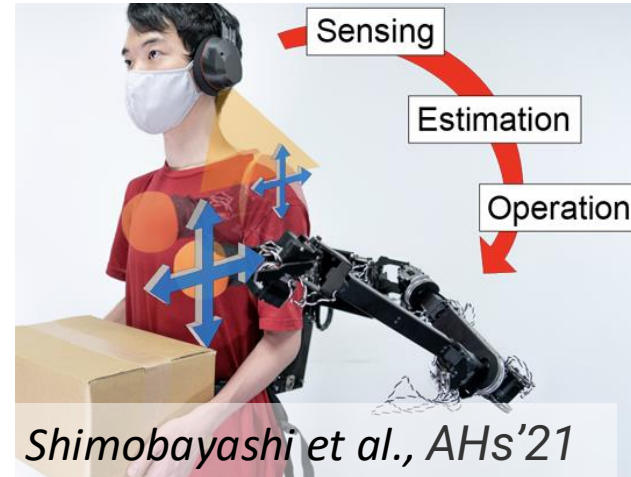
muscle stimulation



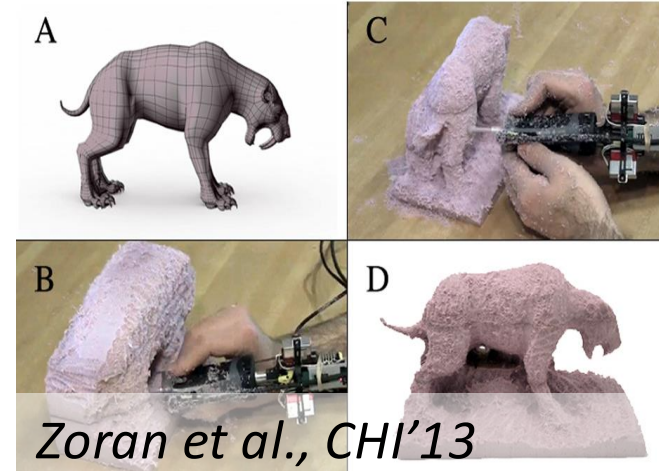
exoskeletons



supernumerary limbs



tools



methods of assisting user

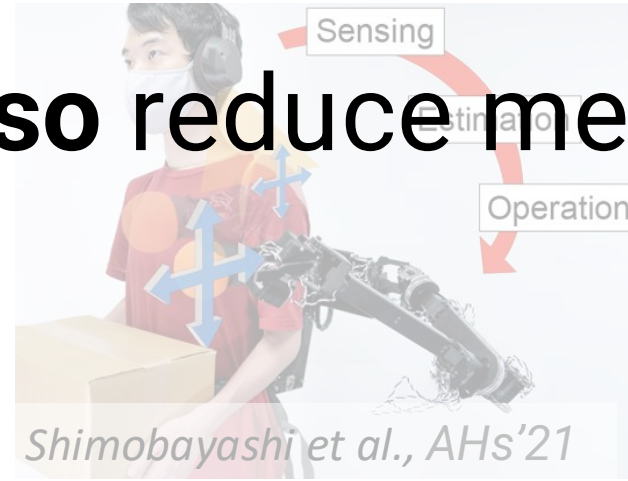
muscle stimulation



exoskeletons



supernumerary limbs



tools



do they also reduce mental effort?

methods of assisting user

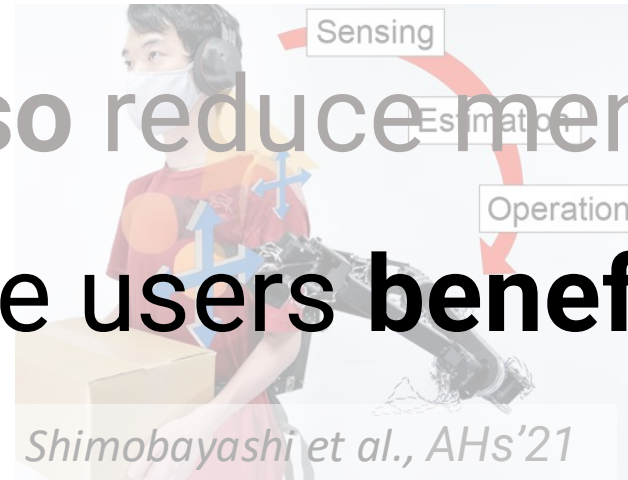
muscle stimulation



exoskeletons



supernumerary limbs



tools



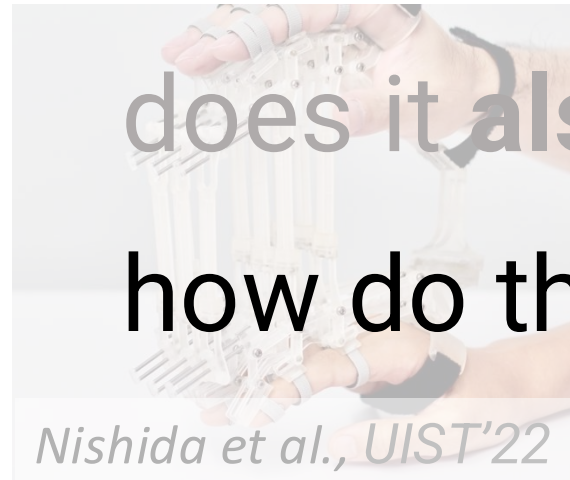
does it **also** reduce mental effort?
how do the users **benefit** from it?

methods of assisting user

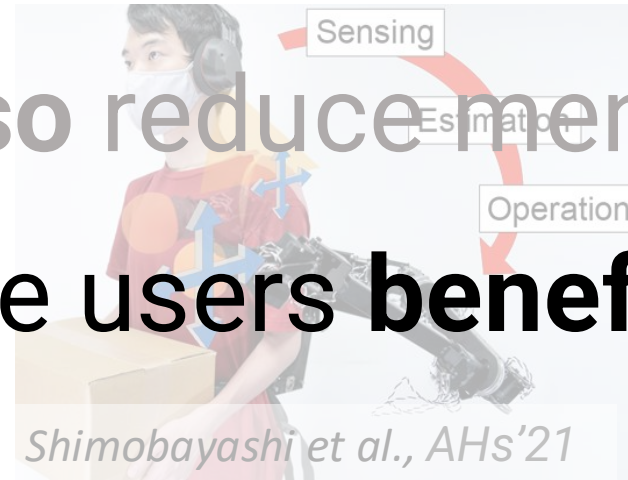
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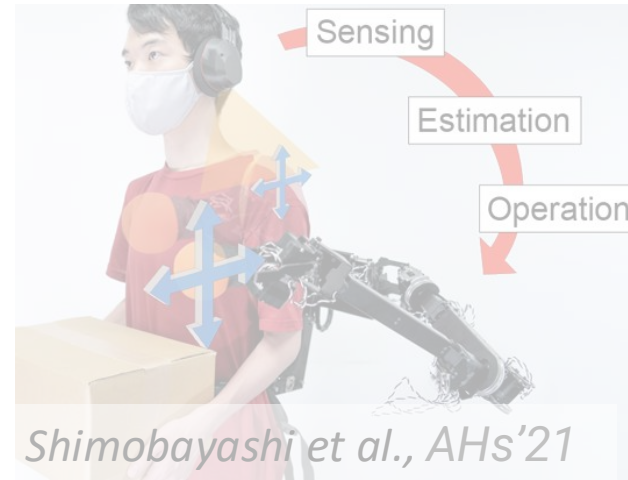
muscle stimulation



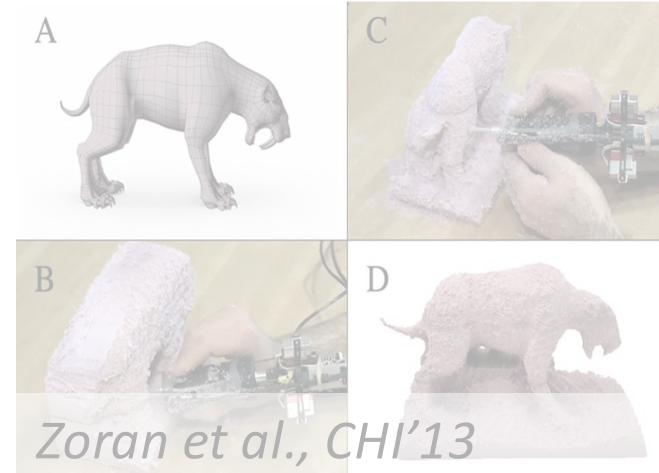
exoskeletons



supernumerary limbs



tools



methods of assisting user

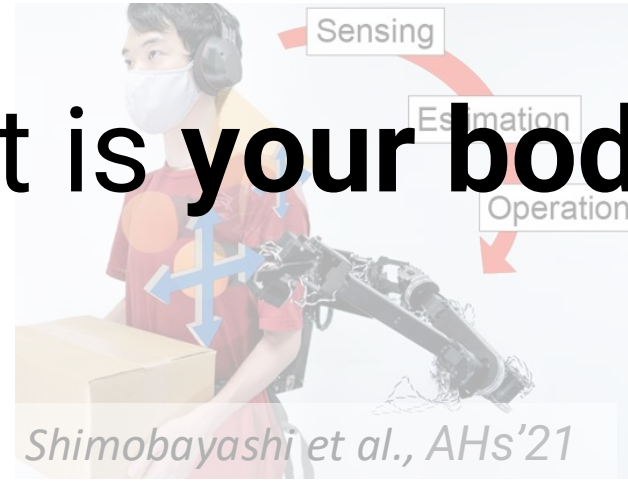
muscle stimulation



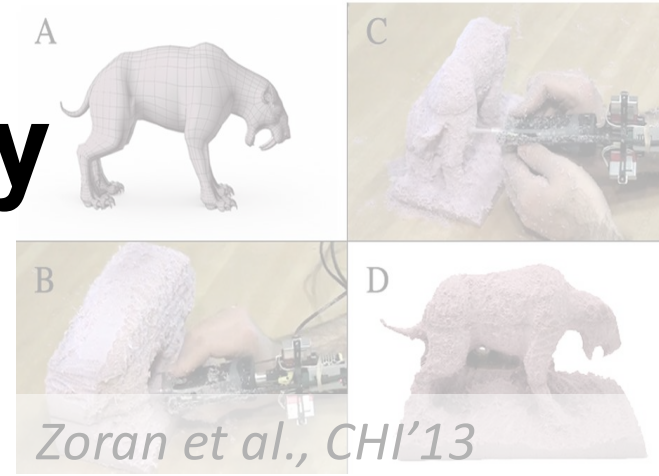
exoskeletons



supernumerary limbs



tools



it is your body

human computer integration lab



SplitBody

reducing mental workload while
multitasking via muscle stimulation

romain nith, yun ho, pedro lopes



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If you need a PPTX/editable version for your class, email us hci@uchicago.edu

More information on this paper (or others of our lab) at: <https://lab.plopes.org/#SplitBody>



SplitBody: Reducing Mental Workload while Multitasking via Muscle Stimulation

Romain Nith, Yun Ho, Pedro Lopes. In Proc. [CHI'24](#) (full paper)

CHI best paper award (top 1%)

Electrical muscle stimulation (EMS) offers promise in assisting physical tasks by automating movements (e.g., shake a spray can that the user is using). However, these systems improve the performance of a task that users are *already* focusing on (e.g., users are already focused the spray can). Instead, we investigate whether these muscle stimulation offer benefits when they automate a task that happens in the *background* of the user's focus. We found that automating a repetitive movement via EMS can reduce mental workload while users perform parallel tasks (e.g., focusing on writing an essay while EMS stirs a pot of soup).



[CHI'24 paper](#)



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