Human Autonomy

through

Robotics Autonomy

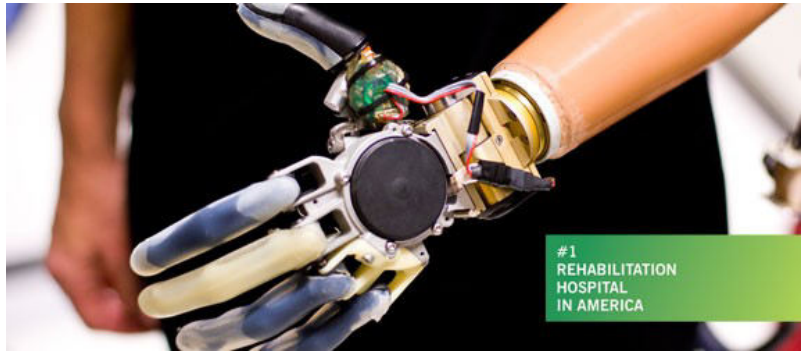
Brenna Argall

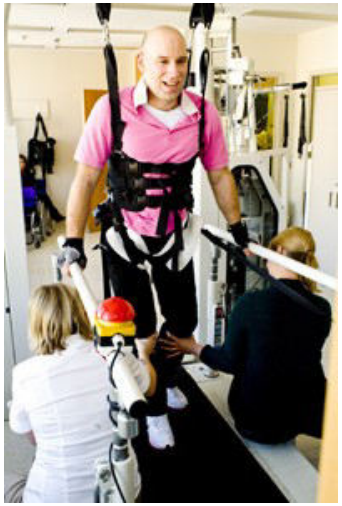
Northwestern University

Rehabilitation Institute of Chicago

[Shirley Ryan AbilityLab]

Human Rehabilitation





Assistive Machines

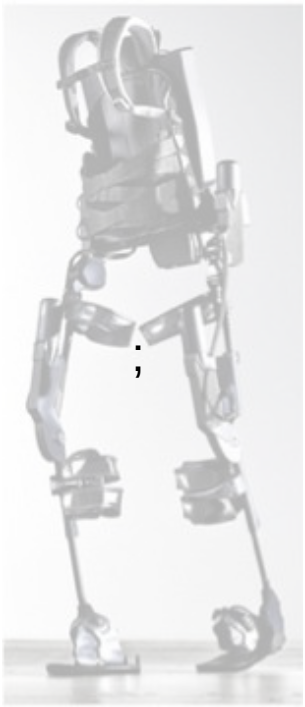
Ekso Bionics

Quantum

Touch Bionics

Kinova Robotics

Assistive Machines



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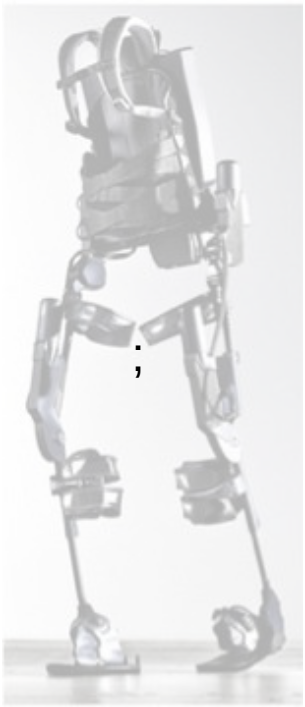
Assistive Machines



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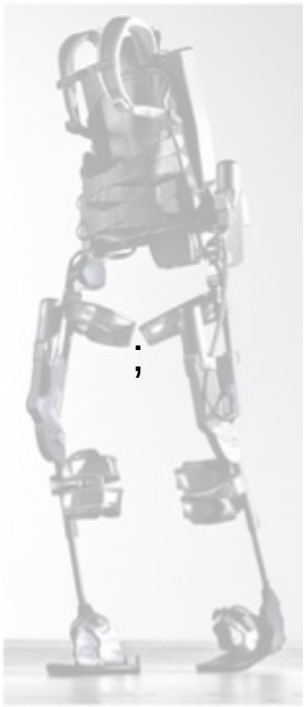
Unassisted Operation

Assistive Machines



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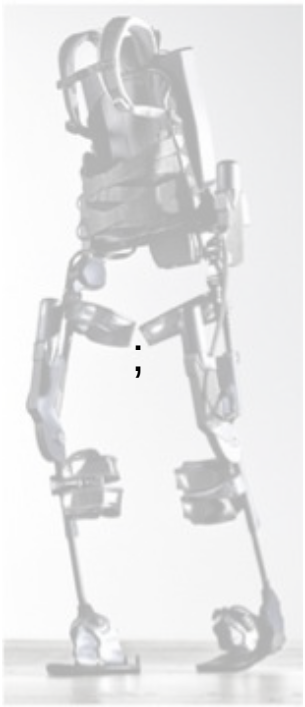

Ekso Bionics

Quantum

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Kinova Robotics

Unassisted Operation

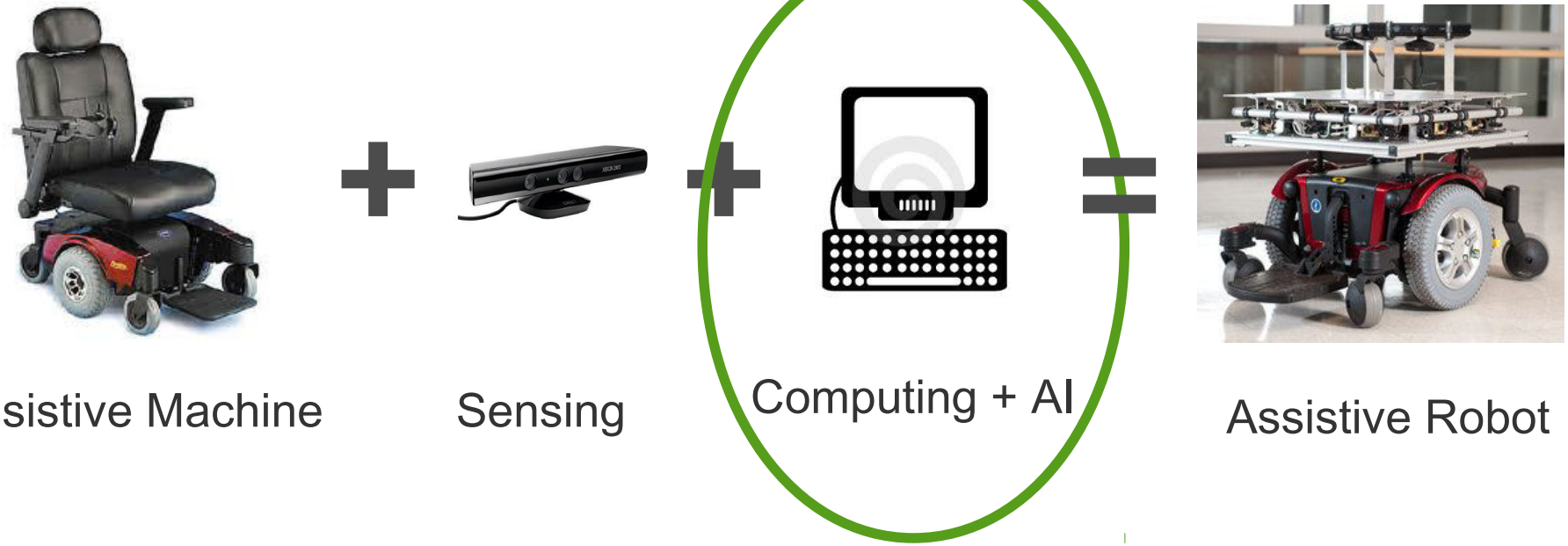
Assistive Machine

Assistive Machine

Assistive Machine → Robot

Assistive Machine + Sensing + Computing + AI = Assistive Robot

Assistive Machine → Robot



How to *share control*

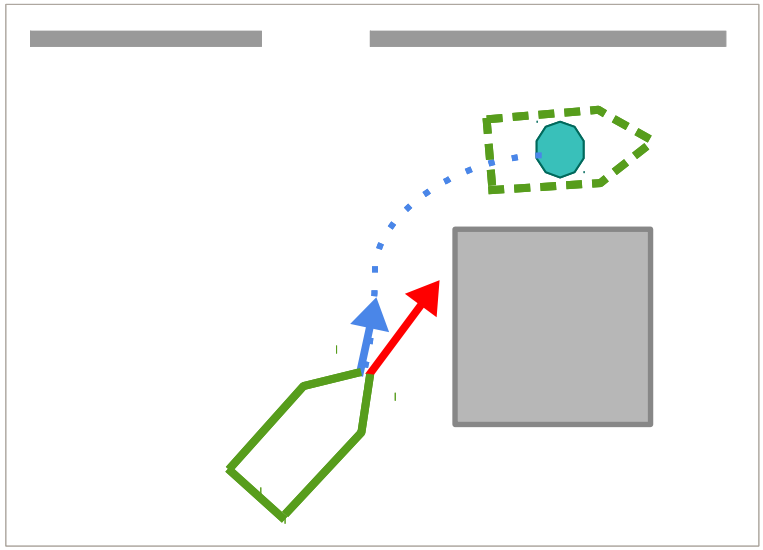
between

the human

and

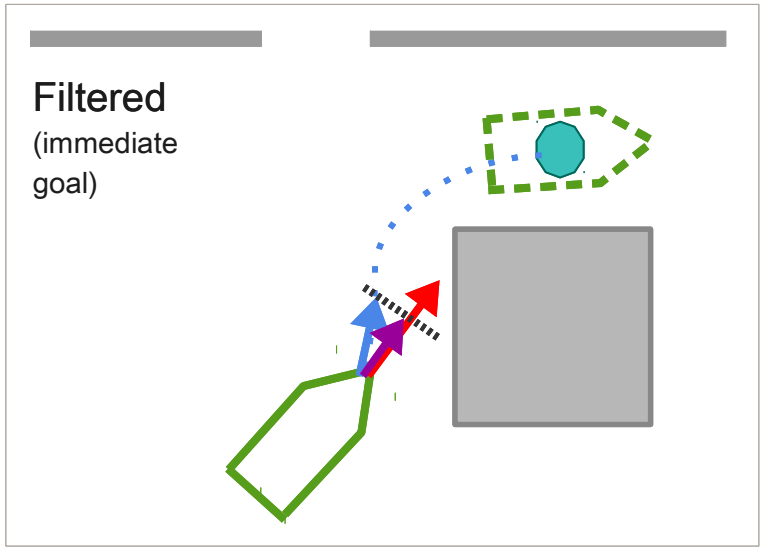
the autonomy?

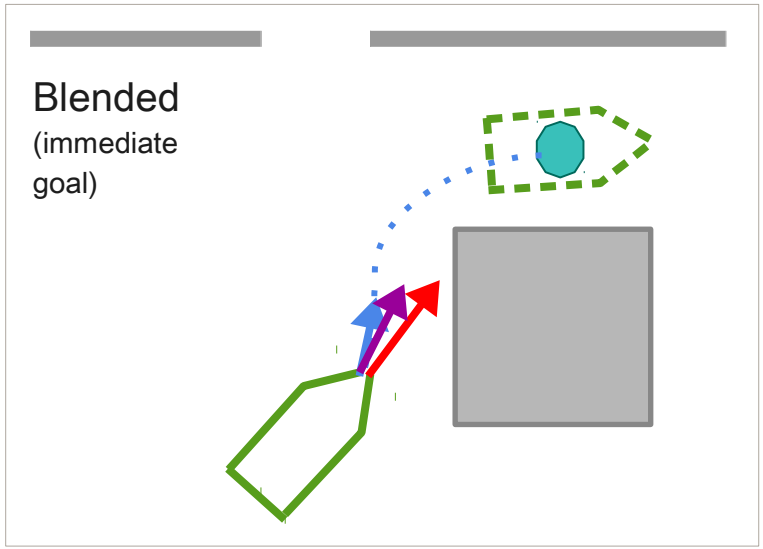
How to Share Control



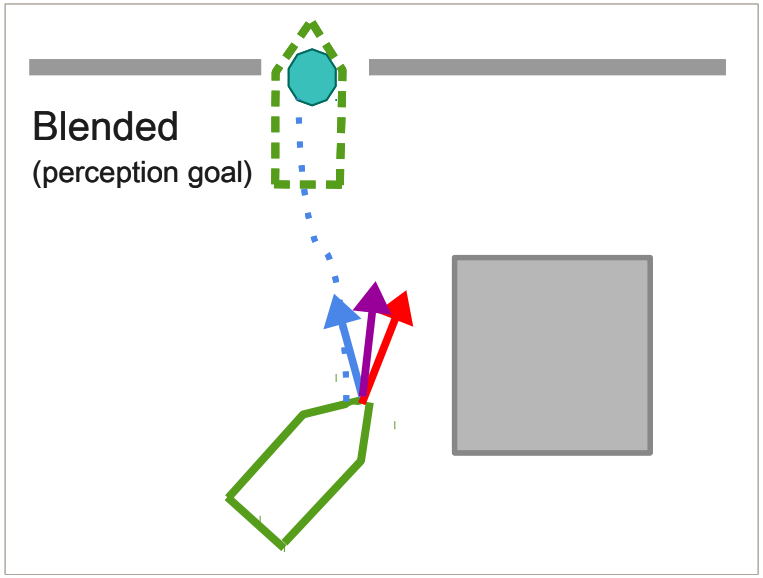
Commands:
User
Autonomy

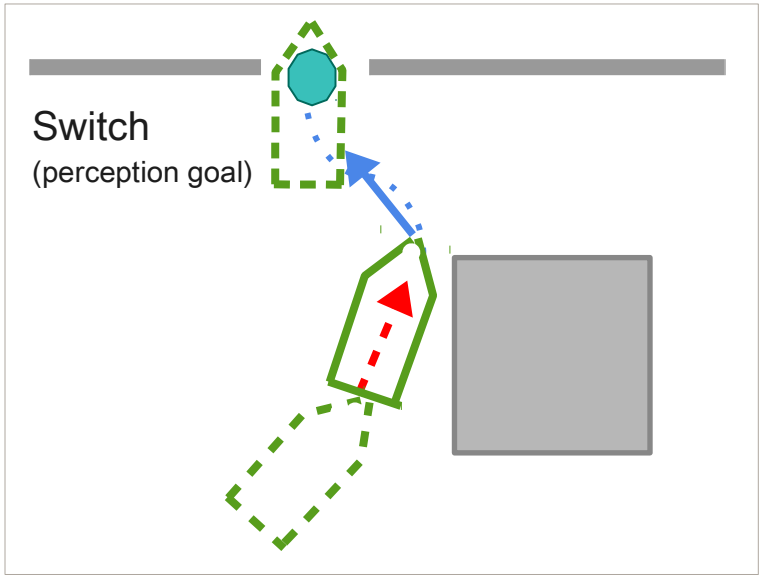
How to Share Control





Commands:
User
Autonomy
Executed





How to Share Control

...similar performance across control-sharing paradigms.

Results :: How to Share Control

...but *not* in user preference

A. Erdogan and B. Argall. *The Effect of Robotic Wheelchair Control Paradigm and Interface on User Performance, Effort and Preference: An Experimental Assessment.* RAS, 2017.

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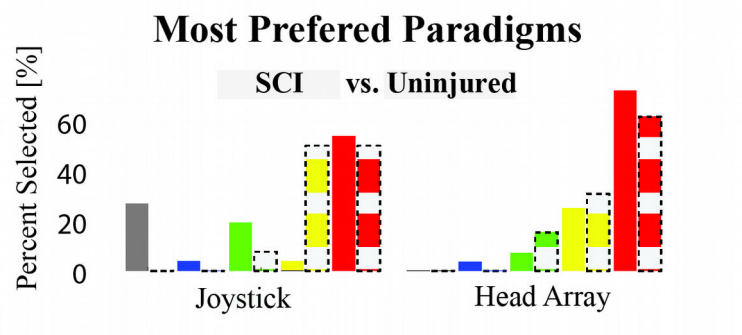

Comparative Study

5 Control paradigms

2 Interfaces

2-4 Sessions

7 SCI subjects

7 Uninjured subjects

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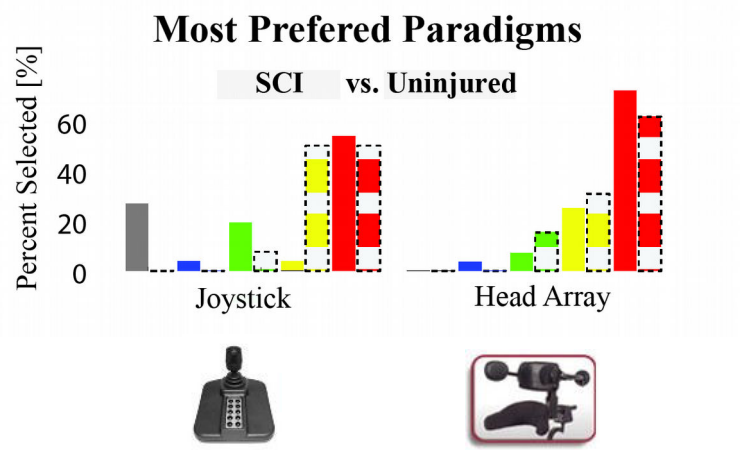
Results :: How to Share Control

...but *not* in user preference,
...or across interfaces.



~50% switch preference with interface

Comparative Study

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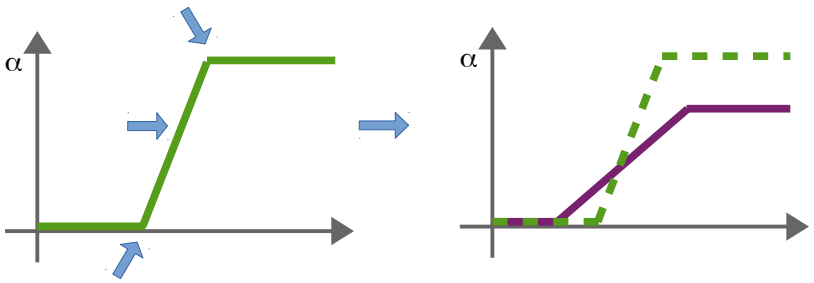
End-user Customization

Without Assistance

With Assistance



D. Gopinath, S. Jain and B. Argall. *Human-in-the-Loop Optimization of Shared Autonomy in Assistive Robotics.* RA-L and CASE, 2016.

Results :: End-user Customization

...*only* end-user customization *eliminated* differences between those with and without injury.

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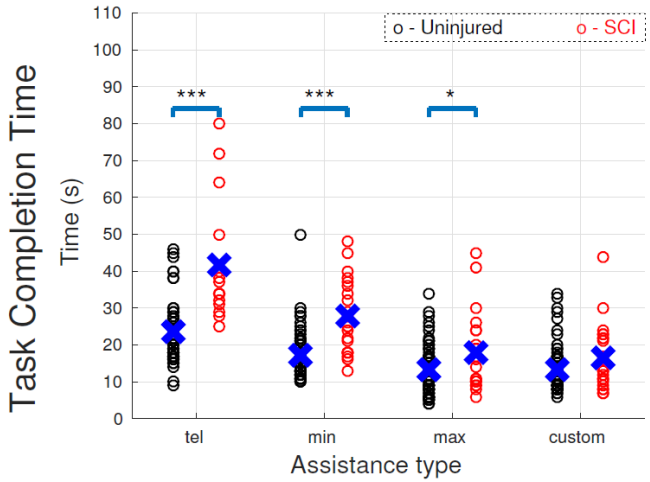

Exploratory Study

4 SCI subjects
13 Uninjured subjects

D. Gopinath, S. Jain and B. Argall. *Human-in-the-Loop Optimization of Shared Autonomy in Assistive Robotics.* RA-L and CASE, 2016.

Advancing Human Autonomy

Advancing Human Autonomy

Robotics autonomy can *bridge gaps* in human function.

Advancing Human Autonomy

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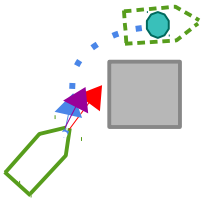
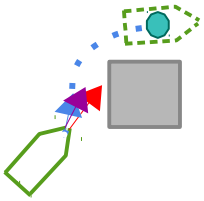


The autonomy should to be *customized* to the human.

Advancing Human Autonomy

Robotics autonomy can *bridge gaps* in human function.



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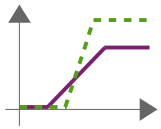

This customization likely needs to *adapt* over time.

Advancing Human Autonomy

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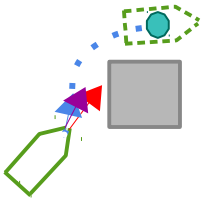

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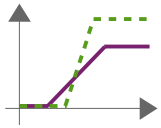

This customization likely needs to *adapt* over time.

Extends to other human-robot teams.