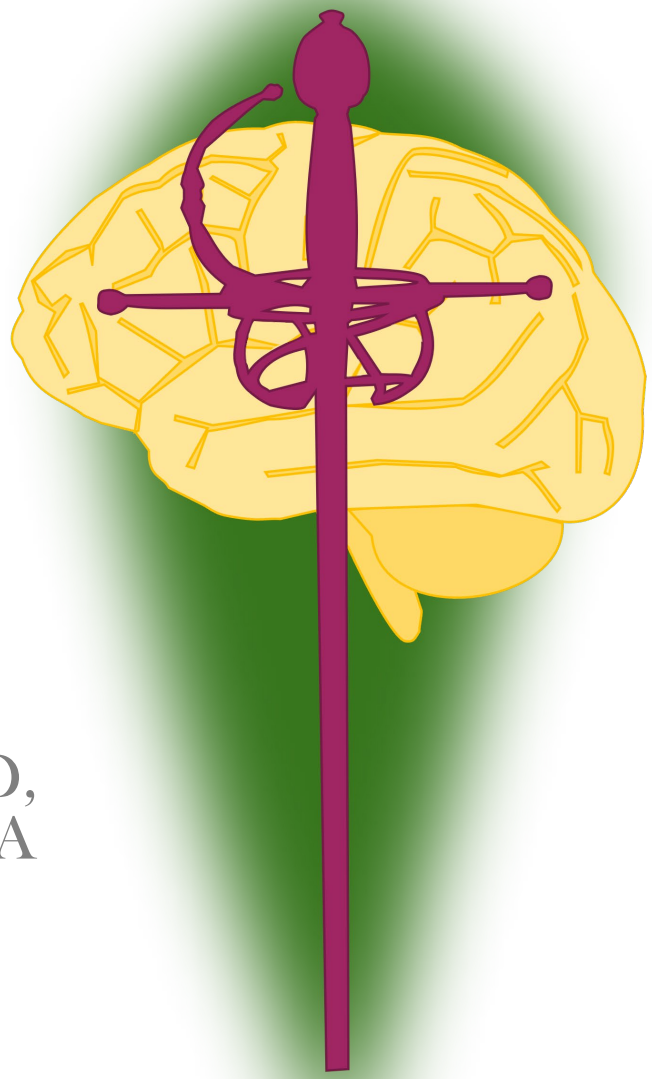
Brockshus Dissertation

Review of Literature



Brandon Brockshus

Iowa State University

POSC: Elizabeth Stegemöller Phd, Jacob Meyer PhD, Kori Khan PhD, Kira Werstein PhD, Brad Dell MFA

2013 BA Liberal Arts and Sciences

- Performing Arts – Acting/Directing

2017 National Stage Combat Workshop

2021 MS Kinesiology

- Motor Control

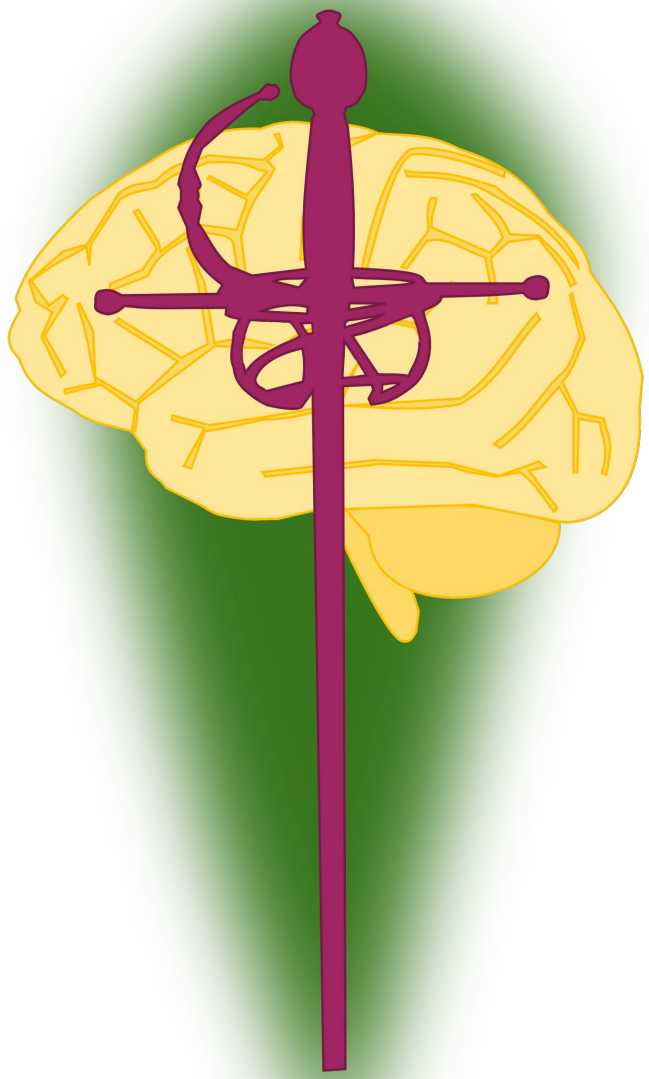
Actors and fighters: Predictors of motor health, cognitive health, and well-being in actor-combatants

2025? PhD Kinesiology

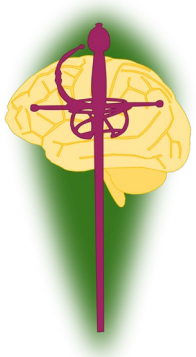
TA – Kin 372: Motor Control and Learning across the Lifespan

RA – SPARX3 Clinical Trial, Exercise Interventionist

Neuromotor Learning of Stage Combat Skills



Stage Combat is an Aesthetic Martial Art



Stage combat: an aesthetic martial art undertaken for the purposes of violent storytelling

2 conflicting goals

- Effectively simulate violence for an audience
- Keep the actors unharmed

8 weapon disciplines

Unarmed	Knife
Staff	Single Sword
Longsword	Sword & Shield
Rapier & Dagger	Smallsword

Compulsory Skill Techniques

Hobbs, 1980; SAFD, 2024


4K
ULTRA HD

Acting

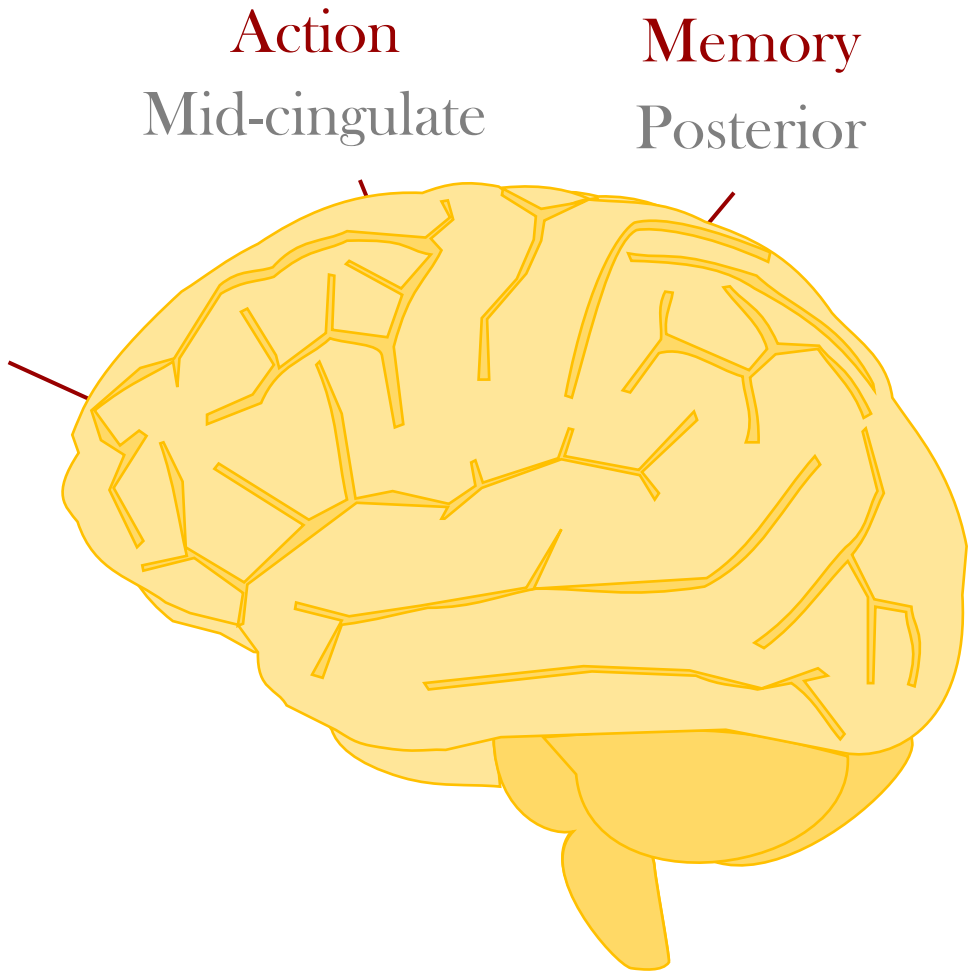
Psychological Acting

Physical Acting

Psychophysical Acting

Emotion — Action — Cognition

Cingulate Cortex



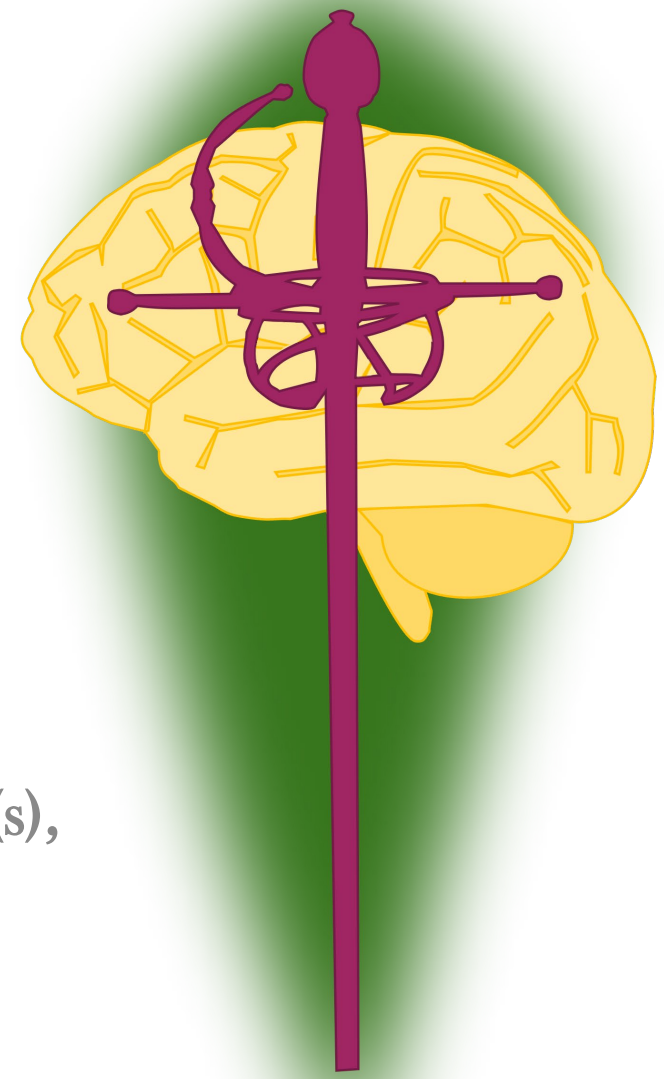
Stansilavsky, 1917; Chekhov, 1953; Grotowski, 1968/2002; Braun, 1979; Lecoq, 1997/2000; Meisner, 1987; Zarilli, 2009; Rolls, 2019

How is neuromotor learning of stage combat skills accomplished?

1) The body matrix extends to incorporate the prop weapon(s), if used, and the scene partner.
2) The brain–body system becomes better at simulating and acting in fictively violent situations.
3) Social-emotional intelligence develops to support competence in stage combat skills.
4) Motor synergies and understanding, supported by neural substrates, re-organize to accommodate skilled movement in the collaborative context of stage combat.

The Self for Motor Learning

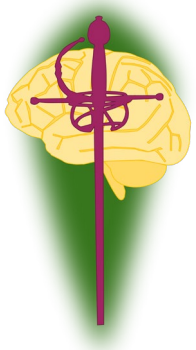
The body matrix extends to incorporate the prop weapon(s), if used, and the scene partner.



Embodied Cognition (Merleau-Ponty, 1945/2000)

Stages of Development (Piaget, 1970)

Why have a nervous system?
(Damasio, 2021)



Bodily Representation
(Head & Holmes, 1911)

Bodily Self-Consciousness
(Riva, 2018)

Flashbulb Paradigm
(Rademaker et al., 2014)

The body is the seat of agency, and movement is the expression of that agency.

Embodied Cognition (Merleau-Ponty, 1945/2000)

Stages of Development (Piaget, 1970)

Why have a nervous system?
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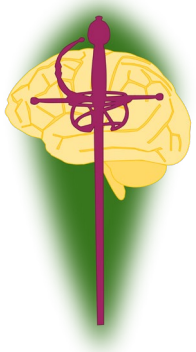


Bodily Representation
(Head & Holmes, 1911)

Bodily Self-Consciousness
(Riva, 2018)

Flashbulb Paradigm
(Rademaker et al., 2014)

Sensorimotor period

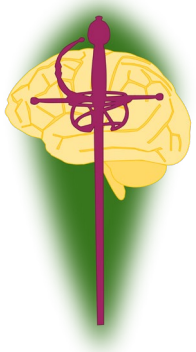
Period of representative intelligence

Period of formal operations

Embodied Cognition (Merleau-Ponty, 1945/2000)

Stages of Development (Piaget, 1970)

Why have a nervous system?
(Damasio, 2021)



Bodily Representation
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Bodily Self-Consciousness
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Flashbulb Paradigm
(Rademaker et al., 2014)

The purpose of life

Intelligence

Feeling & Knowing

Core Self
and Autobiographical Self

Embodied Cognition (Merleau-Ponty,

Stages of Development (Piaget, 197(

Why have a nervous system?
(Damasio, 2021)

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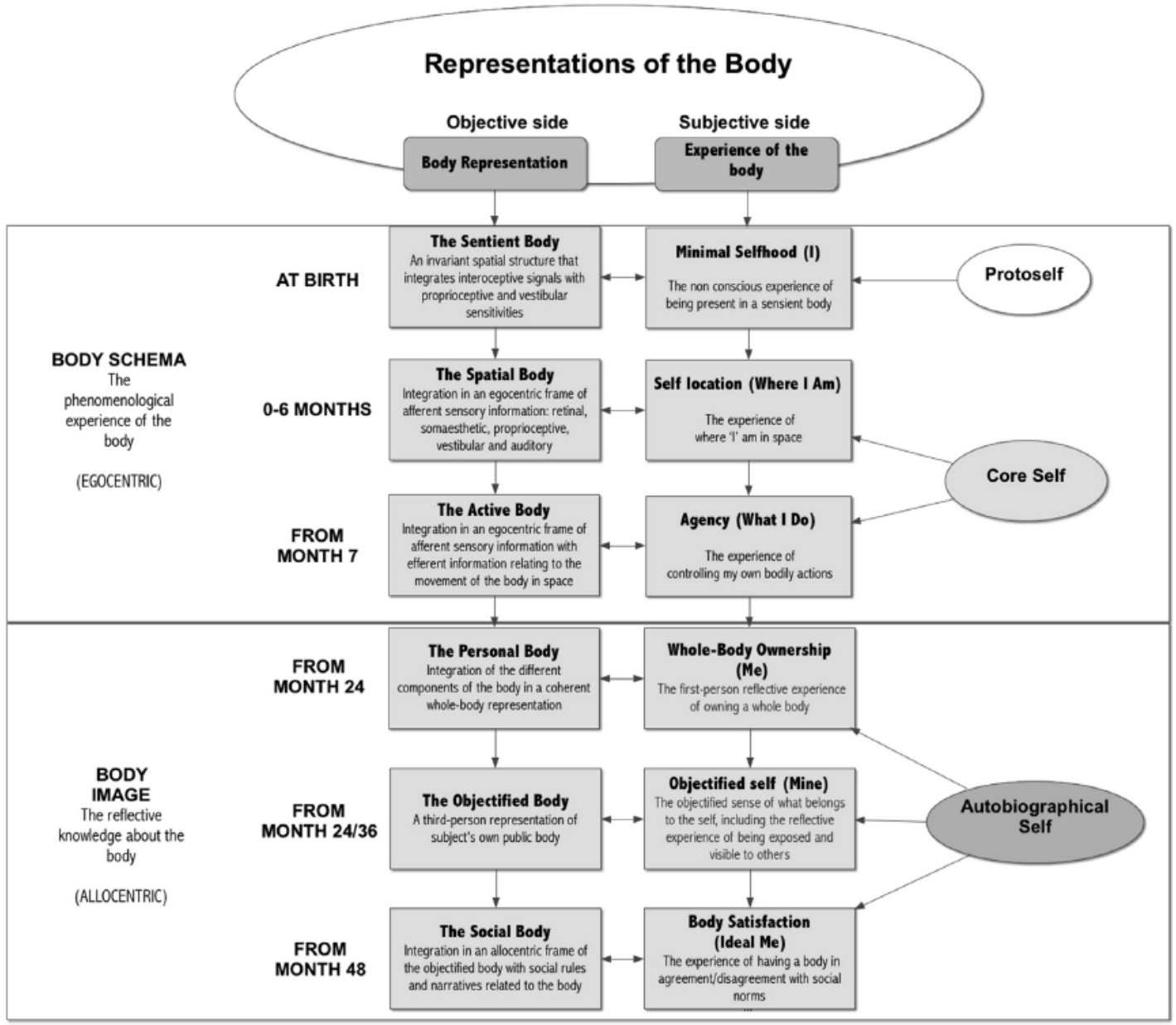

Fig. 2 – Ontogenic development of body representations.

Embodied Cognition (Merlea

Stages of Development (Pi

Why have a nervous syste

(Damasio, 2(

Bodily Representation

(Head & Holmes, 1911)

Bodily Self-Consciousness

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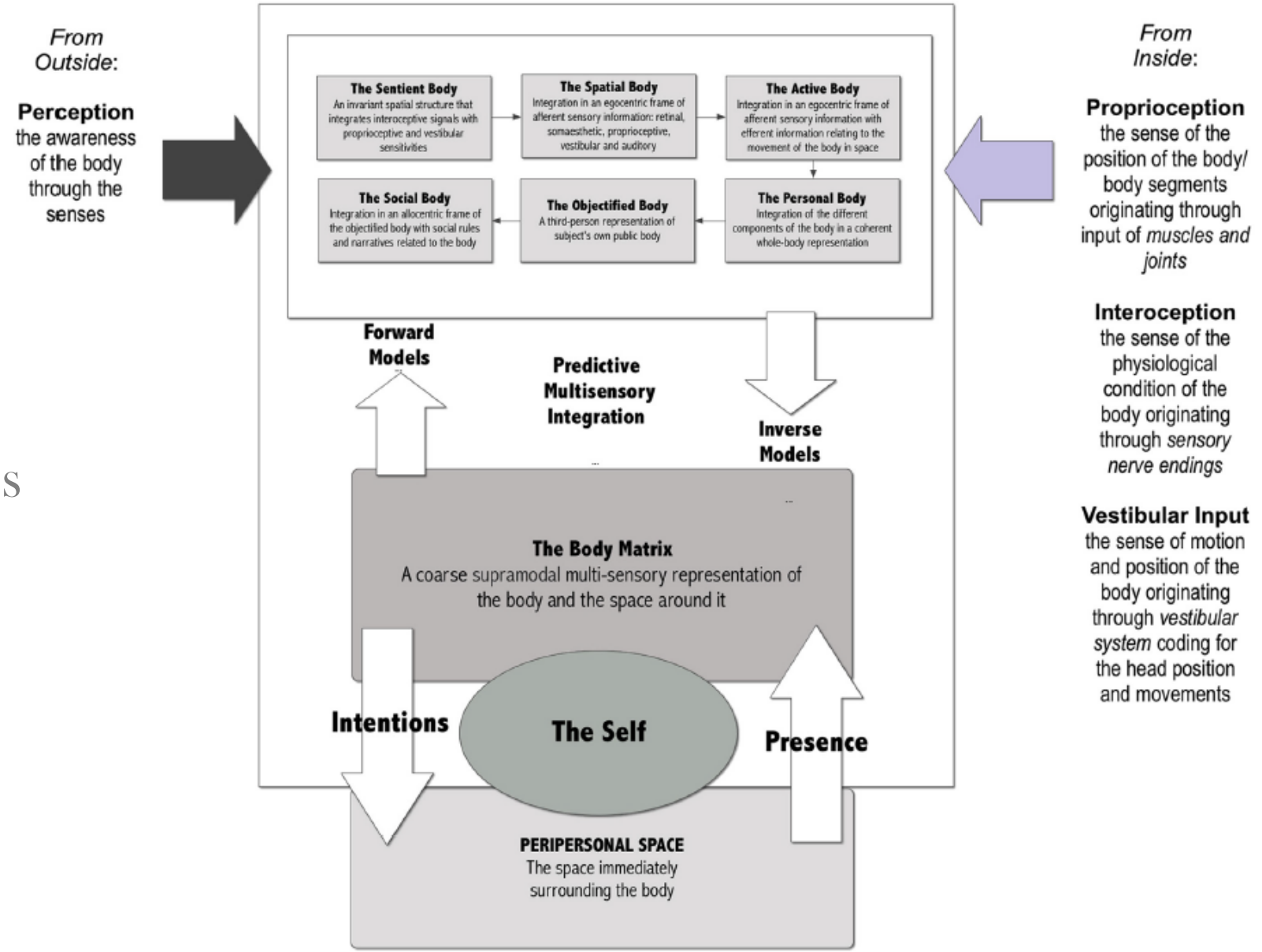


Fig. 3 – The interaction between the self, the body matrix and the different body representations.

Embodied Cognition (Merleau-Ponty,

Stages of Development (Piaget, 197(

Why have a nervous system?

(Damasio, 2021)

Bodily Representation

(Head & Holmes, 1911)

Bodily Self-Consciousness

(Riva, 2018)

Flashbulb Paradigm

(Rademaker et al., 2014)

Log odds

(p) = log [p/(1-p)]

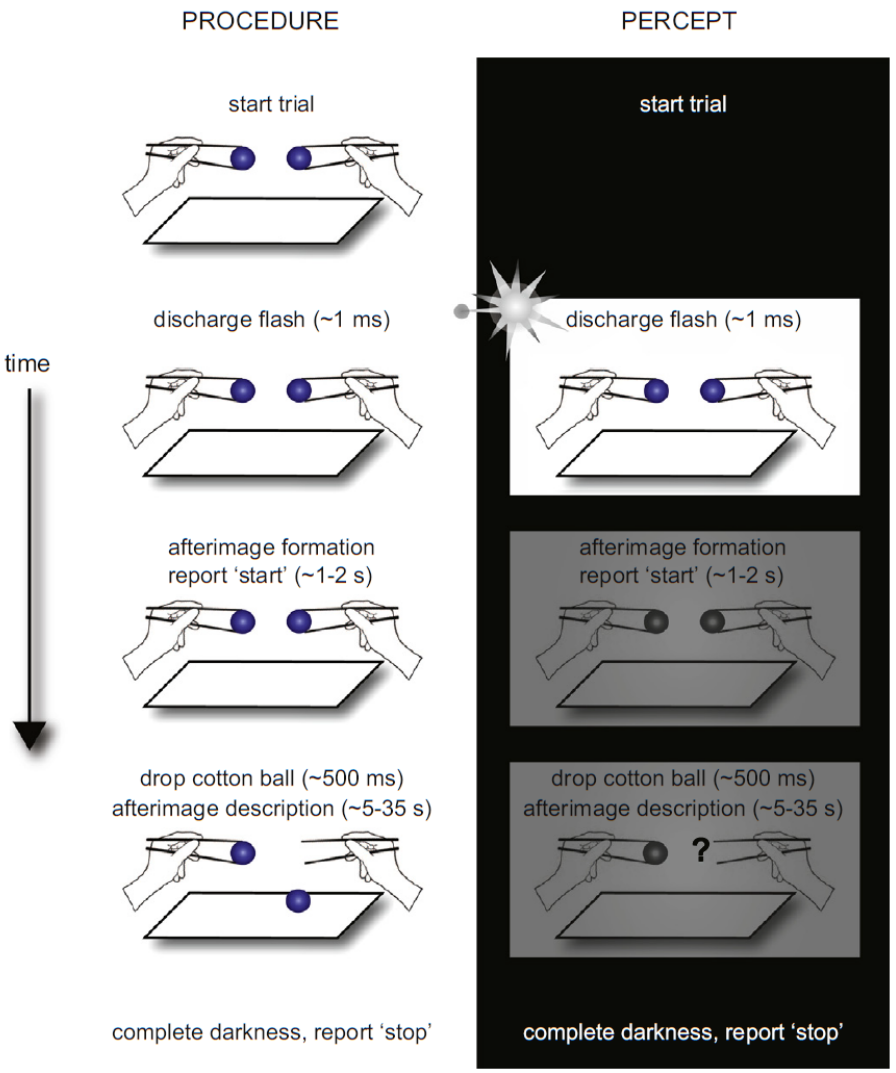
50% chance = 0 log odds

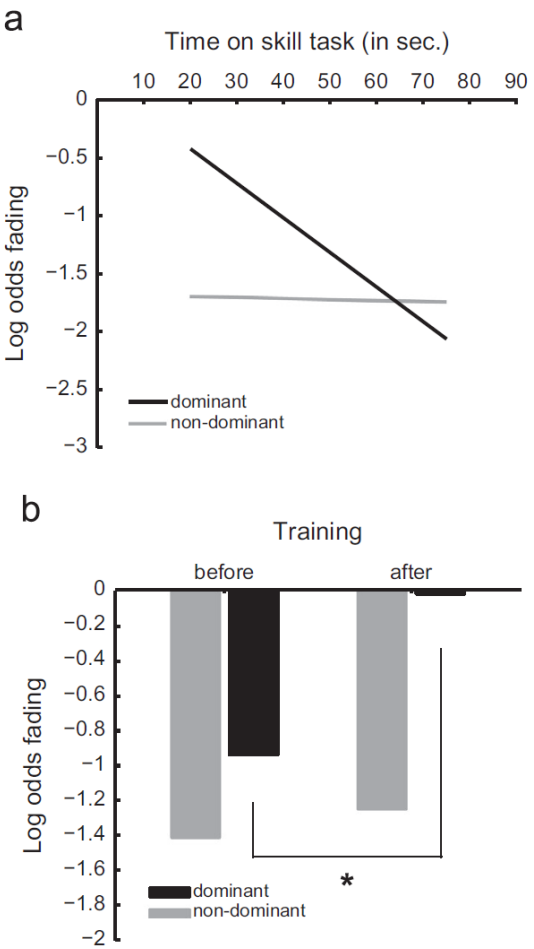
log odds < 0 = < 50% chance

Intensive tool-practice and skillfulness facilitate the extension of body representations in humans

Rosanne L. Rademaker [a,*], Daw-An Wu [b], Ilona M. Bloem [a], Alexander T. Sack [a]

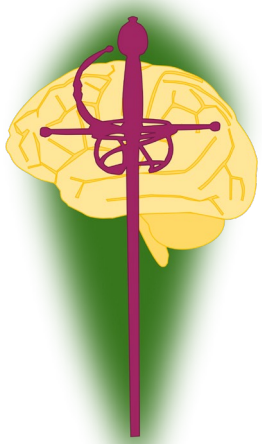
[a] Cognitive Neuroscience Department, Maastricht University, Maastricht, The Netherlands
[b] Caltech Brain Imaging Center, Division of Humanities and Social Sciences, California Institute of Technology, Pasadena, CA, USA





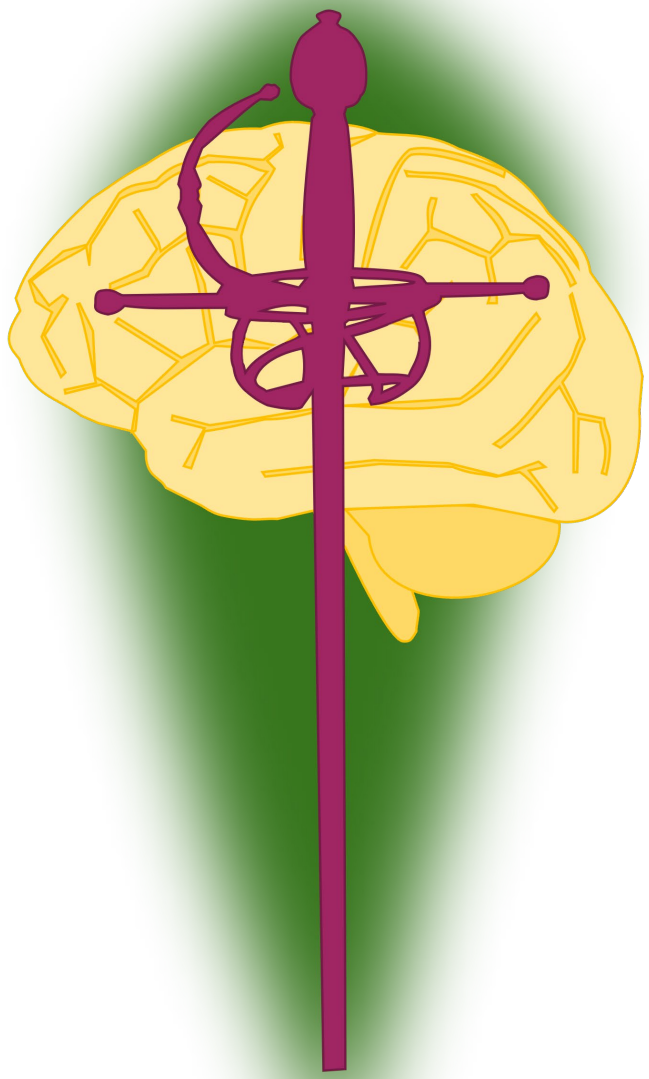
How is neuromotor learning of stage combat skills accomplished?

1) The body matrix extends to incorporate the prop weapon(s), if used, and the scene partner.



Imagination for Action

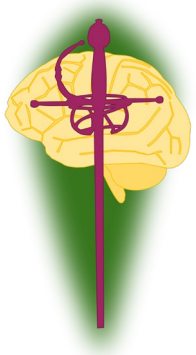
The brain–body system becomes better at
simulating and acting in fictively violent situations.



L'Imaginaire
(Sartre, 1940/2004)

Hippocampus
(Zeidman & Maguire, 2016; Robin, 2018)

Fitts' Law paradigm
(Wong et al., 2013)



Consciousness

- Perception
- Conceptualization
- Imagination

L'Imaginaire
(Sartre, 1940/2004)

Hippocampus
(Zeidman & Maguire, 2016; Robin, 2018)

Fitts' Law paradigm
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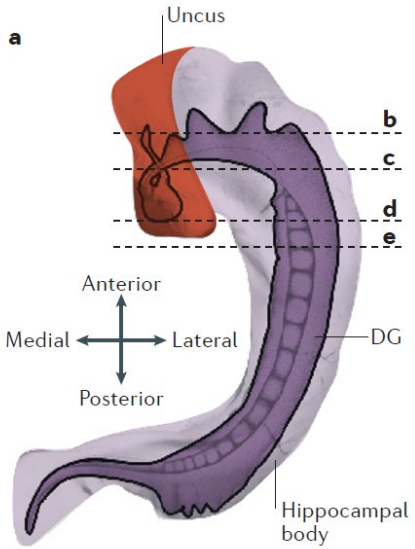

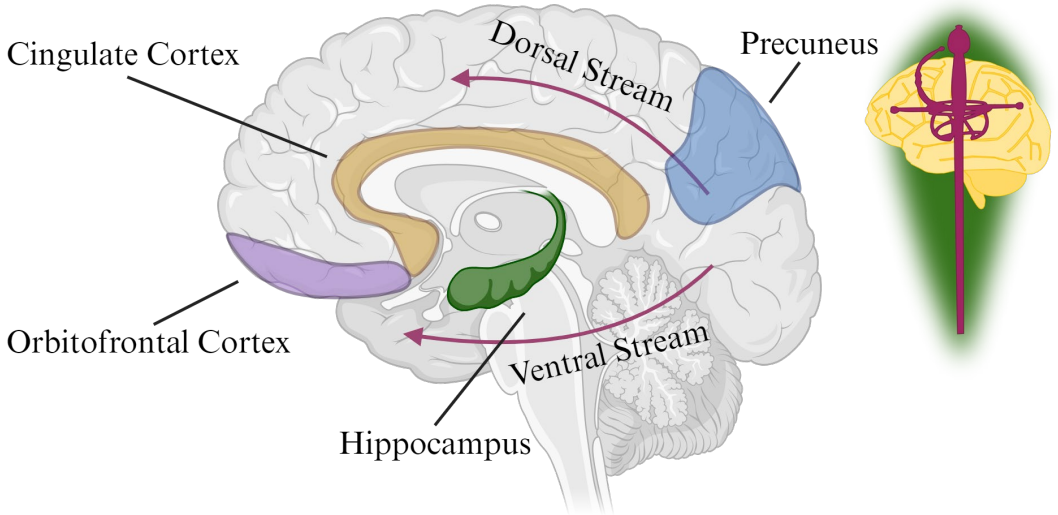

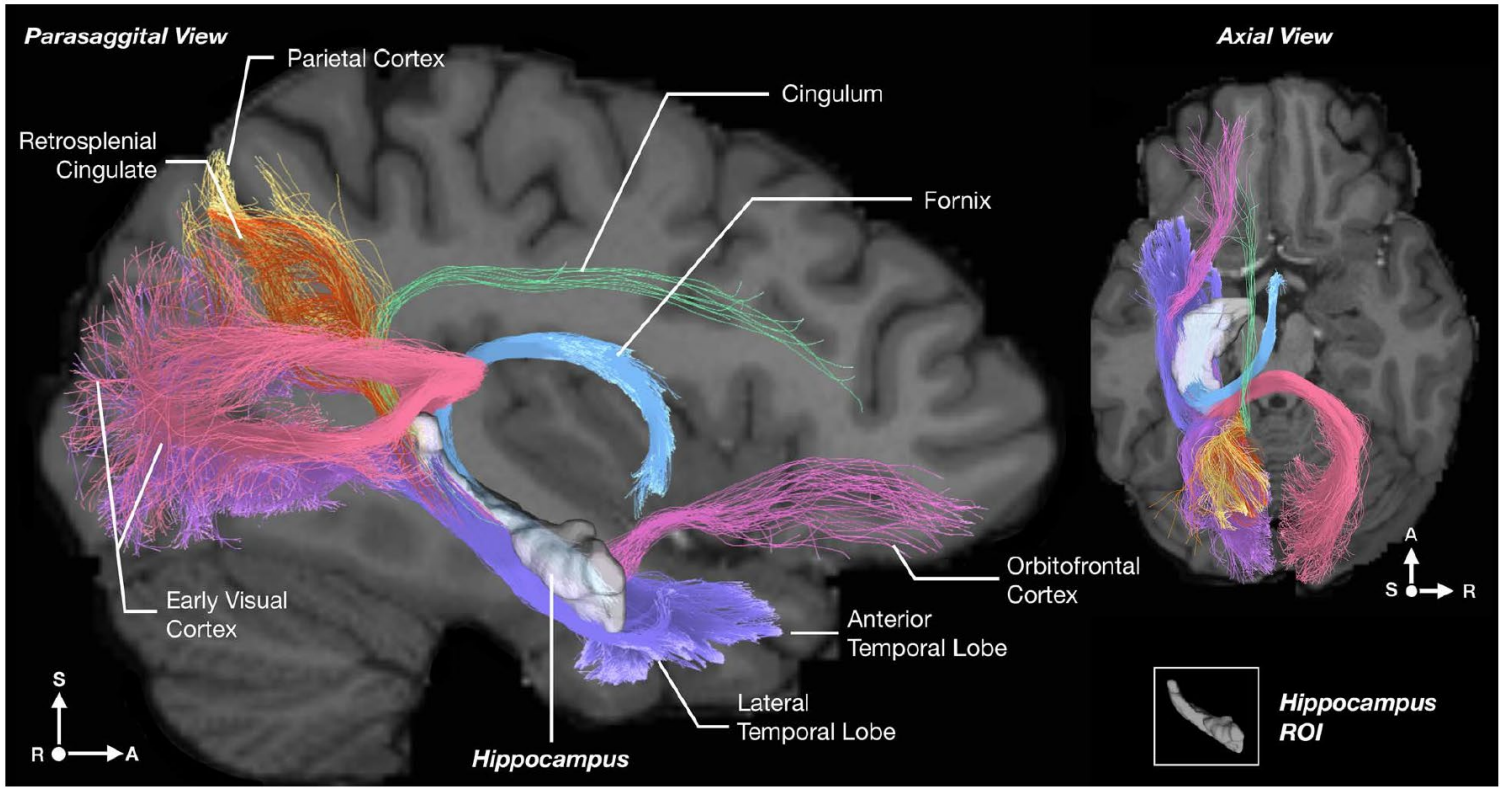

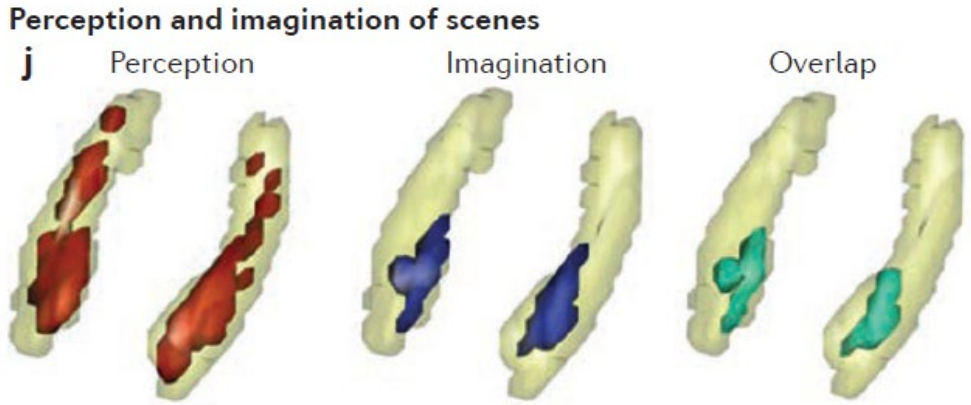

Scene construction theory

Huang et al., 2021; brain figure created with BioRender.com

L'Imaginaire
(Sartre, 1940/2004)

Hippocampus
(Zeidman & Maguire, 2016; Robin, 2018)

Fitts' Law paradigm
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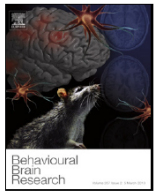
Behavioural Brain Research 257 (2013) 242–252

Contents lists available at ScienceDirect

Behavioural Brain Research

journal homepage: www.elsevier.com/locate/bbr



Research report

On the relationship between the execution, perception, and imagination of action

Lokman Wong[a], Gerome A. Manson[a,b], Luc Tremblay[a,b], Timothy N. Welsh[a,b,*]

[a] Faculty of Kinesiology & Physical Education, University of Toronto, 55 Hardbord Street, Toronto, ON, Canada M5S 2W6
[b] Centre for Motor Control, University of Toronto, Toronto, ON, Canada M5S 2W6

$$MT = a + b\left(\log_2 \frac{2A}{W}\right)$$

$$I_d = -\log_2 \frac{W}{2A} \text{ bits/response}$$

A: amplitude

W: width

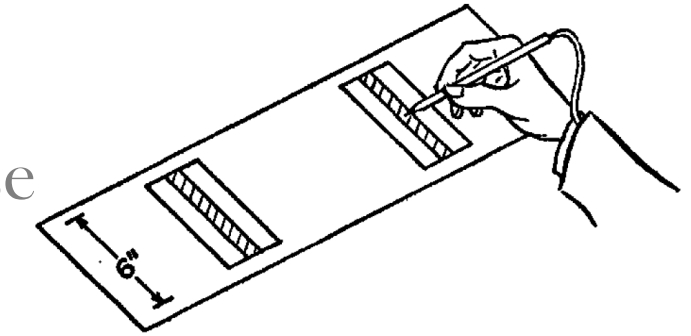
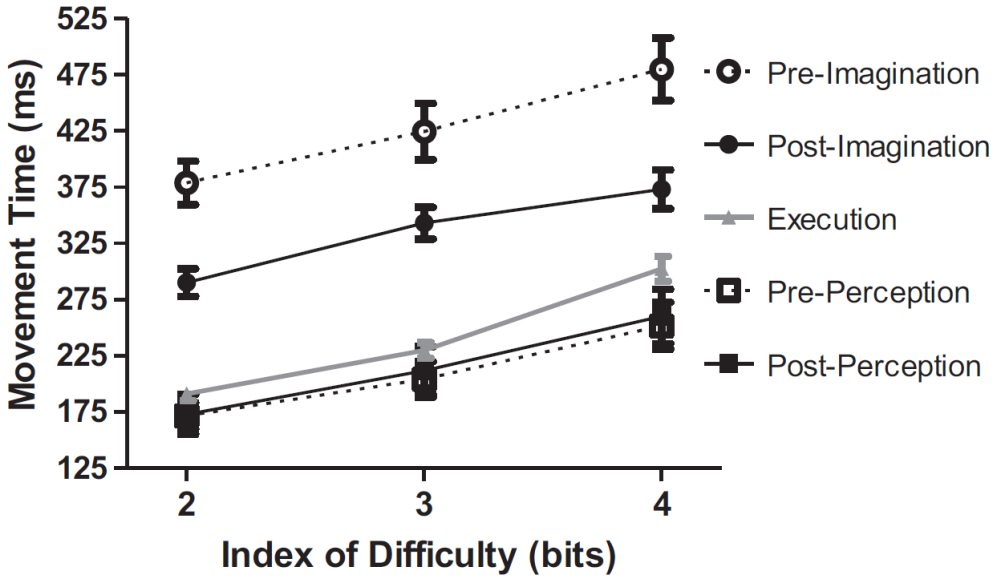


FIG. 1. Reciprocal tapping apparatus. The task was to hit the center plate in each group alternately without touching either side (error) plate.



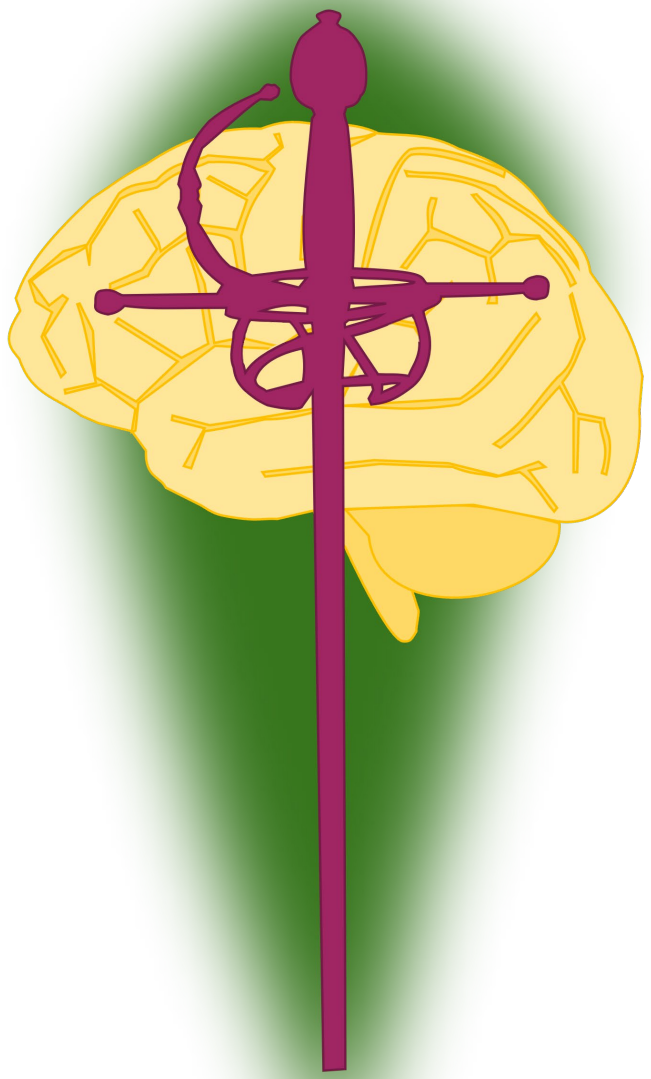
Fitts, 1954

How is neuromotor learning of stage combat skills accomplished?

1) The body matrix extends to incorporate the prop weapon(s), if used, and the scene partner.
2) The brain–body system becomes better at simulating and acting in fictively violent situations.

Emotion for Action

Social-emotional intelligence, self-efficacy, and motivation develop to support competence in stage combat skills.



"The actor is an athlete of the heart."
- Antonin Artaud, 1958, p. 133

Definition

(James, 1890; Dewey, 1894; Johnson-Laird & Oatley, 1992; Lindquist & Feldman Barrett, 2009; Flavell et al., 2022)

Circumplex Model

(Posner et al., 2005)

Neural Substrates

(Rolls, 2019)

Social-emotional imagination

(Gotlieb et al., 2016)

James: feeling of the bodily changes which directly follow the perception of an exciting fact

Dewey: a mode of behavior which is purposive, or has an intellectual content, and which also reflects itself into feeling or Affects, as the subjective valuation of that which is objectively expressed in the idea or purpose

Johnson-Laird & Oatley: function to redistribute cognitive resources at junctures in action; mixtures of the basic emotions – happiness, sadness, anger, fear, disgust, perhaps desire

Feldman Barrett: the result of conceptualizing a core affective state as an instance of emotion

Definition

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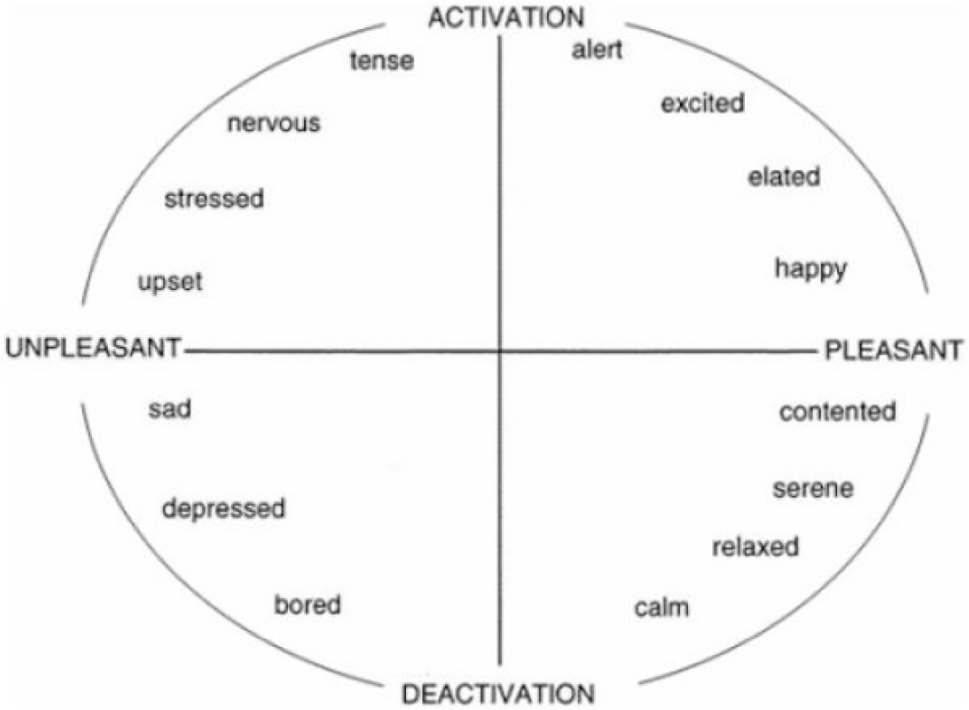

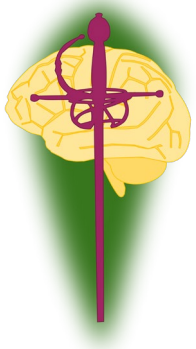

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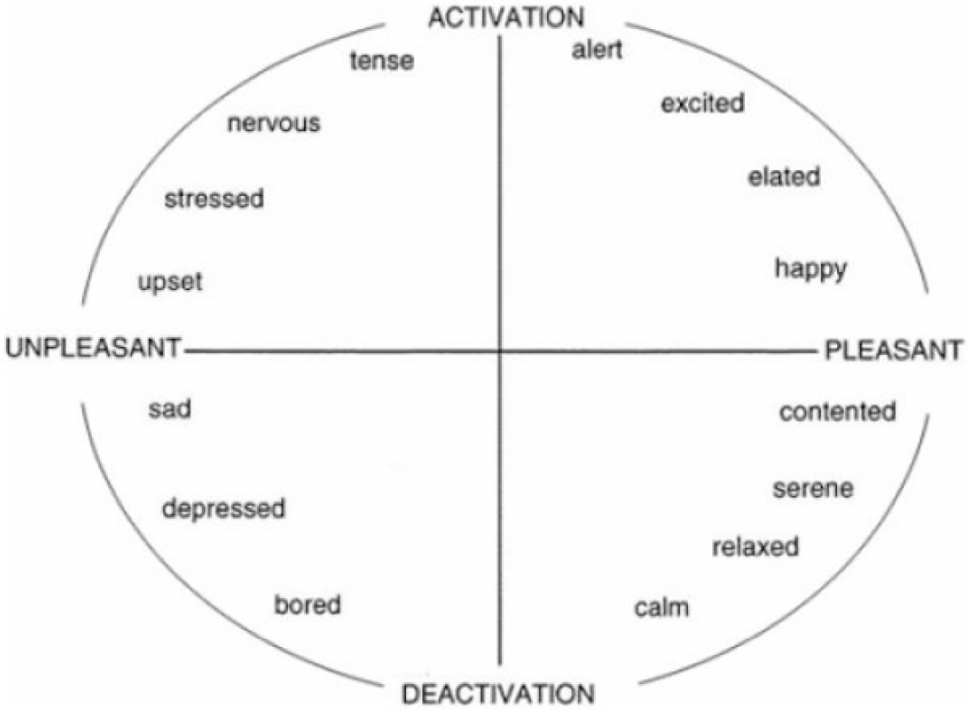
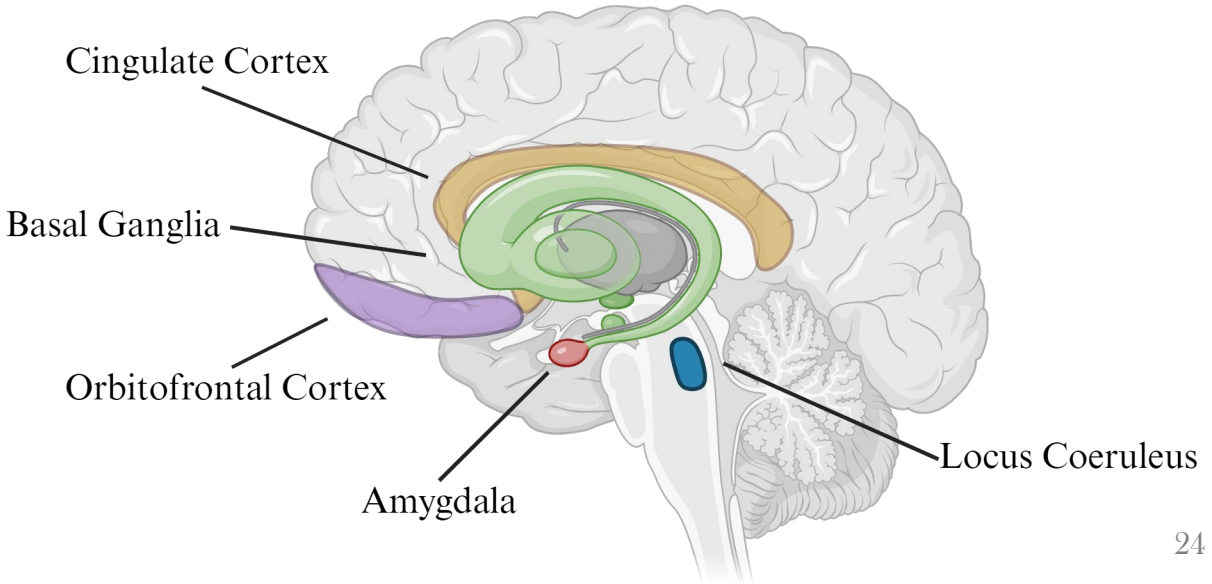
ACC: dorsal – high

arousal ventral – low

Orbitofrontal: lateral – pleasant

valence medial – aversive





Brain figure created with BioRender.com

Definition

(James, 1890; Dewey, 1894; Johnson-Laird & Oatley, 1992; Lindquist & Feldman Barrett, 2009; Flavell et al., 2022)

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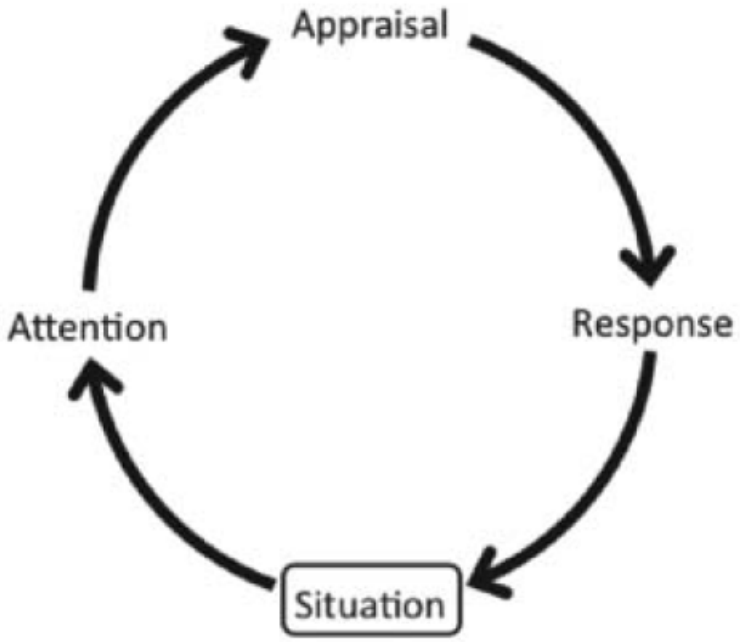
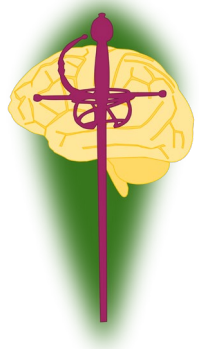
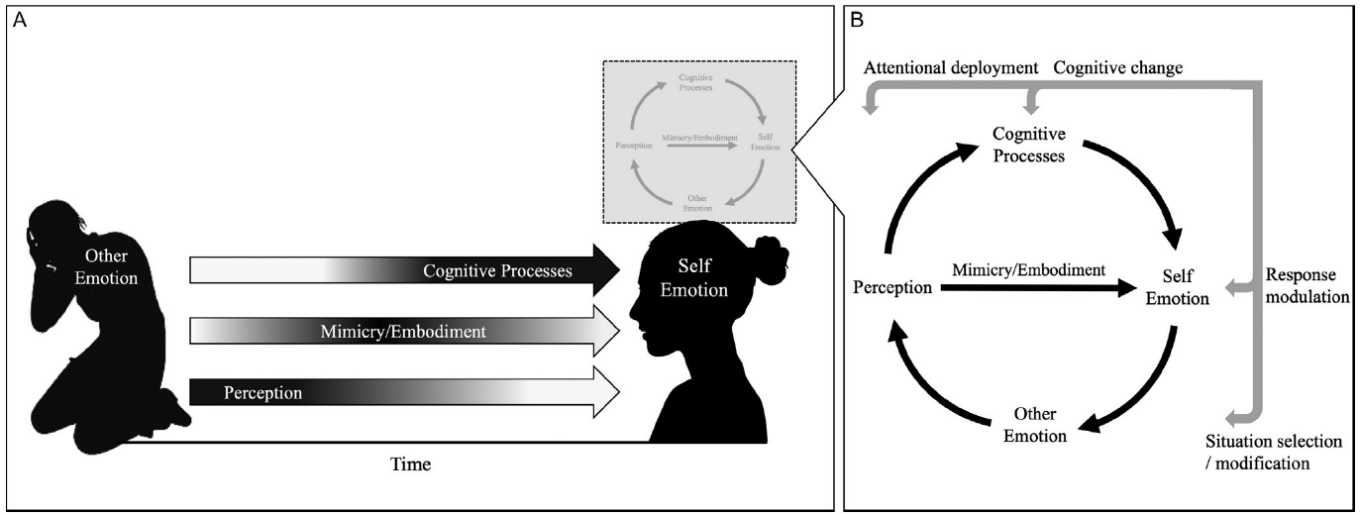


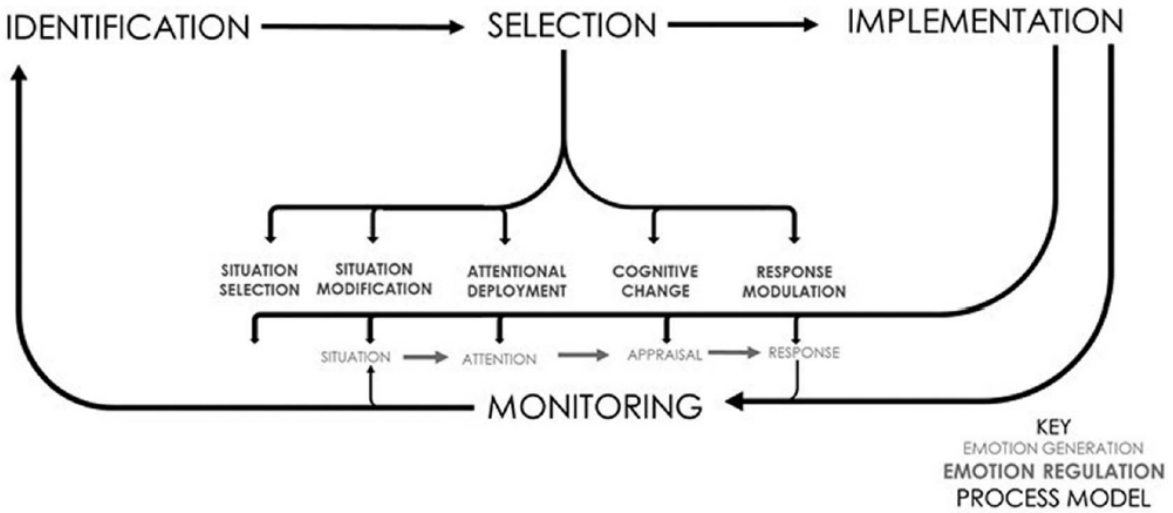
The ability to take another's perspective.

Theory of Mind: infer another's intent

Empathy: infer another's emotion







Gross, 2015; Thompson et al., 2019; McRae & Gross, 2020; Goldstein, 2009

How is neuromotor learning of stage combat skills accomplished?

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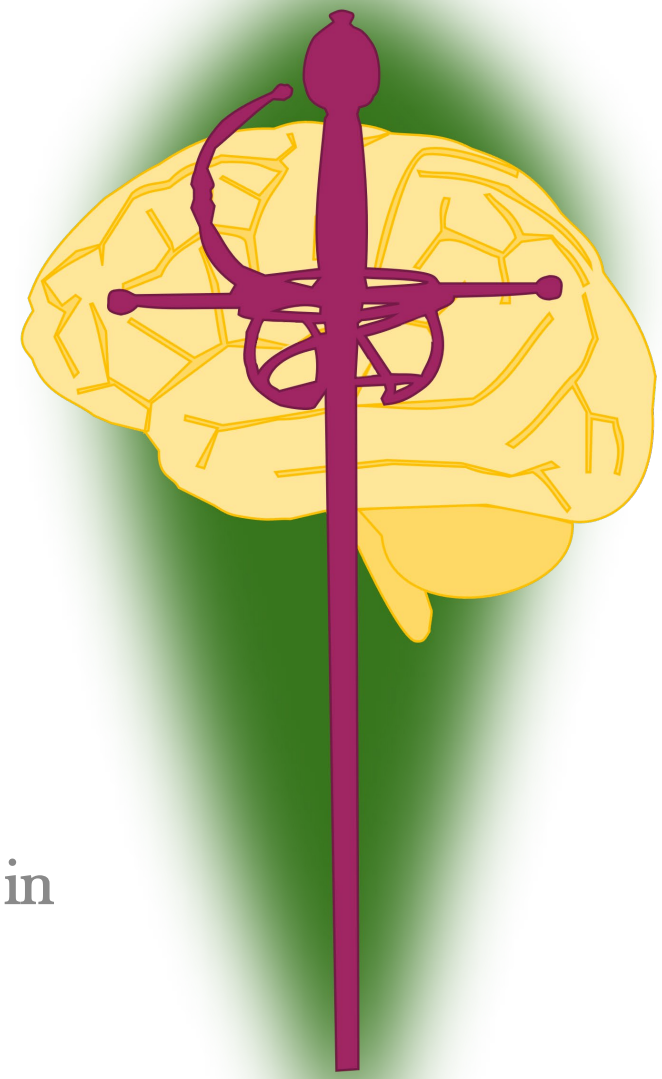
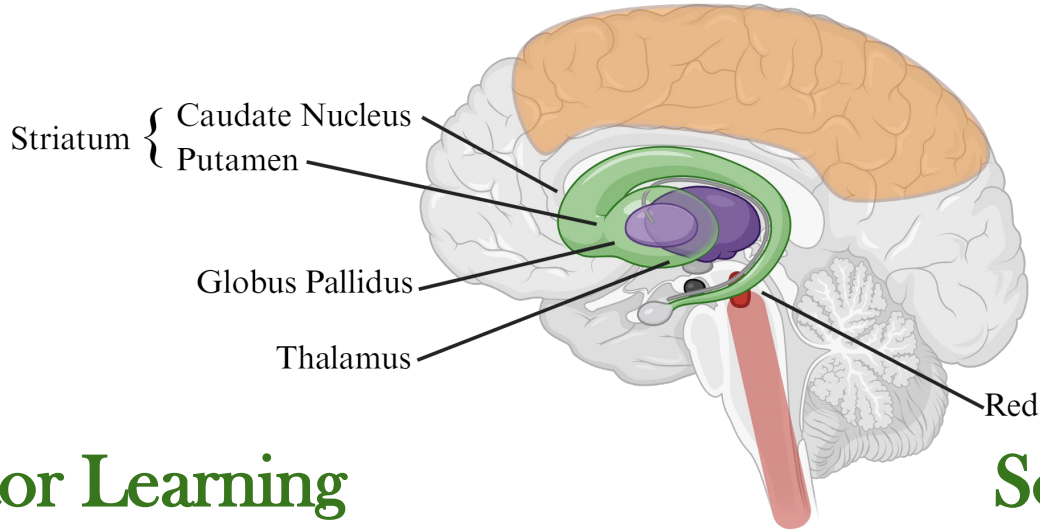
3) Social-emotional intelligence develops to support competence in stage combat skills.

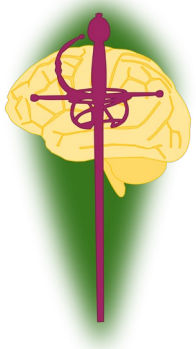
Body and Brain for Motor Learning

Motor synergies and understanding, supported by neural substrates, re-organize to accommodate skilled movement in the collaborative context of stage combat.





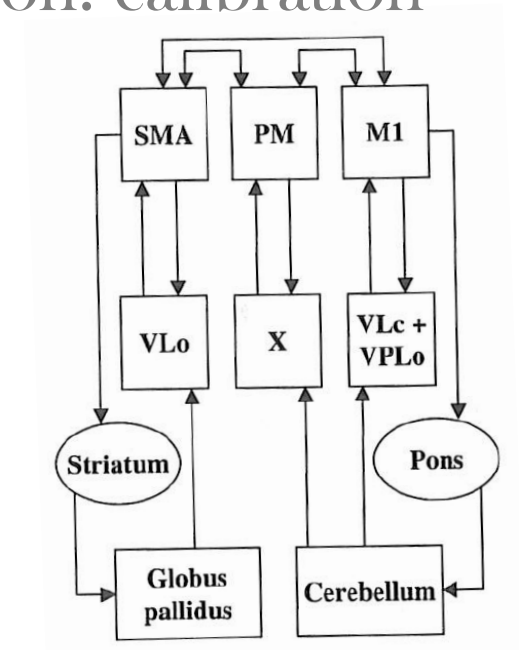
Level D: parietal-premotor; action
Level C: pyramidal-striatal; spatial field
Level B: thalamo-palidar; synergies
Level A: rubrospinal; reflexes and tonus



Motor Learning

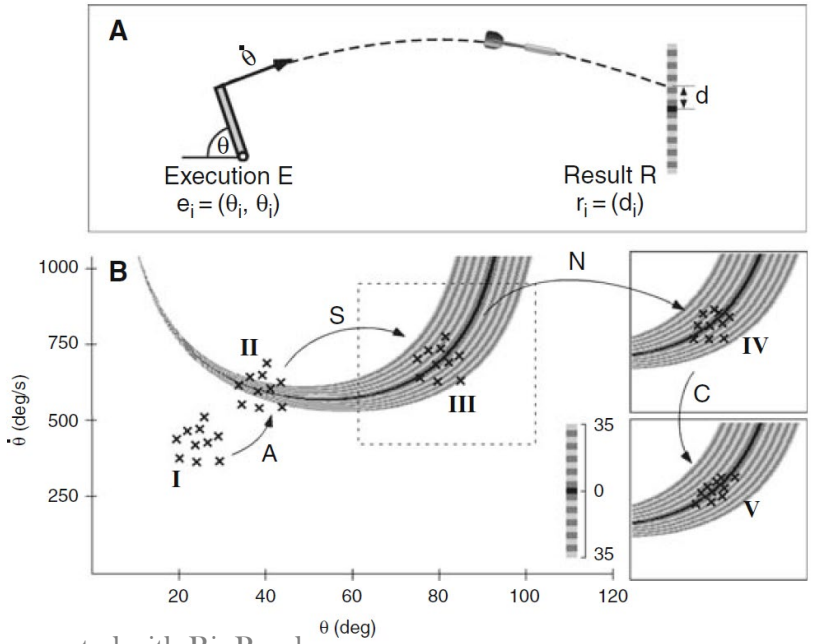
Sequence Learning: attunement

Adaptation: calibration



Solution Manifold

- Approach
- Sensitivity
- Noise Reduction
- Covariation



Bernstein, 1947/2021; Doyon & Ungerleider, 2002; Hacques et al., 2020; Müller & Sternad, 2009; brain figure created with BioRender.com

Levels of Construction
(Bernstein, 1947/2021)

Attunement and Calibration
(Hacques et al., 2020)

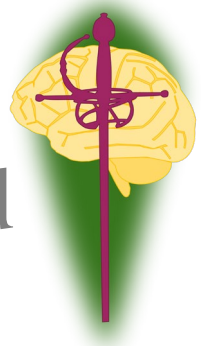
Solution Manifold
(Müller & Sternad, 2009)

Metalearning
(Doya, 2002)

Referent Control
(Feldman, 2015)

Synergies
and Understanding
(Latash, 2021)

Neurotransmitters



Dopamine: prediction of rewards and punishments

Serotonin: controls timescale of reward prediction

Norepinephrine: arousal/relaxation and exploration/exploitation

Acetylcholine: memory storage and renewal

Function to set metaparameters of learning

Levels of Construction
(Bernstein, 1947/2021)

Attunement and Calibration
(Hacques et al., 2020)

Solution Manifold
(Müller & Sternad, 2009)

Metalearning
(Doya, 2002)

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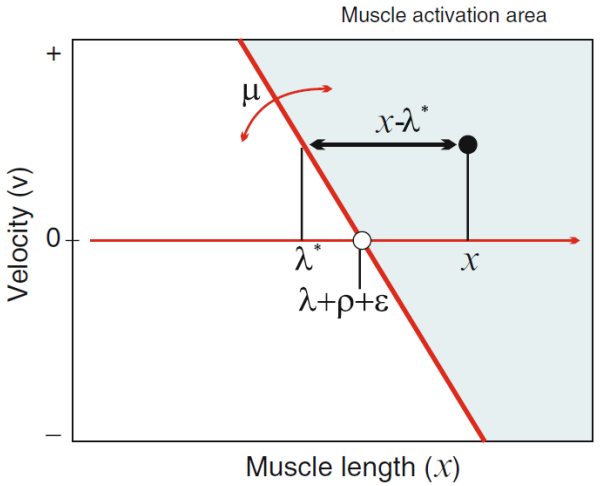
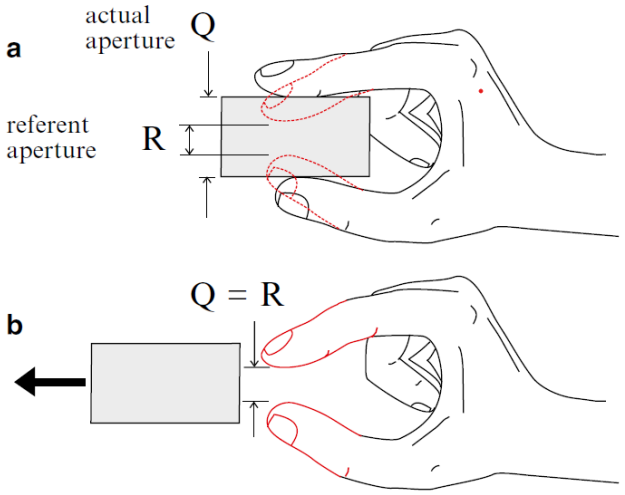
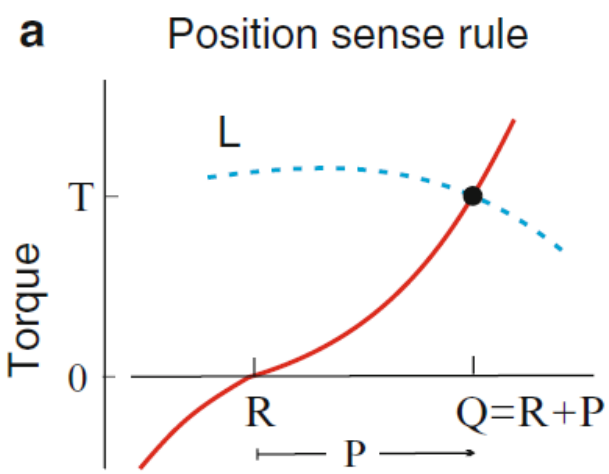
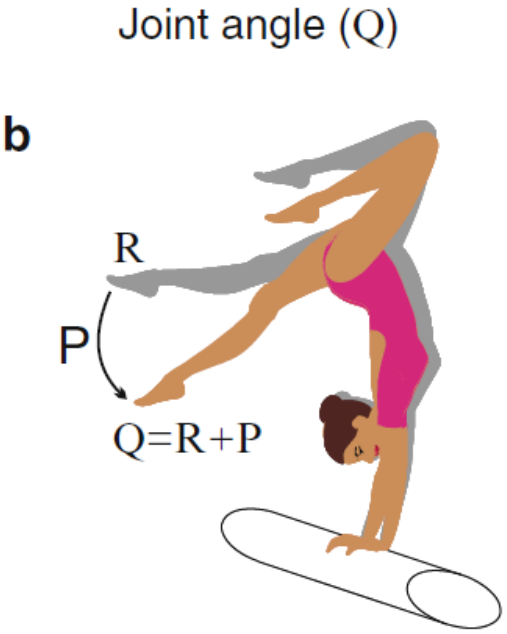








λ* = dynamic threshold length; μ = sensitivity; ρ = heteronymous reflexes; ε = Hx-dependent properties of α-MNs

L = load; P = deviation; R = central component of position sense

Levels of Construction
(Bernstein, 1947/2021)

Attunement and Calibration
(Hacques et al., 2020)

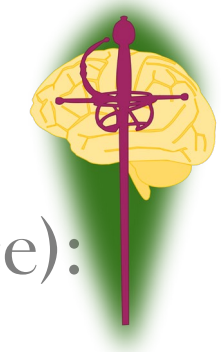
Solution Manifold
(Müller & Sternad, 2009)

Metalearning
(Doya, 2002)

Referent Control
(Feldman, 2015)

Synergies
and Understanding
(Latash, 2021)

Combinations of grouping plus co-variation plus optimization



- **Understanding** (cognitive neuroscience): the discovery of co-variation between groups of relevant cognitive variables based on optimization, likely related to minimizing energy expenditure inside the system
- **Synergy** (movement neuroscience): grouping numerous elements into stable groups to reduce the number of variables manipulated by the brain; co-varying group involvement with the purpose to ensure dynamical stability of actions in the unpredictable environment

How is neuromotor learning of stage combat skills accomplished?

1) The body matrix extends to incorporate the prop weapon(s), if used, and the scene partner.
2) The brain–body system becomes better at simulating and acting in fictively violent situations.
3) Social-emotional intelligence develops to support competence in stage combat skills.
4) Motor synergies and understanding, supported by neural substrates, re-organize to accommodate skilled movement in the collaborative context of stage combat.

Fight Kindly

PhD Degree Requirements by Category

72 credits minimum beyond Bachelor's degree

Kinesiology Specialization

15 credits minimum

At least 9 credits in primary area

Course	Date	Credit	Grade
KIN 472*	F 20	3	A
KIN 560	F 22	3	A-
KIN 661*	F 22	3	A

At least 6 credits in secondary area

Course	Date	Credit	Grade
H S 564	S 20	3	A
KIN 567	S 21	3	A

Focus Area Outside Department

9 credits minimum

Course	Date	Credit	Grade
PSYCH 316	F 20	3	A
PSYCH 516	F 21	3	A
PSYCH 533	F 21	3	A
PSYCH 519*	S 22	3	A

* denotes neuroscience minor courses

# denotes statistics minor courses

Statistics / Research Methods

9 credits minimum

Course	Date	Credit	Grade
KIN 501	S 20	3	A
STAT 587#	F 20	4	A
STAT 575#	F 22	3	A
STAT 588#	S 23	4	A
STAT 586#	S 24	3	-

Research Ethics and PhD Seminar

Ethics seminar 1 credit minimum

PhD seminar 6 credits minimum

Course	Date	Credit	Grade
GrSt 565	S 21	1	S
KIN 615	S 21 thru F 23	6	S x5

Other

Course	Date	Credit	Grade
KIN 590B	S 20	3	A
HD FS 510	SS 21	3	A
EDUC 680X	SS 22	3	A
NUTRS 505	SS 22	1	S
NEURO 696*	S 22 F 22 S 23	3	S

Dissertation Research

21 credits minimum

9 credits minimum prior to prelims

9 credits minimum after prelims

Course	Date	Credit	Grade
KIN 699	S 21 thru F 23	21	S
KIN 699	F 23 thru end	9	-