Sensory modulation challenges in PTSD – impacts on daily activity performance as measured by a virtual platform

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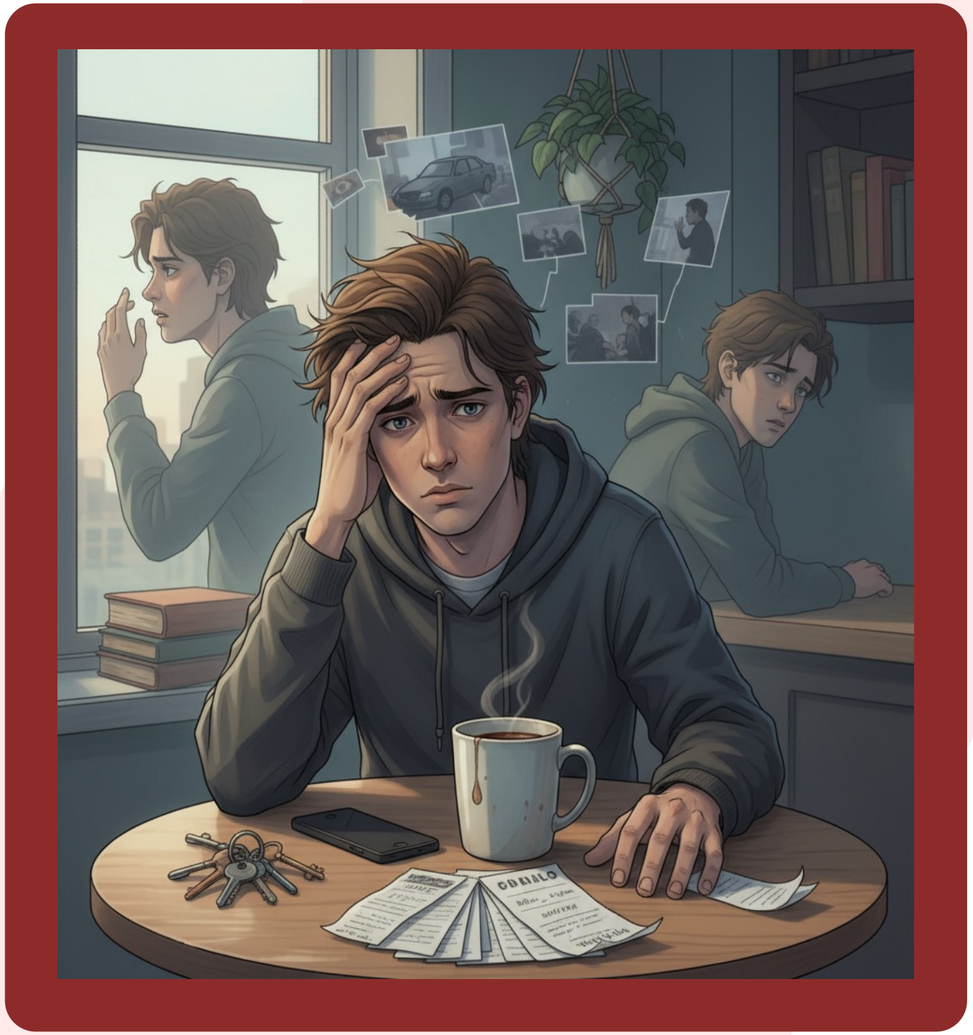
Background

Post-Traumatic Stress Disorder (PTSD)

PTSD develops following direct or indirect exposure to a life-threatening or deeply distressing event.

Symptoms are generally categorized into four areas:

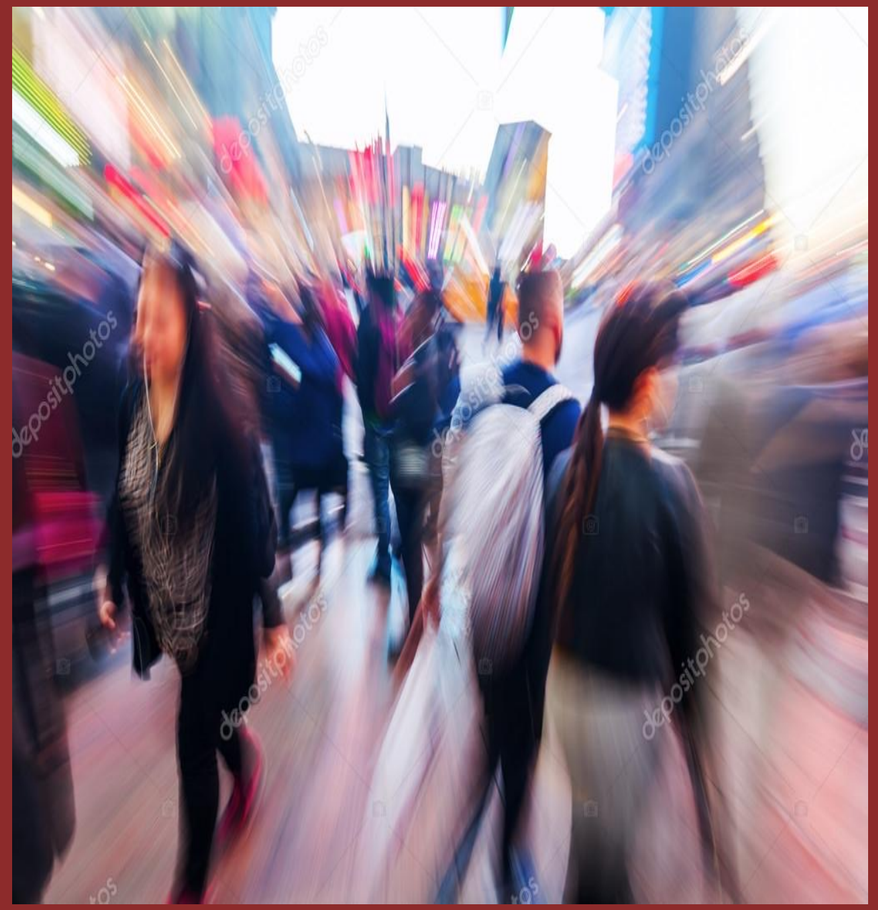
- **Intrusions:** Flashbacks, nightmares, and distressing memories.
- **Avoidance:** Avoiding interactions, locations, or thoughts that are connected to the trauma.
- **Cognition & Mood:** Persistent negative emotions or distorted beliefs about oneself.
- **Arousal:** Hypervigilance, being easily startled, or feeling constantly "on edge.



(American Psychiatric Association (APA), 2022)

Background

Post-Traumatic Stress Disorder (PTSD)



Individuals with PTSD often encounter significant barriers to performing daily activities, which can impede **meaningful participation** and diminish their overall **quality of life (QOL)**.

A key feature of this condition is **Sensory Modulation (SM)** challenges.

(Edgelow et al., 2019)

Sensory Modulation (SM) challenges

- SM refers to the ability to modulate sensory information and to organize this sensory input to respond to situational demands.
  - Dunn's (1997) model, which refers to sensory-processing and modulation abilities as expressed in daily life.

☞These challenges often restrict daily activity performance, yet evidence regarding the specific nature of these restrictions is limited.

Neurological threshold	Behavioral Response: Passive	Behavioral Response: active
High	**Low registration** The physiological response to sensation is a weak response and quick habituation, often failing to register or respond to environmental input.	**Sensation seeking** The physiological response to sensation is a weak and slow habituation, due to counteract behavior that pursues sensation.
Low	**Sensory sensitivity** The physiological response to sensation is strong response with slow habituation, due to accordance behavior that involves a sustained recognition of available sensation.	**Sensation avoiding** The physiological response to sensation is a strong response with quick habituation, due to counteract behavior that withdraws from sensation.

(Harricharan et al., 2021; Engel-Yeger et al., 2013; Engel-Yeger et al., 2012; Punski-Hoogervorst et al., 2022)

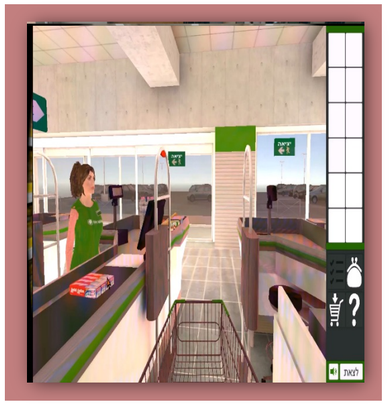
Study Objectives

1. To profile sensory modulation patterns in individuals with PTSD using self-report measures.

2. To compare daily activity performance between individuals with PTSD and healthy controls using *Virtual Action Planning Supermarket (VAP-S 2).*

3. To examine the correlation between sensory modulation patterns and activity performance within the PTSD group.

Sensation
Daily activity



Shopping
VR

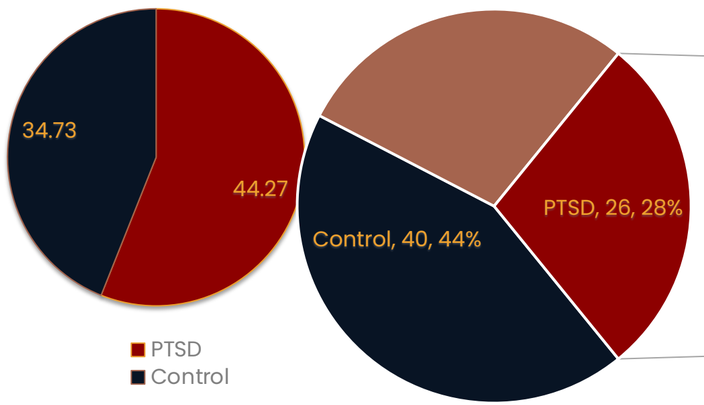
Methodology – Participants

Study Design: Cross-sectional and correlative.

Exclusion criteria:

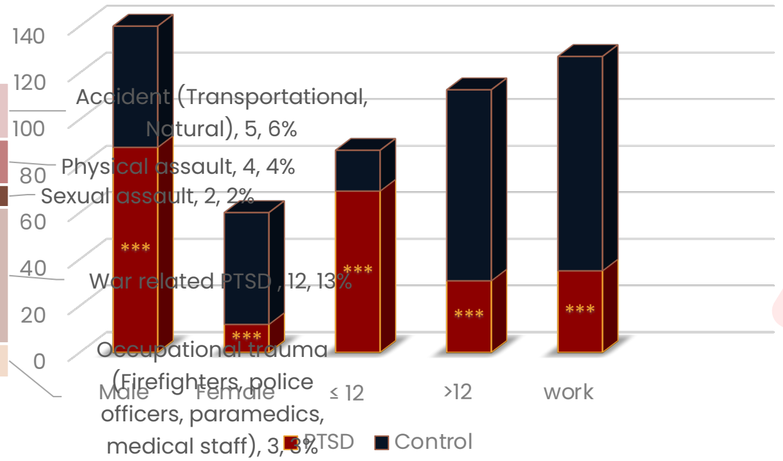
- Physical\ psychiatric diagnosis that is not PTSD.
- Severe health condition (such as cancer, CVA).
- Cognitive decline.
- Use of drugs /substances in the study group (except the use of prescription drugs for PTSD).
- ADHD symptoms in the control group only (T-Score > 65).

Age average



Participants

Gender, education years and work



Methodology – Assessment Tools

The clinical profile:

- A socio-demographic-health questionnaire included information about participants' health status, sociodemographic status, medications, and treatments; also used to determine inclusion\ exclusion criteria.
    - The Conner's Adult ADHD Rating Scales (CAARS™) (Conners, et al., 1999) was used to screen symptoms of ADHD in the groups.
        - The Hamilton Anxiety Rating Scale (HARS) (Hamilton, 1969) measured emotional status to profile anxiety, depression, and stress.

(Conners, et al., 1999; Hamilton, 1969)

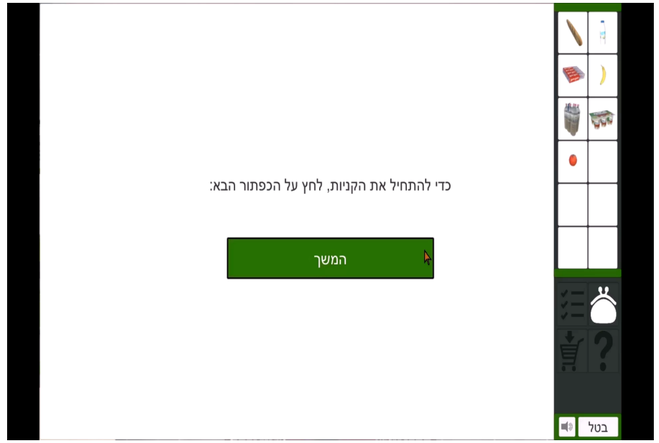
Methodology – Assessment Tools

- The Adolescent/Adult Sensory Profile –AASP evaluated sensory modulation (Brown & Dunn, 2002)

ADOLESCENT/ADULT SENSORY PROFILE

- Four sensory processing quadrants: *sensory sensitivity, low registration, sensation seeking, and sensation avoidance.*
- Age-based norms; Score range: 5–75; Cut score: 1–2 SD from mean; Higher = more difficulties.

- Virtual Action Planning Supermarket (VAP-S 2) (Klinger et al., 2006, 2019)



Task steps:

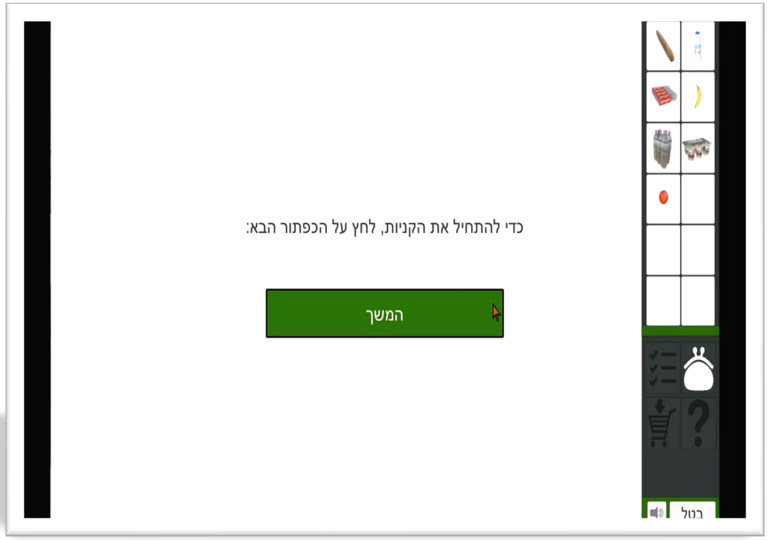
Collect groceries from a list → Go to cashier → Pay → Exit the supermarket.

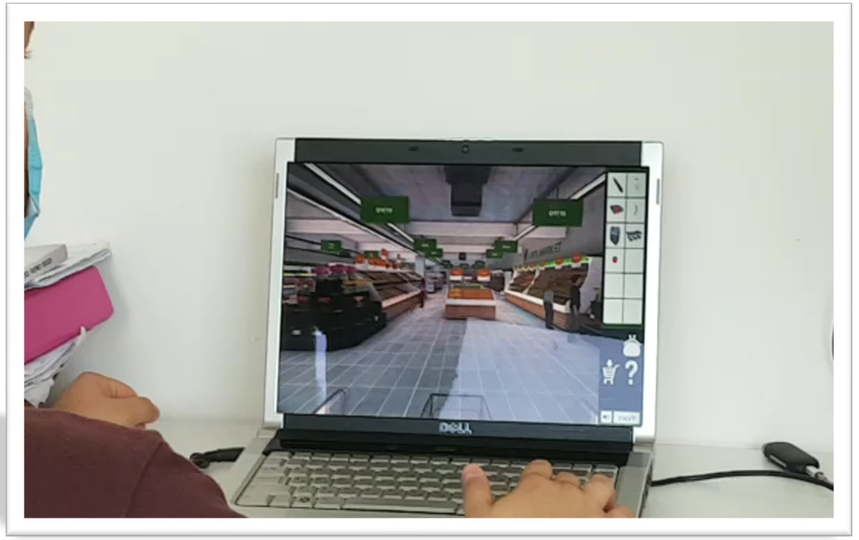
- Performance-based assessment simulating a shopping task, and experience, including supermarket auditory and visual stimuli.

(Brown & Dunn, 2002; Josman, Hof, et al., 2006; Klinger et al., 2006; Klinger & Josman, 2019)

Methodology – Assessment Tools

The sensory experience in the Virtual Action Planning Supermarket (VAP-S 2):





Includes realistic auditory and visual supermarket stimuli.

- Auditory intrusions — background supermarket sounds, cashier beeps, a child calling “Dad,” and random ambient noises such as cart movements or pouring legumes.
- Visual intrusions — realistic aisles, similar products, cashiers, shoppers.

Measures activity performance and efficiency, including impulsivity, categorization, and strategy use, while responding to complex auditory and visual stimuli.

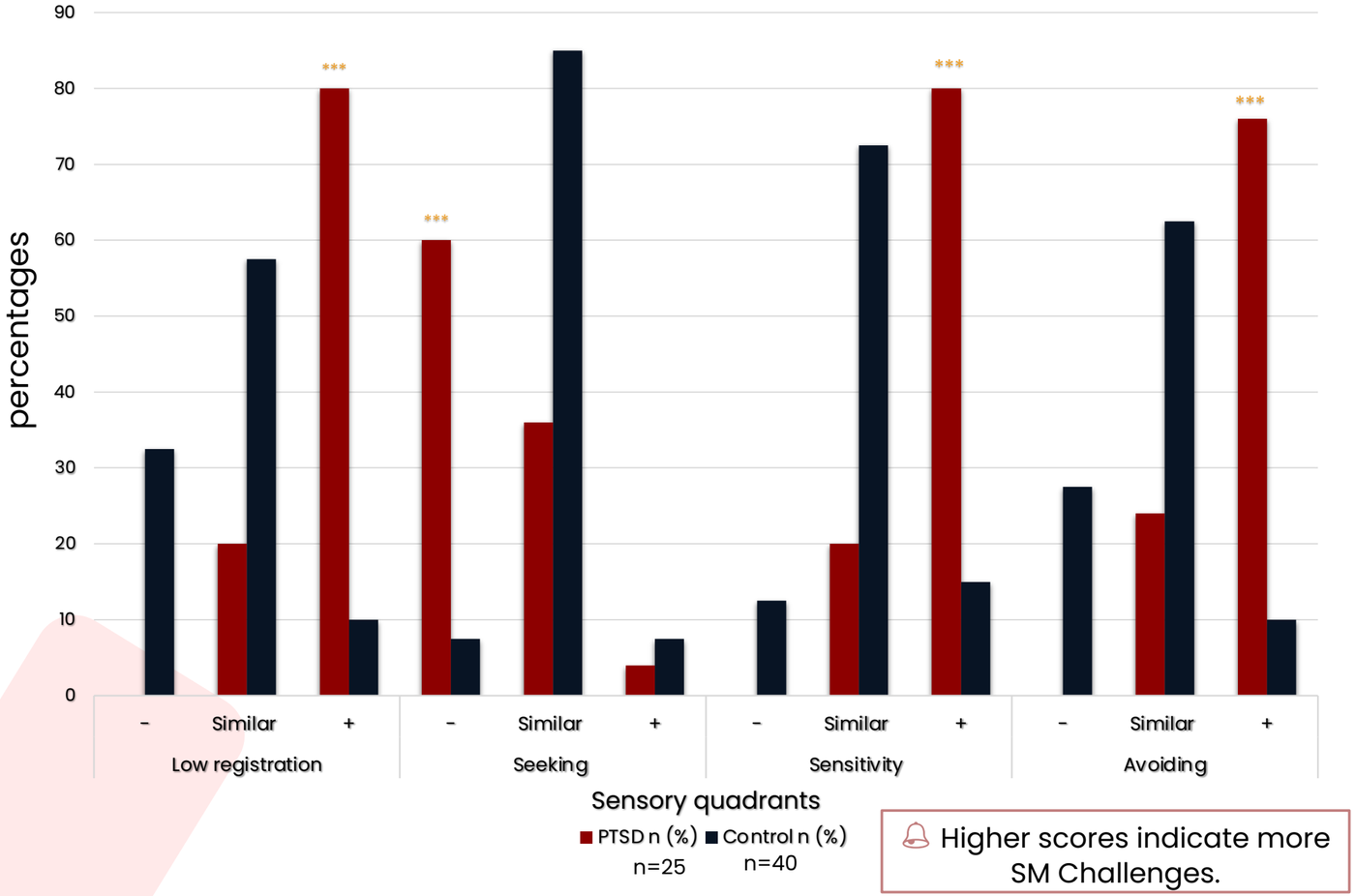
The Process

1. Interested individuals contacted research coordinator by phone.
2. Eligibility confirmed.
3. Quiet room meeting (psych dept/home):
   signed consent,
   completed questionnaires,
   AASP, and VAP-S 2.

Results – Sensory Modulation Profiles

- **Significant Differences:** The PTSD group showed distinct sensory profiles compared to controls.
- **Hyper-responsivity:** Higher levels of **Sensory Sensitivity** and **Sensory Avoidance**.
- **Hypo-responsivity:** of higher levels of **Low Registration** and lower levels of **Sensory Seeking**.

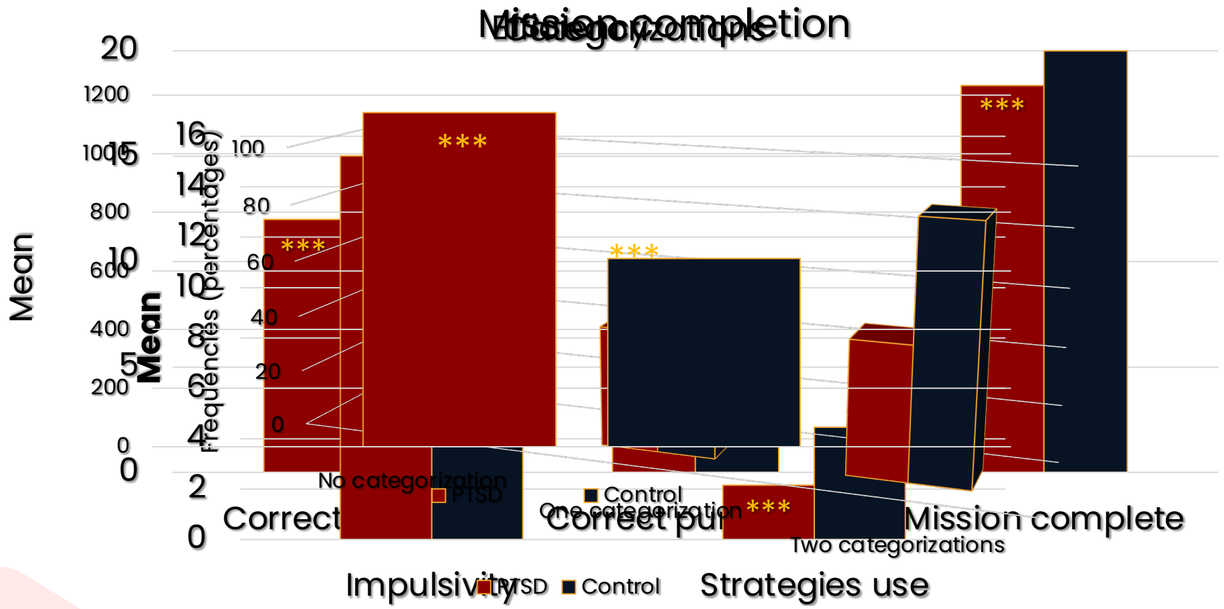
Prevalence of participants in each sensory modulation pattern



Higher scores indicate more SM Challenges.

Results – Activity Performance in VAP-S 2

Performance Restrictions: The PTSD group showed significantly more restricted activity performance, reflected in greater difficulty completing the shopping task efficiently (e.g., longer time, more errors, trajectory inefficiency).



Results – Activity Performance in VAP-S 2

Figure 1
A 32 years-old man with PTSD performing the VAP-S 2

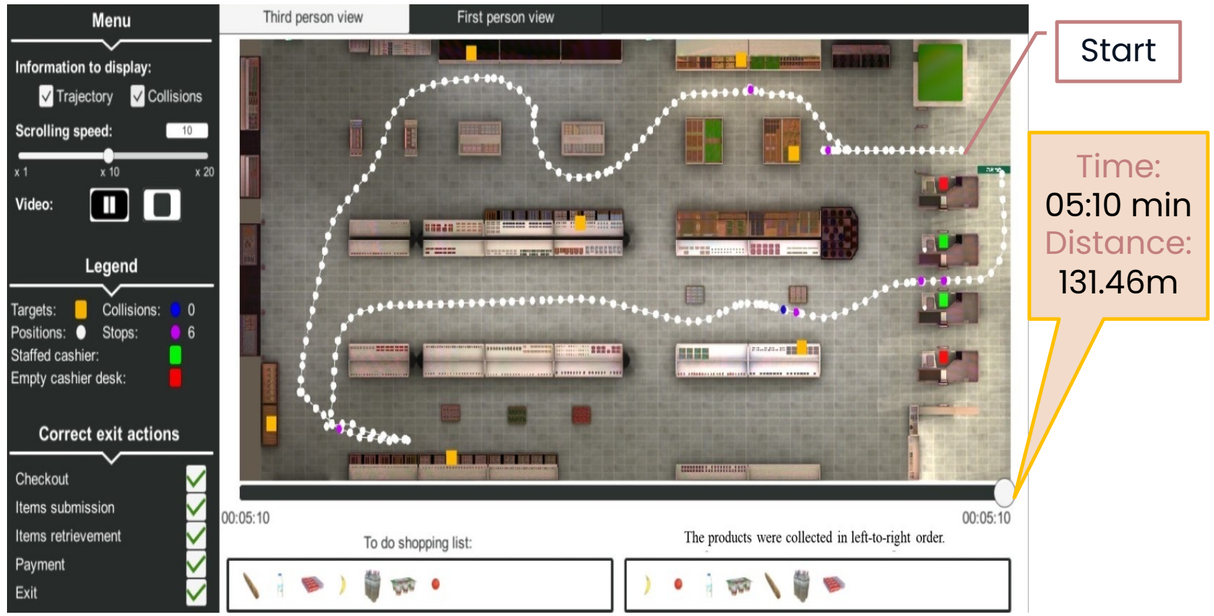


Figure 2
A 33 years-old healthy man performing the VAP-S 2

- Figures 1 and 2 illustrate the trajectory of a PTSD and a healthy participants. The PTSD participant demonstrated lower efficiency performance and used fewer strategies and categorizations than the control.

Examples of participants' spontaneous reactions during the VAP-S 2 task.

1. "This noise is driving me crazy! Where is it coming from?"
2. "It's just like real life. Shopping isn't for me."
3. "Where did the bananas go? … Oh, now I see them."
4. "I saw people and tried to ignore them. I took a big detour to get to the product."
5. Self-talk: "Stay with me… okay? Stay with me."
6. Self-talk: "Yogurt… yo-gurt…"

Correlation

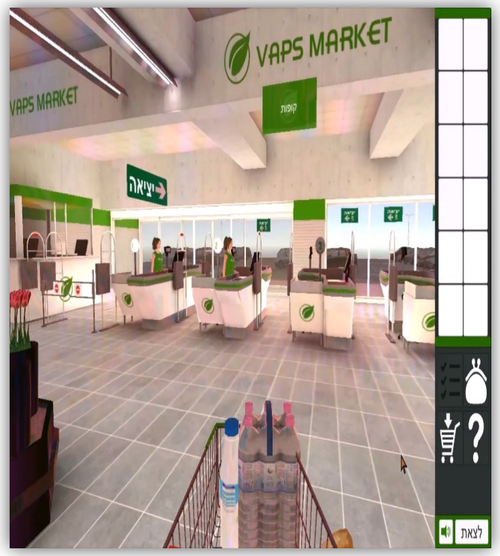
SM and performance

- A moderate and positive correlation was observed between intrusions and Sensory Sensitivity, *r= 0.454, p < 0.05.*
- A higher number of "intrusions" (distractions) during the shopping task significantly correlated with higher Sensory Sensitivity scores on the AASP.
- These findings suggest that heightened sensory sensitivity may increase vulnerability to visual and auditory intrusions in the VAP-S 2, potentially contributing to less efficient task performance and completion.

Discussion & Clinical Implications

Ecological Understanding: Sensory modulation challenges are highly prevalent among individuals with PTSD. These challenges may restrict daily activity performance and reduce functional participation, as shown in the VAP-S.2

Routine Assessment: Occupational therapists should routinely assess sensory modulation to understand its profound impact on the daily lives of clients with PTSD.



Conclusion & Future Directions

Implications for OT: Integrating sensory-based strategies into VR interventions can lead to better function in real-world daily settings.

VR in practice: VR platforms like VAP-S 2 provide a safe, controlled, yet realistic environment to assess and improve functional outcomes.

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THANK YOU

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References:

American Psychiatric Association (APA). (2022). Posttraumatic Stress Disorder. In *Diagnostic and Statistical Manual of Mental Disorders, (DSM-5)* (5th ed.).

Brown, C. E., & Dunn, W. (2002). *Adolescent/Adult Sensory Profile*. Pearson.

Brown, C., Tollefson, N., Dunn, W., Cromwell, R., & Filion, D. (2001). The Adult Sensory Profile: Measuring patterns of sensory pro-cessing. *American Journal of Occupational Therapy*, 55. http://AOTA.org/terms

Conners, C. K., Erhardt, D., & Sparrow, E. P. (1999). The Conner's Adult ADHD Rating Scales (CAARS-S:S) technical manual. Multi-Health Systems Inc.

Dunn, W. (1997). The Impact of Sensory Processing Abilities on the Daily Lives of Young Children and Their Families: A Conceptual Model. *Infants & Young Children, 9*(4), 23-35.

Edgelow, M. M., MacPherson, M. M., Arnaly, F., Tam-Seto, L., & Cramm, H. A. (2019). Occupational therapy and posttraumatic stress disorder: A scoping review. *Canadian Journal of Occupational Therapy*, *86*(2), 148–157. https://doi.org/10.1177/0008417419831438

Engel-Yeger, B., Palgy-Levin, D., & Lev-Wiesel, R. (2013). The Sensory Profile of People With Post-Traumatic Stress Symptoms. *Occupational Therapy in Mental Health*, *29*(3), 266–278. https://doi.org/10.1080/0164212X.2013.819466

Engel-Yeger, B. (2012). Validating the Adolescent/Adult Sensory Profile and examining its ability to screen sensory processing difficulties among Israeli people. *British Journal of Occupational Therapy*, *75*(7), 321–329. https://doi.org/10.4276/030802212X13418284515839

Harricharan, S., McKinnon, M. C., & Lanius, R. A. (2021). How Processing of Sensory Information From the Internal and External Worlds Shape the Perception and Engagement With the World in the Aftermath of Trauma: Implications for PTSD. *FRONTIERS IN NEUROSCIENCE*, *15*. https://doi.org/10.3389/fnins.2021.625490

Hamilton, M. (1969). Diagnosis and rating of anxiety. *Br J Psychiatry*, *3*(special issue), 76–79.

References:

Josman, N., Hof, E., Klinger, E., Marié, R. M., Goldenberg, K., Weiss, P. L., & Kizony, R. (2006). Performance within a virtual supermarket and its relationship to executive functions in post-stroke patients. *Fifth International Workshop on Virtual Rehabilitation, IWVR 2006*, 106–109. https://doi.org/10.1109/iwvr.2006.1707536

Klinger, E., Chemin, I., Lebreton, S., & Marié, R. (2006). Virtual Action Planning in Parkinson's Disease: A Control Study. *CyberPsychology & Behavior, 9(3), 342–347. https://doi-org.ezproxy.haifa.ac.il/10.1089/cpb.2006.9.342*

Klinger, E., & Josman, N. (2019, June). Virtual environments to evaluate and treat cognitive deficits in every days function. *Presentation Presented at ICVR Workshop*.

Punski-Hoogervorst, J. L., Avital, A., & Engel-Yeger, B. (2022). Challenges in Basic and Instrumental Activities of Daily Living among Adults with Posttraumatic Stress Disorder: A Scoping Review. *Occupational Therapy in Mental Health, 1-27.* https://doi.org/10.1080/0164212X.2022.2094523

Safi N., Jahjah E., Bergmann E., Fruchter E., Caspi Y., Oren U., Josman N., Klinger E. and Engel-Yeger B. (2025) Executive functions in post-traumatic stress disorder: their relation to PTSD severity and daily functioning. Front. Psychiatry 16:1620472. doi: 10.3389/fpsyt.2025.1620472