

INS 2026
MID-YEAR MEETING
Neuropsychology Without Limits: Expanding Horizons

Psychological Factors Associated with Persistent Concussion Symptoms: A Path Model of Catastrophizing and Maladaptive Behaviours

Lisa Dussard,
Christina Leonard & Sylvie Willems
Liège University (Belgium)

 DUBLIN, IRELAND

International Neuropsychological Society Mid-Year Meeting 2026

 22-24 JULY

No conflict of interest.
Funding : Fund for Scientific Research (FNRS)





INS 2026
MID-YEAR MEETING
DUBLIN, IRELAND
22-24 JULY

1. *Background*

In Europe, **2.5 million** individuals suffer from traumatic brain injury each year, of which **60-95%** are mild (mTBI).

Post-concussion symptoms :

Somatic

e.g. headache,
vertigo, light/noise
sensitivity

Cognitive

e.g. “brain fog”,
concentration, memory

Psychological

e.g. PTSD, anxiety, irritability

→ Should resolve naturally within **2-12 weeks**

Lefevre-Dognin et al., 2021; Silverberg et al., 2023; Rohling et al., 2011; Levin et Diaz-Arrastia, 2015

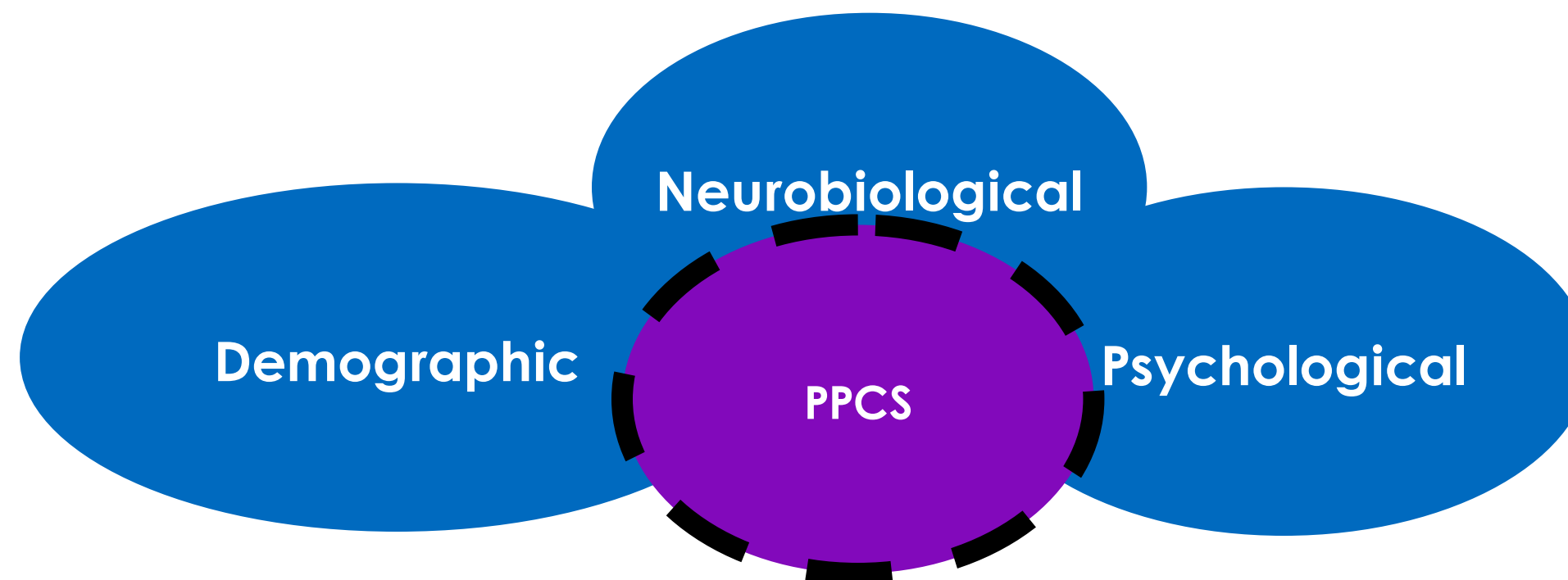


1. *Background*

However, **18-31%** still experience **persistent post-concussion symptoms (PPCS)** after 3 months and up to several years post-injury...

This can have significant consequences at both the individual (e.g. quality of life, return to work) and societal levels (e.g. healthcare cost). → **Identifying individuals at risk of prolonged recovery is crucial !**

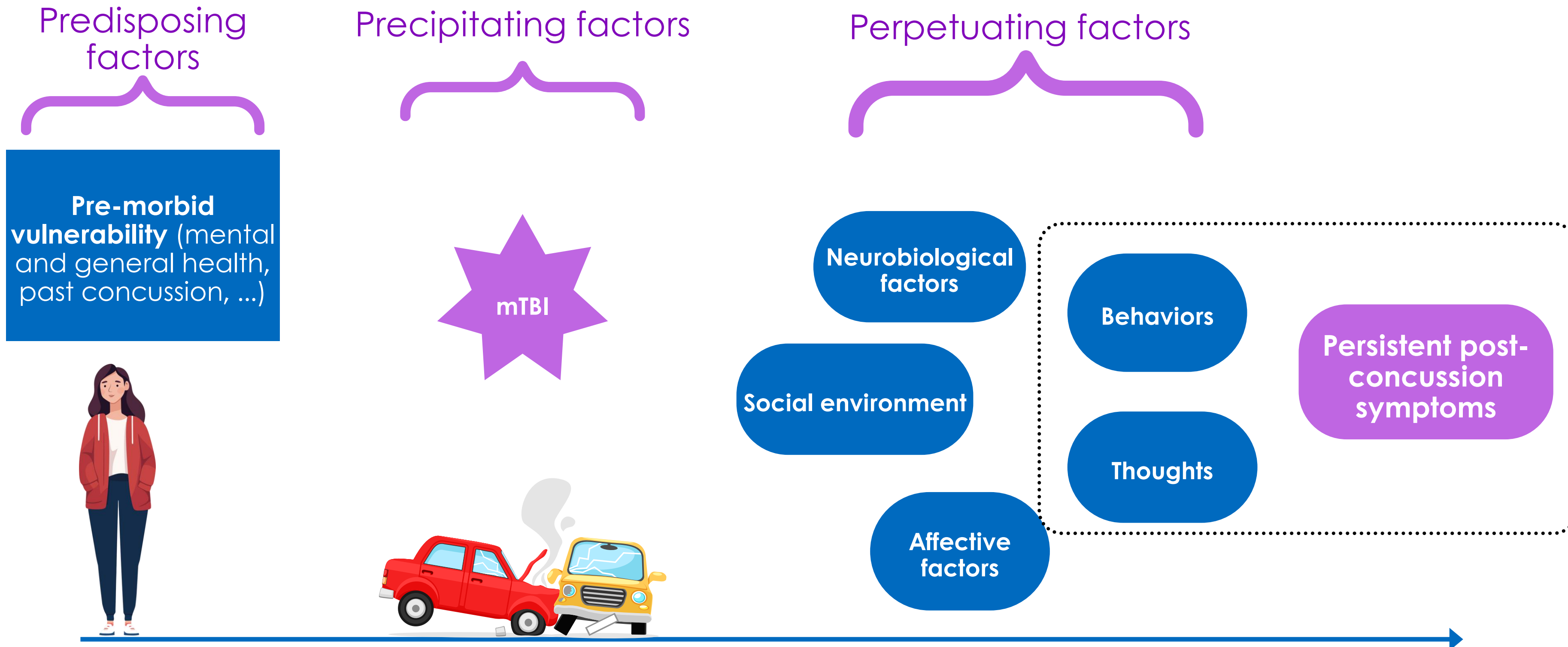
Not an easy task : the origin of PPCS is likely complex, with several factors in interaction :



1. Background



INS 2026
MID-YEAR MEETING
DUBLIN, IRELAND
22-24 JULY



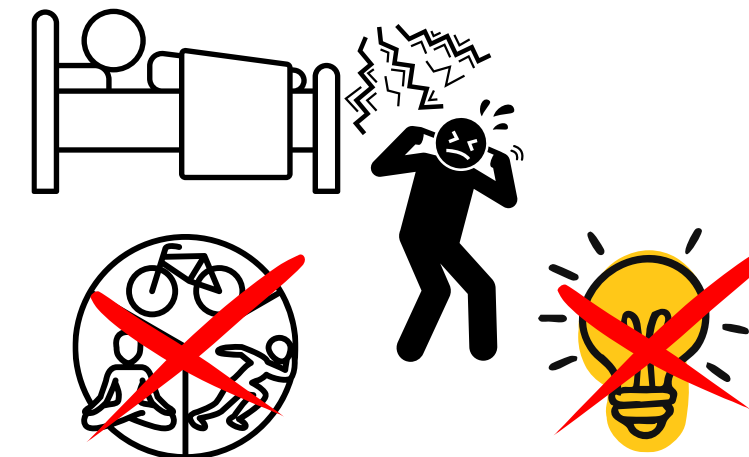
2. Our focus



INS 2026
MID-YEAR MEETING
DUBLIN, IRELAND
22-24 JULY



Fear-avoidance behaviors



Endurance behaviors

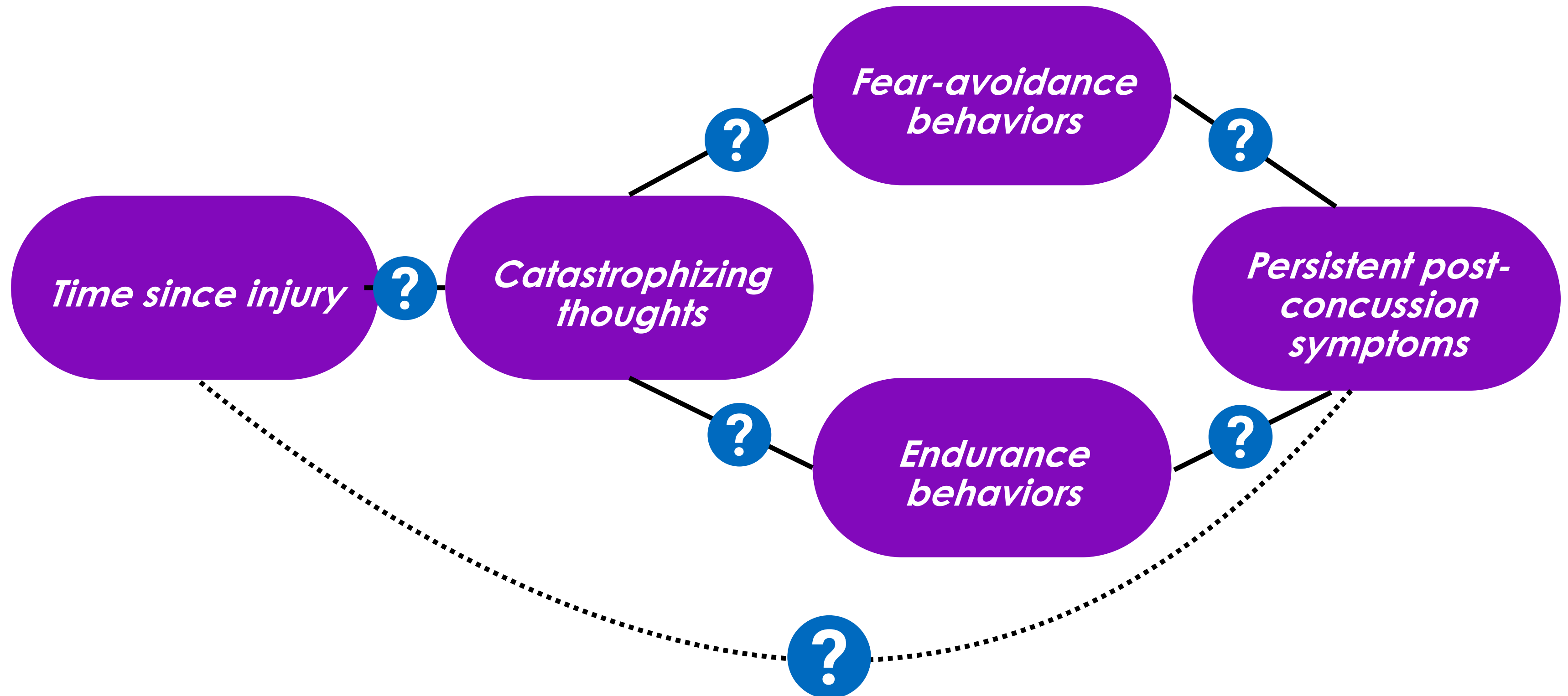


Vlaeyen & Linton, 2012; Hasenbring et al., 2020; Terpstra et al., 2021; Silverberg et al., 2017; Lam et al., 2026; Silverberg et al., 2018; Wijenbergh et al., 2017

2. Our focus

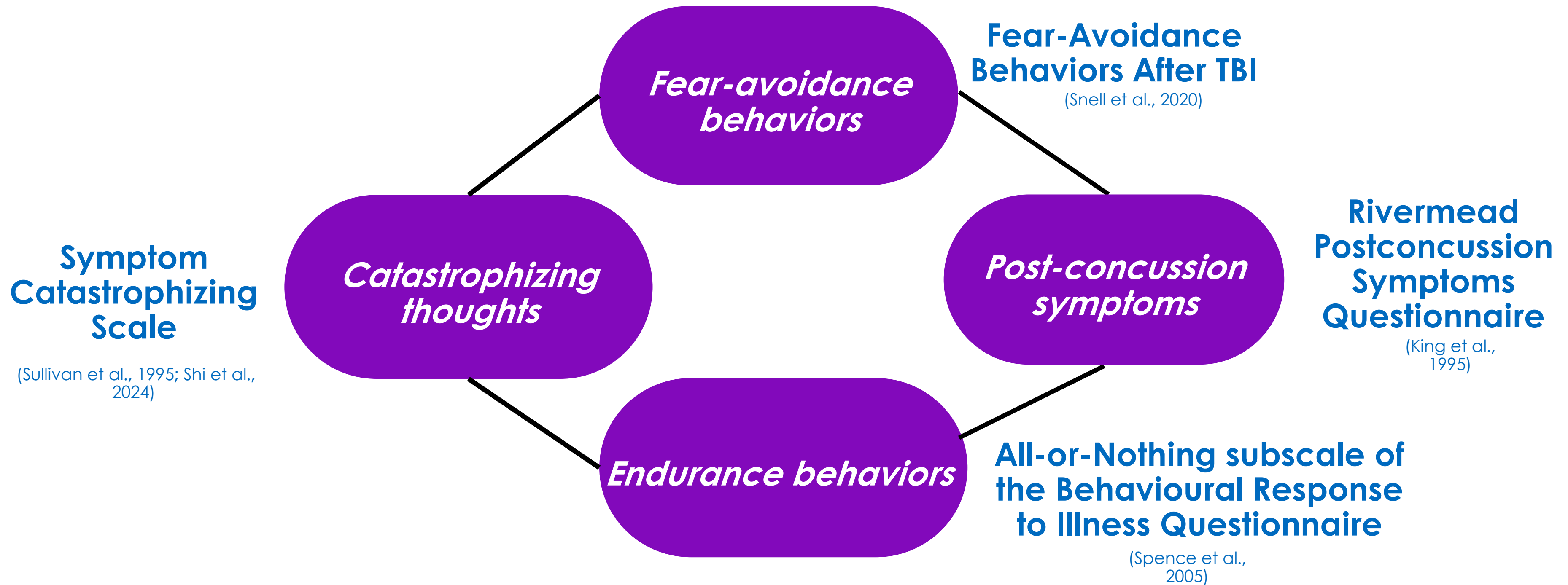


INS 2026
MID-YEAR MEETING
DUBLIN, IRELAND
22-24 JULY



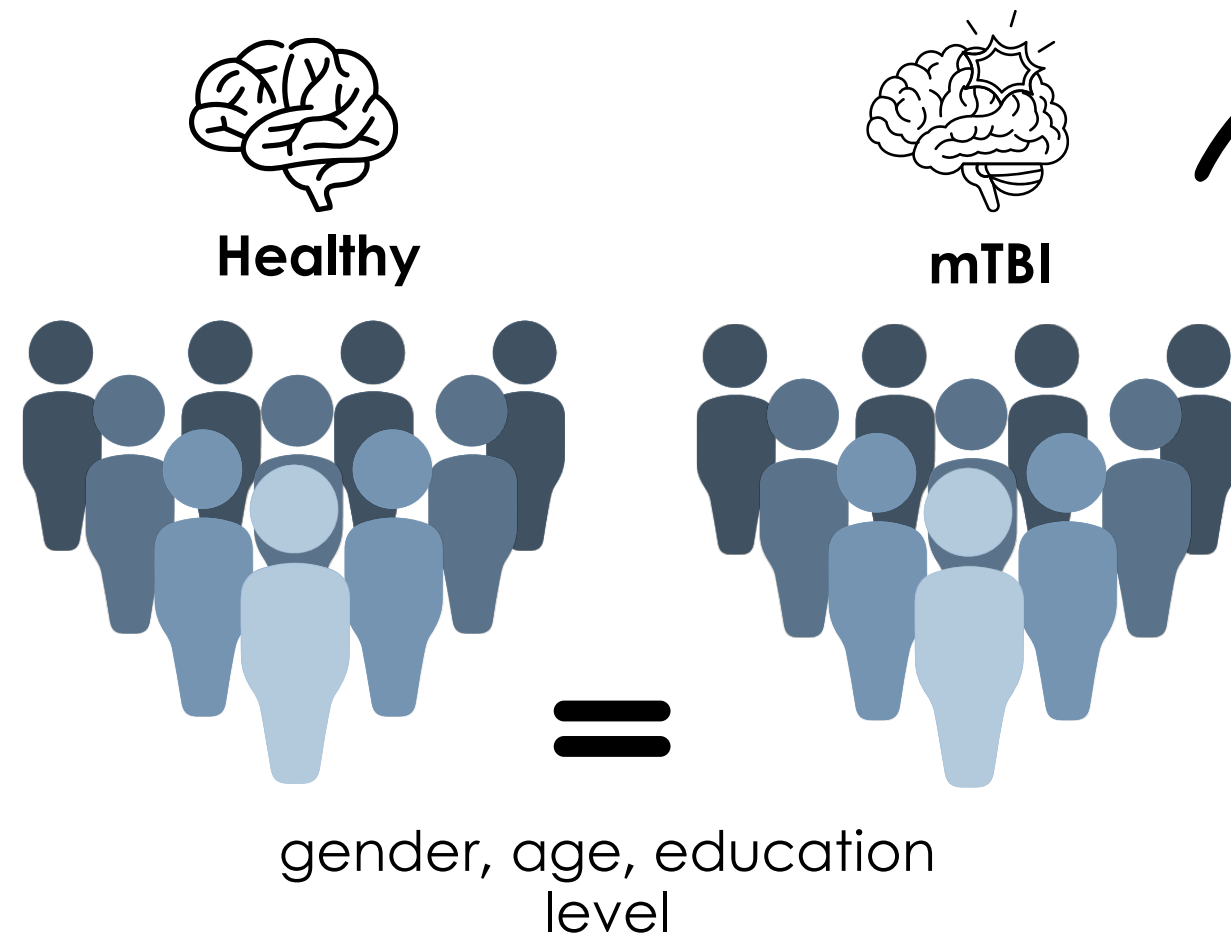


3. *Methods : measures*





3. *Methods : participants*



- N = 74 in each group
- 60% of women
- M = 39 years old
- M = 15 years of education

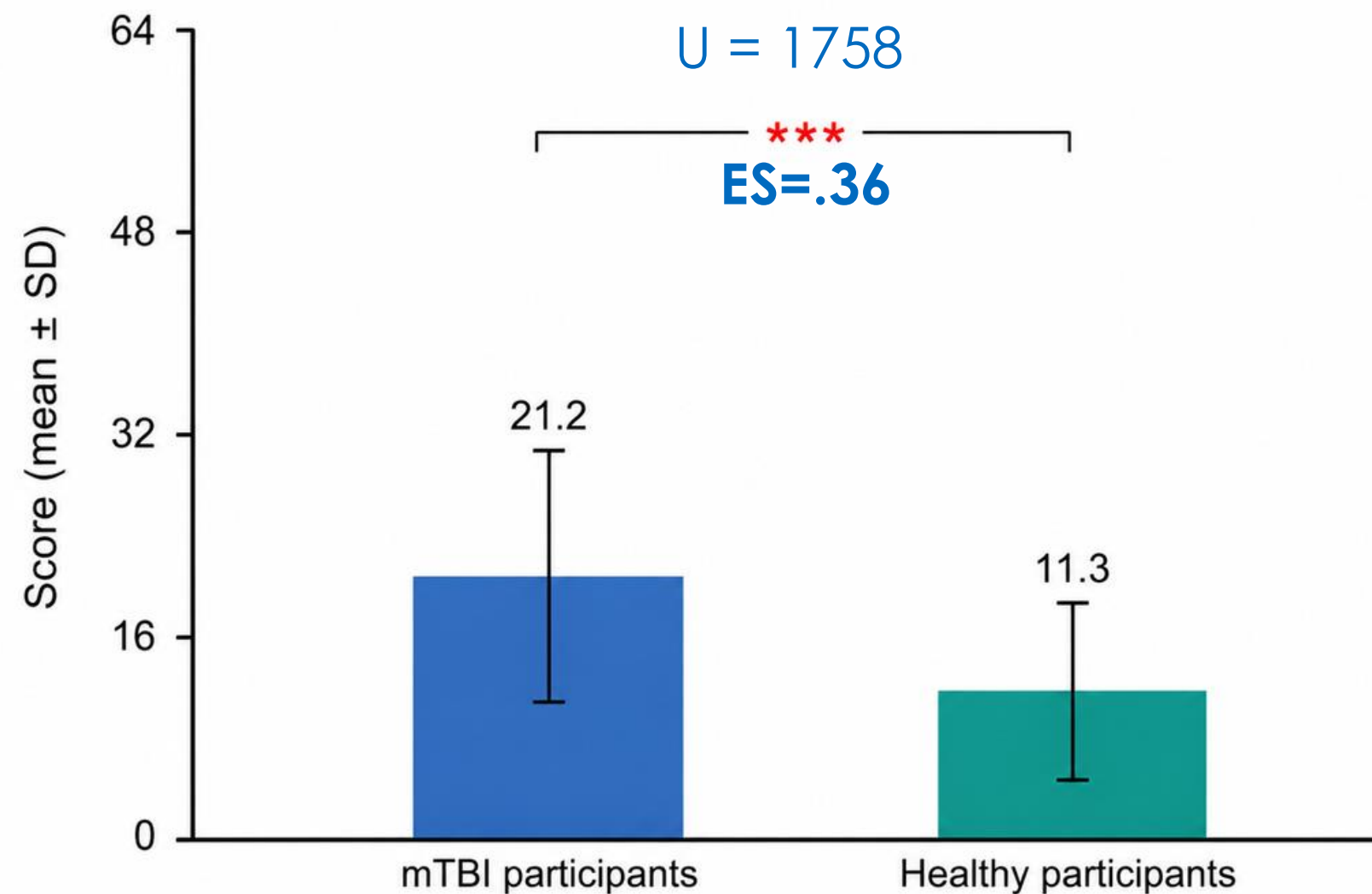
- **Recruitment** : hospital (28%) / self-declared
- **Time since injury** : M = 59.8 months (SD = 111; range: 3 days – 47 years)
- **Loss of consciousness** (<30 minutes) : 37,8 %
- **Injury origin** : fall (37%), car accident (20%), sport (20%), aggression (7%), other (16%)
- **>1 concussion** : 8,1%

4. Results



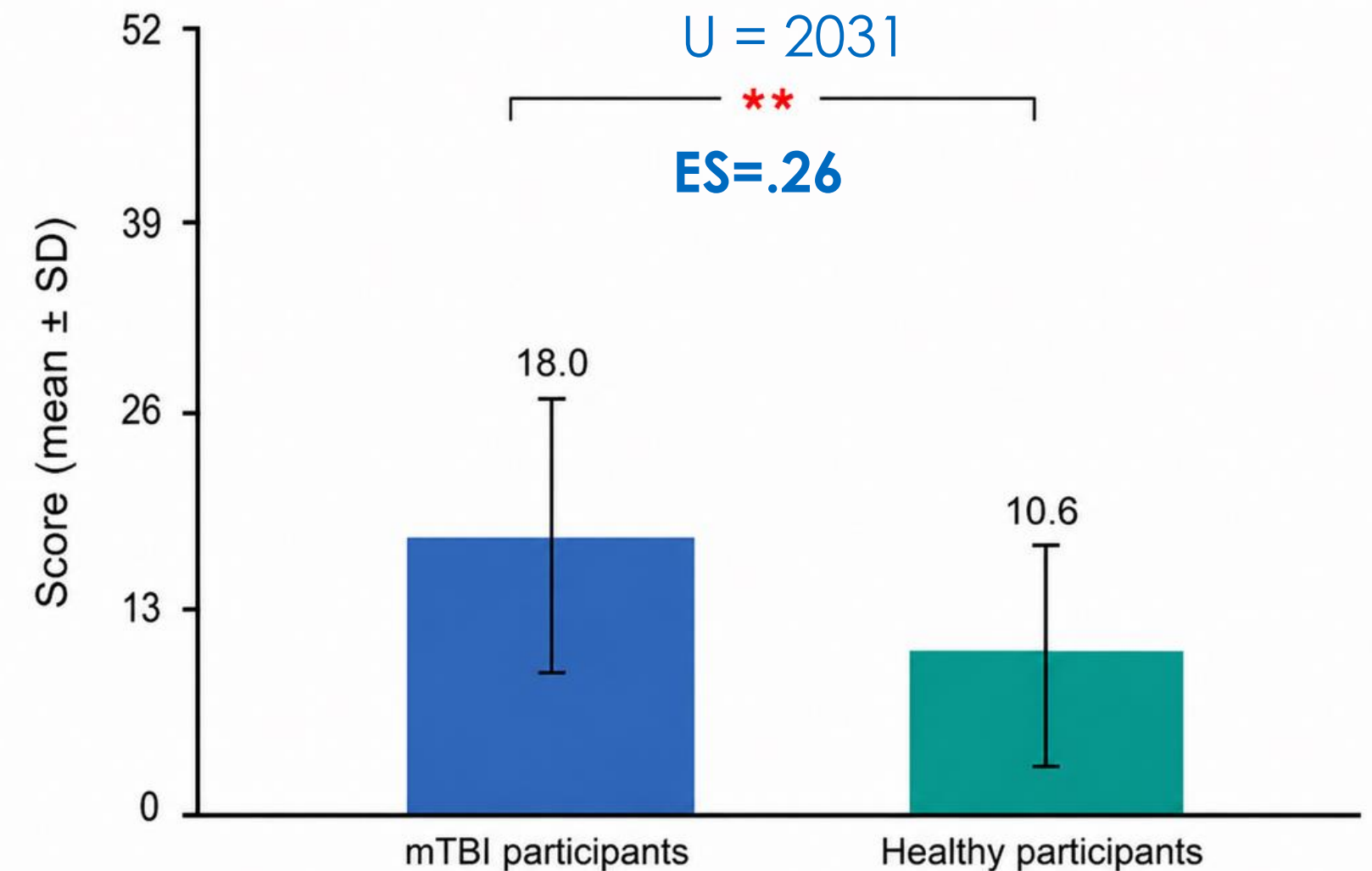
INS 2026
MID-YEAR MEETING
DUBLIN, IRELAND
22-24 JULY

Post-concussion symptoms



* $<.05$; ** $<.01$; *** $<.001$.

Catastrophizing



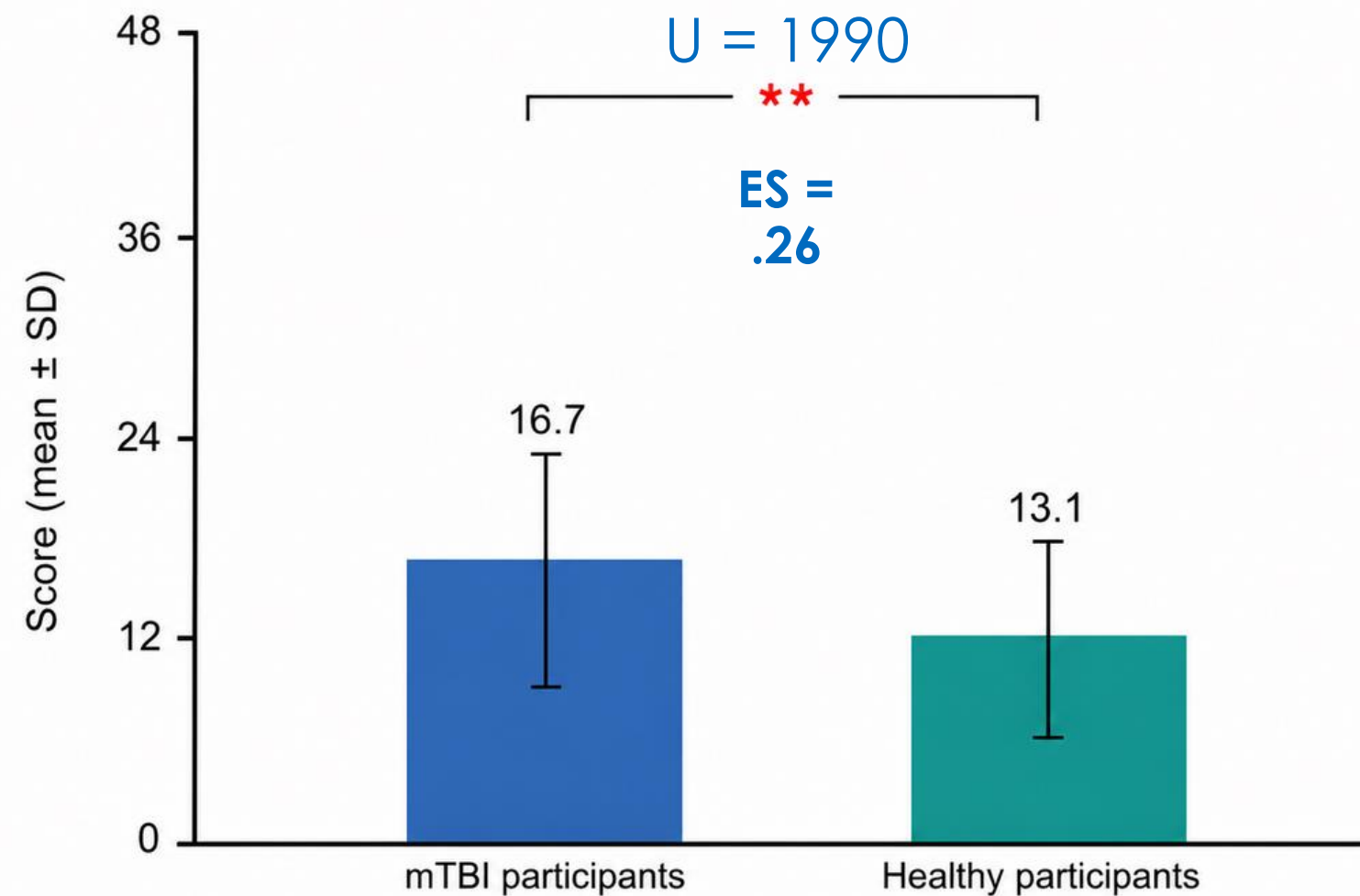
➔ **Rumination*** ($ES = .21$)
Helplessness** ($ES = .30$)

4. Results

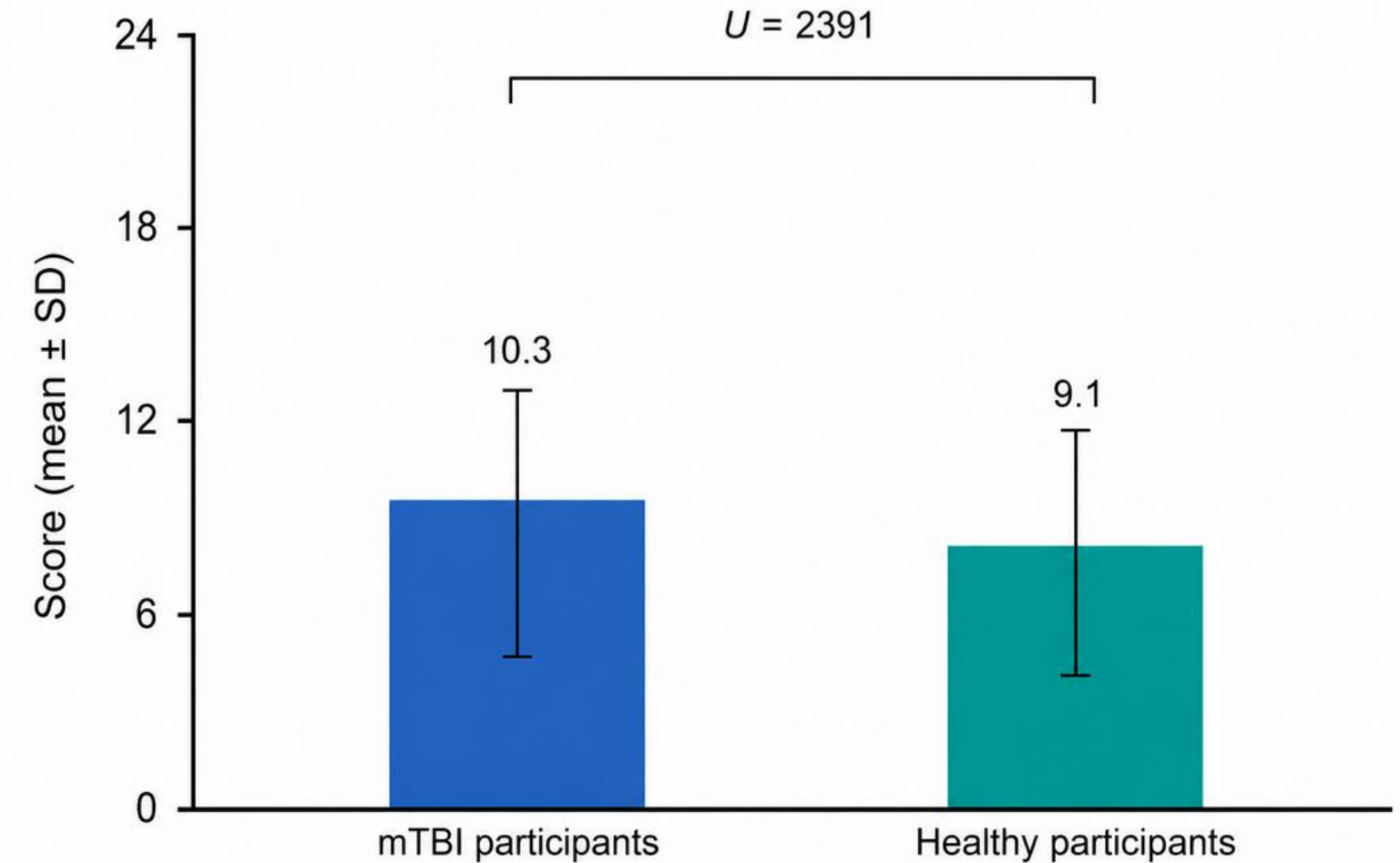


INS 2026
MID-YEAR MEETING
DUBLIN, IRELAND
22-24 JULY

Fear-avoidance behaviors



Endurance behaviors



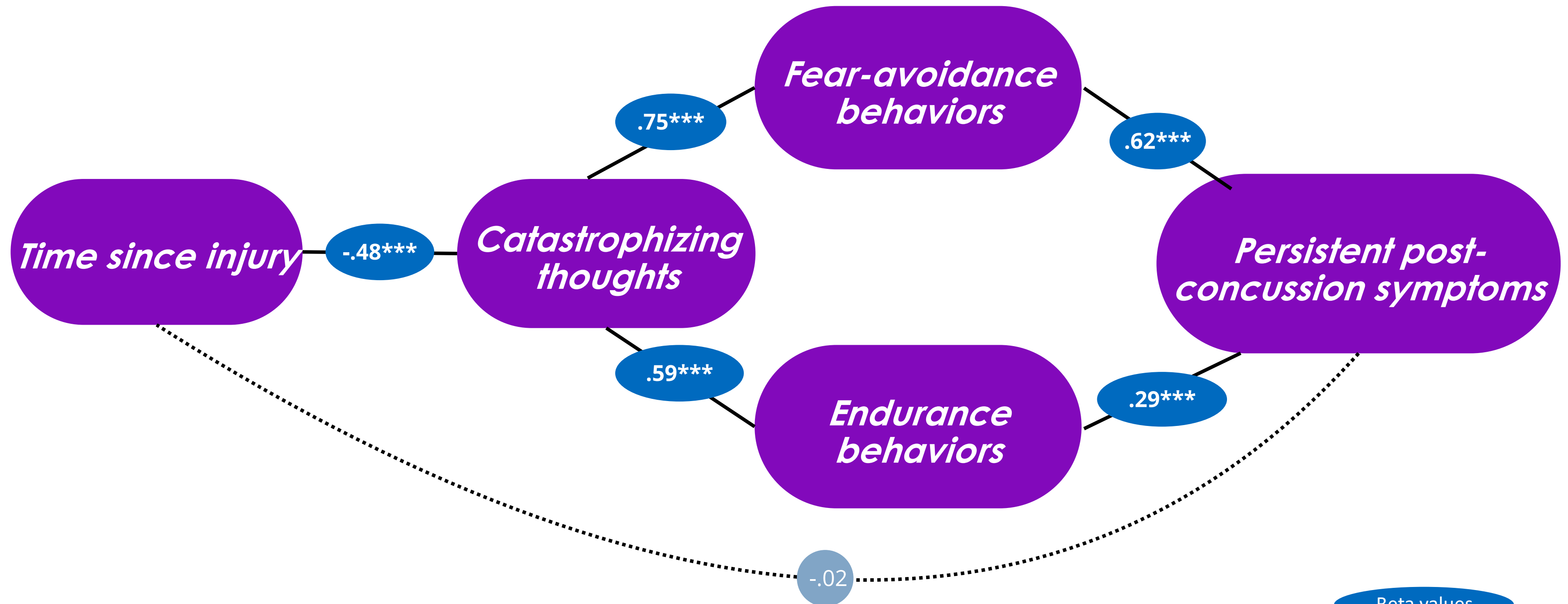
➔ **Cogniphobia***** (ES = .32)
Symptom avoidance** (ES = .25)

* $<.05$; ** $<.01$; *** $<.001$.

4. Results



INS 2026
MID-YEAR MEETING
DUBLIN, IRELAND
22-24 JULY



The model explained **65%** of variance in persistent post-concussions symptoms
Good fit to the data ($\chi^2(4) = 4.39, p = .36$)

Beta values

* $<.05$; ** $<.01$; *** $<.001$.



5. *Take home message*

Importance of identifying at-risk patients early after injury

→ *Screening and monitoring with questionnaires* (Symptom Catastrophizing Scale, Fear

Avoidance Behaviors after TBI, Behavioural Response to Illness Questionnaire)

Catastrophizing

Psychoeducation,
cognitive reframing,
mindfulness

Greenberg et al., 2020 ; Terpstra
et al., 2021

Fear-avoidance behaviors

Graded exposure

Rioux et al., 2025; Hecker et al.,
2025; Silverberg et al., 2022

Endurance

Pacing strategies

Silverberg et al., 2022

→ Metacognitive therapy?

Rauwenhoff et al.,
2024

6. *Future research*



INS 2026
MID-YEAR MEETING
DUBLIN, IRELAND
22-24 JULY

When do catastrophizing thoughts translate into maladaptive behaviors?

→ Longitudinal studies



The link and temporal dynamics between **endurance and avoidance** is still to be investigated



What is the role of these maladaptive cognitions and behaviours in the persistence of **cognitive difficulties**?





INS 2026
MID-YEAR MEETING
DUBLIN, IRELAND
22-24 JULY



Thank you !

lisa.dussard@uliege.be

Bibliography



INS 2026
MID-YEAR MEETING
DUBLIN, IRELAND
22-24 JULY

Lefevre-Dognin, C., Cogné, M., Perdrieau, V., Granger, A., Heslot, C., & Azouvi, P. (2021). Definition and epidemiology of mild traumatic brain injury. *Neurochirurgie*, 67(3), 218–221. <https://doi.org/10.1016/j.neuchi.2020.02.002>

Silverberg, N. D., Iverson, G. L., ACRM Brain Injury Special Interest Group Mild TBI Task Force members:, Cogan, A., Dams-O'Connor, K., Delmonico, R., Graf, M. J. P., Iaccarino, M. A., Kajankova, M., Kamins, J., McCulloch, K. L., McKinney, G., Nagele, D., Panenka, W. J., Rabinowitz, A. R., Reed, N., Wethe, J. V., Whitehair, V., ACRM Mild TBI Diagnostic Criteria Expert Consensus Group:, Anderson, V., ... Zemek, R. (2023). The American Congress of Rehabilitation Medicine Diagnostic Criteria for Mild Traumatic Brain Injury. *Archives of physical medicine and rehabilitation*, 104(8), 1343–1355. <https://doi.org/10.1016/j.apmr.2023.03.036>

Levin, H. S., & Diaz-Arrastia, R. R. (2015). Diagnosis, prognosis, and clinical management of mild traumatic brain injury. *The Lancet Neurology*, 14(5), 506-517.

Rohling, M. L., Binder, L. M., Demakis, G. J., Larrabee, G. J., Ploetz, D. M., & Langhinrichsen-Rohling, J. (2011). A meta-analysis of neuropsychological outcome after mild traumatic brain injury: Re-analyses and reconsiderations of Binder et al., Frencham et al., and Pertab et al. *The Clinical Neuropsychologist*, 25(4), 608-623. <https://doi.org/10.1080/13854046.2011.565076>

Cancelliere, C., Verville, L., Stubbs, J. L., Yu, H., Hincapié, C. A., Cassidy, J. D., ... & Silverberg, N. D. (2023). Post-concussion symptoms and disability in adults with mild traumatic brain injury: A systematic review and meta-analysis. *Journal of Neurotrauma*, 40(11–12), 1045–1059. <https://doi.org/10.1089/neu.2022.0185>

Carroll, E. L., Outtrim, J. G., Forsyth, F., Manktelow, A. E., Hutchinson, P. J. A., Tenovuo, O., Posti, J. P., Wilson, L., Sahakian, B. J., Menon, D. K., & Newcombe, V. F. J. (2020). Mild traumatic brain injury recovery: a growth curve modelling analysis over 2 years. *Journal of Neurology*, 267(11), 3223–3234. <https://doi.org/10.1007/s00415-020-09979-x>

Gaudette, É., Seabury, S. A., Temkin, N., Barber, J., DiGiorgio, A. M., Markowitz, A. J., Manley, G. T., & TRACK-TBI Investigators (2022). Employment and Economic Outcomes of Participants With Mild Traumatic Brain Injury in the TRACK-TBI Study. *JAMA network open*, 5(6), e2219444. <https://doi.org/10.1001/jamanetworkopen.2022.19444>

Snell, D. L., Siegert, R. J., Debert, C., Cairncross, M., & Silverberg, N. D. (2020). Evaluation of the fear avoidance behavior after traumatic brain injury questionnaire. *Journal of neurotrauma*, 37(13), 1566-1573. <https://doi.org/10.1089/neu.2019.6729>

Ponsford, J., Nguyen, S., Downing, M., Bosch, M., McKenzie, J. E., Turner, S., Chau, M., Mortimer, D., Gruen, R. L., Knott, J., & Green, S. (2019). Factors associated with persistent post-concussion symptoms following mild traumatic brain injury in adults. *Journal of rehabilitation medicine*, 51(1), 32–39. <https://doi.org/10.2340/16501977-2492>

Hou, R., Moss-Morris, R., Peveler, R., Mogg, K., Bradley, B. P., & Belli, A. (2012). When a minor head injury results in enduring symptoms: A prospective investigation of risk factors for postconcussional syndrome after mild traumatic brain injury. *Journal of Neurology, Neurosurgery & Psychiatry*, 83(2), 217–223. <https://doi.org/10.1136/jnnp-2011-300767>

Biagianti, B., Stocchetti, N., Brambilla, P., & Van Vleet, T. (2020). Brain dysfunction underlying prolonged post-concussive syndrome: A systematic review. *Journal of affective disorders*, 262, 71-76. <https://doi.org/10.1016/j.jad.2019.10.058>

Broshek, D. K., De Marco, A. P., & Freeman, J. R. (2015). A review of post-concussion syndrome and psychological factors associated with concussion. *Brain Injury*, 29(2), 228–237. <https://doi.org/10.3109/02699052.2014.974674>

Bibliography



INS 2026
MID-YEAR MEETING
DUBLIN, IRELAND
22-24 JULY

Silverberg, N. D., Gardner, A. J., Brubacher, J. R., Panenka, W. J., Li, J. J., & Iverson, G. L. (2015). Systematic review of multivariable prognostic models for mild traumatic brain injury. In *Journal of Neurotrauma* (Vol. 32, Issue 8, pp. 517–526). Mary Ann Liebert Inc. <https://doi.org/10.1089/neu.2014.3600>

Hasenbring, M. I., Hallner, D., Klasen, B., Streitlein-Böhme, I., Willburger, R., & Rusche, H. (2012). Pain-related avoidance versus endurance in primary care patients with subacute back pain: psychological characteristics and outcome at a 6-month follow-up. *Pain*, 153(1), 211-217. doi:10.1016/j.pain.2011.10.019

Vlaeyen, J. W., & Linton, S. J. (2012). Fear-avoidance model of chronic musculoskeletal pain: 12 years on. *Pain*, 153(6), 1144-1147. doi: 10.1016/j.pain.2011.12.009

Wijenbergh, M. L., Stapert, S. Z., Verbunt, J. A., Ponsford, J. L., & Van Heugten, C. M. (2017). Does the fear avoidance model explain persistent symptoms after traumatic brain injury? *Brain Injury*, 31(12), 1597–1604. <https://doi.org/10.1080/02699052.2017.1366551>

Terpstra, A. R., Cairncross, M., Yeates, K. O., Vranceanu, A. M., Greenberg, J., Hunt, C., & Silverberg, N. D. (2021). Psychological mediators of avoidance and endurance behavior after concussion. *Rehabilitation Psychology*, 66(4), 470–481. <https://doi.org/10.1037/rep0000390>

Silverberg, N. D., Panenka, W. J., & Iverson, G. L. (2018b). Fear avoidance and clinical outcomes from mild traumatic brain injury. *Journal of Neurotrauma*, 35(16), 1864–1873. <https://doi.org/10.1089/neu.2018.5662>

Silverberg, N. D., Iverson, G. L., & Panenka, W. J. (2017). Cogniphobia in mild traumatic brain injury. *Journal of Neurotrauma*, 34(13), 2141–2146. <https://doi.org/10.1089/neu.2016.4719>

Sullivan, M. J. L., Bishop, S., & Pivik, J. (1995). The Pain Catastrophizing Scale: Development and validation. *Psychological Assessment*, 7, 524–532.

Shi, S., Picon, E. L., Rioux, M., Panenka, W. J., & Silverberg, N. D. (2023). Catastrophizing is associated with excess cognitive symptom reporting after mild traumatic brain injury. *Neuropsychology*. <https://doi.org/10.1037/neu0000930>

Snell, D. L., Siegert, R. J., Debert, C., Cairncross, M., & Silverberg, N. D. (2020). Evaluation of the fear avoidance behavior after traumatic brain injury questionnaire. *Journal of neurotrauma*, 37(13), 1566-1573. <https://doi.org/10.1089/neu.2019.6729>

Spence, M., Moss-Morris, R., & Chalder, T. (2005). The Behavioural Responses to Illness Questionnaire (BRIQ): a new predictive measure of medically unexplained symptoms following acute infection. *Psychological medicine*, 35(4), 583-593. <https://doi.org/10.1017/S0033291704003484>

King, N. S., Crawford, S., Wenden, F. J., Moss, N. E., & Wade, D. T. (1995). The Rivermead Post Concussion Symptoms Questionnaire: a measure of symptoms commonly experienced after head injury and its reliability. *Journal of neurology*, 242(9), 587–592. <https://doi.org/10.1007/BF00868811>

Rauwenhoff, J., Hagen, R., Karaliute, M., Hjemdal, O., Kennair, L. E. O., Solem, S., Asarnow, R. F., Einarsen, C., Halvorsen, J., Paoli, S., Saksvik, S., Smevik, H., Storvig, G., Wells, A., Skandsen, T., & Olsen, A. (2024). Metacognitive therapy for people with post-traumatic stress disorder: A randomized controlled trial.

Bibliography



INS 2026
MID-YEAR MEETING
DUBLIN, IRELAND
22-24 JULY

Rioux, M., Brasher, P. M., McKeown, G., Yeates, K. O., Vranceanu, A. M., Snell, D. L., ... & Silverberg, N. D. (2025). Graded exposure therapy for adults with persistent symptoms after mTBI: A historical comparison study. *Neuropsychological rehabilitation*, 35(7), 1349-1365. <https://doi.org/10.1080/09602011.2024.2403647>

Hecker, L., King, S., Wijenberg, M., Geusgens, C., Stapert, S., Verbunt, J., & Van Heugten, C. (2025). Catastrophizing thoughts and fear-avoidance behavior are related to persistent post-concussion symptoms after mild traumatic brain injury. *Neurotrauma Reports*, 6(1), neur-2024. <https://doi.org/10.1089/neur.2024.0136>

Silverberg, N. D., Cairncross, M., Brasher, P. M., Vranceanu, A. M., Snell, D. L., Yeates, K. O., ... & Canadian Traumatic Brain Injury Research Consortium. (2022). Feasibility of concussion rehabilitation approaches tailored to psychological coping styles: a randomized controlled trial. *Archives of physical medicine and rehabilitation*, 103(8), 1565-1573. <https://doi.org/10.1016/j.apmr.2021.12.005>

Greenberg, J., Mace, R. A., Funes, C. J., Silverberg, N. D., Iverson, G. L., Caplan, D. N., & Vranceanu, A. M. (2020). Pain catastrophizing and limiting behavior mediate the association between anxiety and postconcussion symptoms. *Psychosomatics*, 61(1), 49-55. <https://doi.org/10.1016/j.psych.2019.09.004>

Path analysis details



INS 2026
MID-YEAR MEETING
DUBLIN, IRELAND
22-24 JULY

Table 3. *Parameter estimates for path analysis*

	β	95%CI	z
Time since <u>mTBI</u> → post-concussion symptoms (RPQ)	-0.02	-0.17, 0.13	-0.27
Time since concussion → catastrophic thinking (SCS)	-0.48***	-0.68, -.0.28	-4.66
Time since concussion → catastrophic thinking (SCS) → fear avoidance (FAB-TBI) → post-concussion symptoms (RPQ)	-.23***	-.34, -.11	-3.70
Time since concussion → <u>catastrophic thinking</u> (SCS) → <u>→ endurance</u> (All-or-nothing) → post-concussion symptoms (RPQ)	-.08**	-.14, -.02	-2.64
Catastrophic thinking (SCS) → fear avoidance (FAB- TBI)	0.75***	0.60, 0.90	9.74
Catastrophic thinking (SCS) → endurance (All-or- nothing)	0.59***	0.41, 0.78	6.24
Fear avoidance (FAB-TBI) → post-concussion symptoms (RPQ)	0.62***	0.46, 0.78	7.77
Endurance (All-or-nothing) → post-concussion symptoms (RPQ)	0.29***	0.14, 0.44	3.73

Note. * $<.05$; ** $<.01$; *** $<.001$.