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A Meta-Analysis on the Differences in Neuroplasticity Between Women and Men After Traumatic Brain Injuries

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A META-ANALYSIS ON THE DIFFERENCES IN NEUROPLASTICITY BETWEEN WOMEN AND MEN AFTER TRAUMATIC BRAIN INJURIES

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THE CREATION OF THIS PROJECT

BACKGROUND INFORMATION

TRAUMATIC BRAIN INJURIES

- A TBI is usually caused from a blow or forceful jolt that is inflicted on the head or skull and affects typical brain function[1]
- Commonly caused by sports, motor vehicle accidents, and physical violence[2]

- Effects[3]:
  - Changes in personality
  - Changes in memory
  - Changes in the ability to do activities independently
  - Changes in the ability to maintain stable emotions

TRAUMATIC BRAIN INJURIES

- Prevalence[2]:
  - 1.4 million people every year in the US
  - 5.3 million in the US have disability because of a TBI
- A leading cause of death and disability worldwide[1,4]

TRAUMATIC BRAIN INJURIES

- Only a young man problem?
- The frequency of TBIs is the same for women and men throughout childhood and in older adults[5]
- The only difference is from puberty to middle age[5]
- Women still make up 1/4 - 1/3 of the number of incidences[5]

Neuroplasticity

- The brain's ability to adapt and change primarily through learning or after a brain injury[6]
- Can also be observed with behavior
  - Taxi drivers have better navigation related structures in their brains which they improve on the longer they work as a taxi driver[7]
- Little is known about specific individual differences related to neuroplasticity

GENDER DIFFERENCES

- Issues with research:
  - Publication bias
    - Differences are more likely to be published[8]
  - Neurosexism
    - The belief in strict differences leads to bias in how studies are conducted and how results are interpreted[9]
- There is a debate on which sex has the worst outcome after a TBI[1]

THE CURRENT STUDY

WHY A META-ANALYSIS?

- A meta-analysis is a statistical analysis that combines the results of multiple studies
- Gives a bigger picture of what the true effect is
- Helps eliminate bias

HYPOTHESIS AND JUSTIFICATION

- Hypothesis:
  - Based on the findings of Farace and Alves (2000) I believed that women would have a worse outcome than men after a TBI indicating less neuroplasticity
- Justification:
  - More information on how to better treat people with brain injuries
  - A better idea of whether there are sex-differences in how plastic the brain is

METHOD

INCLUSION CRITERIA

- Had to specify the sex of the participants
- Include an outcome variable
- Participants had to be diagnosed with a TBI
- The outcome variables had to have at least 3 different samples of participants
- No restrictions on the severity of the injury

OUTCOME MEASURES

- Trails A
  - Measures attention
- Trails B
  - Measures mental flexibility
- Wisconsin Card Sorting Test
  - Measures executive functioning
- Glasgow Coma Scale
  - Measures level of consciousness
- Grooved Pegboard
  - Measures motor functioning

STUDIES

- Bounds et al. (2003)
  - Female = 23; Male = 55
  - Trails A, Trails B, Grooved Pegboard
- Johnson et al. (1996)
  - Female = 66; Male = 31
  - Glasgow Coma Scale
- Kokkinou et al. (2020)
  - Female = 40; Male = 163
  - Glasgow Coma Scale
- Liossi & Wood (2009)
  - Female = 75; Male = 75
  - Glasgow Coma Scale, Trails A, Trails B

STUDIES

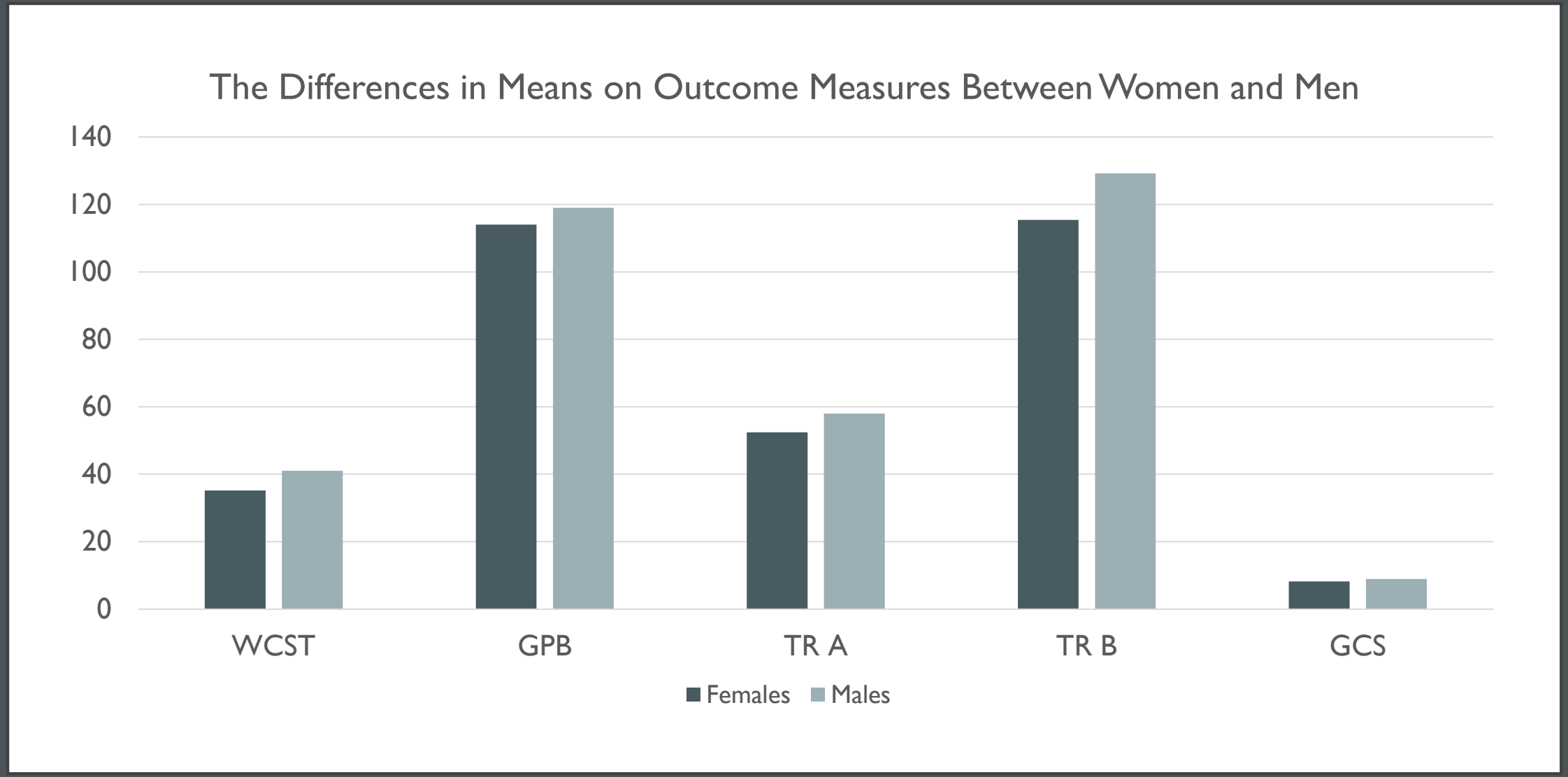
- Niemeier et al (2007)
  - Female = 1023; Male = 1054
  - Glasgow Coma Scale
- Niemeier et al. (2013)
  - Female = 315; Male = 1054
  - Trails A, Trails B, Grooved Pegboard, Wisconsin Card Sorting Test
- Ratcliff et al. (2007)
  - Female = 100; Male = 225
  - Trails A, Trails B, Grooved Pegboard, Wisconsin Card Sorting Test
- Rigon et al. (2016)
  - Female = 25; Male = 28
  - Trails B

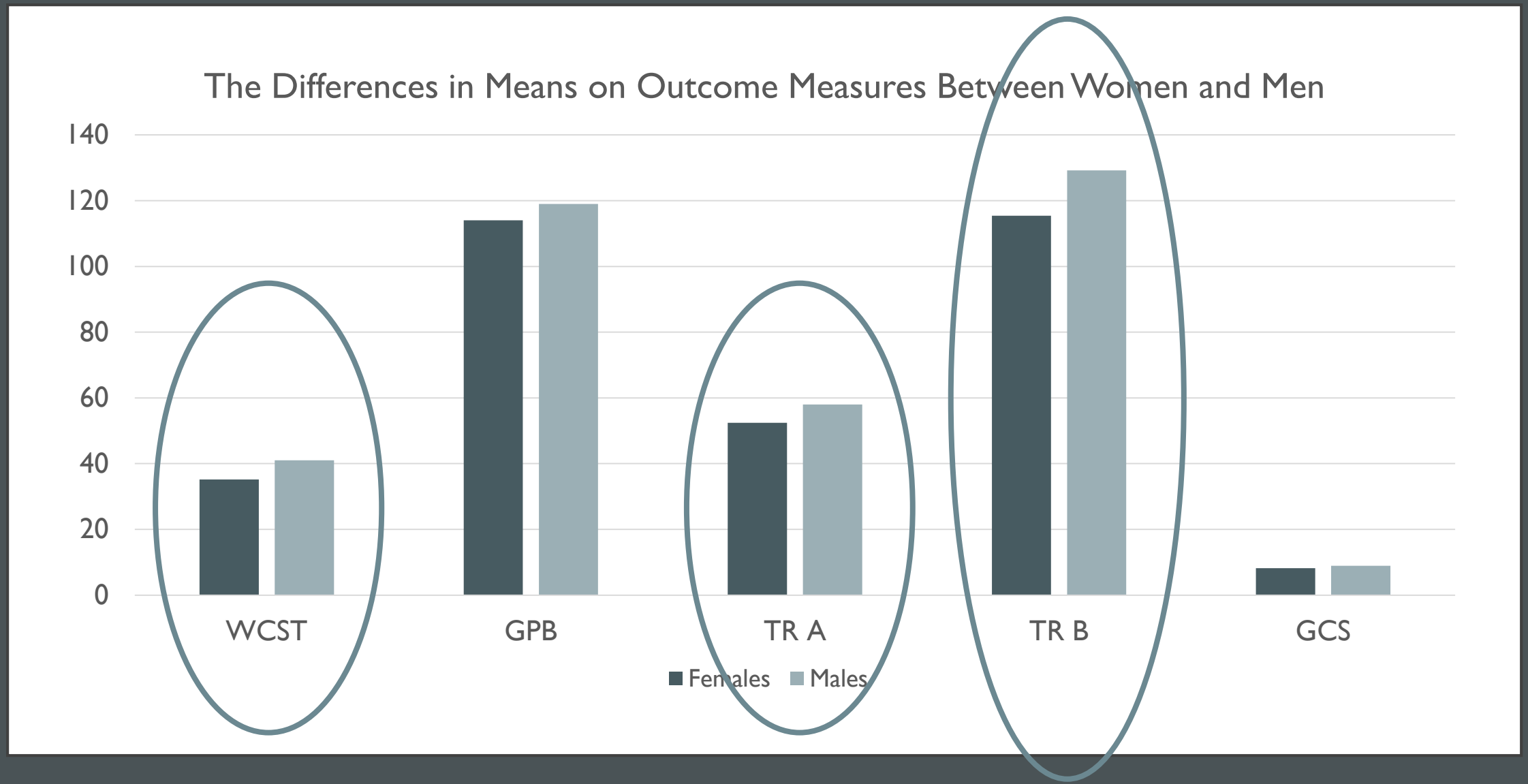
RESULTS

RESULTS

Meta-analytic results for each outcome variable

	k	Total *N*	*MD* (95% CI)	*Q* (*df*)	I^2
Level of Consciousness					
Females	4	1,204	.09 (-.28, .11)	2.26 (3)	0.00
Males	4	3,033			
Motor Functioning					
Females	3	406	.56 (-1.39, .27)	5.13 (5)	2.59
Males	3	1,265			
Attention					
Females	4	513	1.01* (-1.70, -.32)	9.25 (6)	35.11
Males	4	1,409			
Cognitive Flexibility					
Females	5	509	.98* (-1.96, -.003)	7.56 (7)	7.10
Males	5	1,326			
Executive Functioning					
Females	2	341	2.11* (-3.90, -.32)	3.04 (4)	0.00
Males	2	992			


The Differences in Means on Outcome Measures Between Women and Men
140
120
100
80
60
40
20
0
WCST
GPB
TR A
TR B
GCS
Females
Males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TR B
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CONCLUSION

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- Hypothesis was wrong and men scored worse than women
- However due to the limitations of this study and the biases found in gender research
- This study and previous studies may not be looking at the bigger picture with individual differences in neuroplasticity

CONCLUSION

- Could differences in neuroplasticity be more due to difference in behavior than due to sex differences?

- Nature vs Nurture debate
- Current studies are focused too much on “nature” and have not considered some of the implications “nurture” could have on individual differences in the brain

CONCLUSION

- We change how we behave based on the environment we are in and the people we are with
  - Code Switching
  - Elevator experiment[10]
- How we behave can be impacted by stereotypes
- Our behavior can change our brains
  - Taxi driver experiment[7]
  - Bilingualism[11]

CONCLUSION

- There are differences in our brains because of the regular behavior we do, and this could ultimately play a factor in how our brains operate and change to accommodate for head injuries

LIMITATIONS

- Small number of articles
- No unpublished data
- No studies in other languages
- A lack of multiple different databases to find articles
- Many people do not identify as women and men

FUTURE DIRECTIONS

- A diverse large-scale meta-analysis that addresses the limitations in the current study
- Looking at femininity versus masculinity
- What kinds of people get TBIs and how their behavior could affect recovery

FUTURE PLANS

aps | ASSOCIATION FOR PSYCHOLOGICAL SCIENCE

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THANK YOU!

QUESTIONS?