

Supplement to “An investigation into the relationship of presence, performance, and task-type in virtual reality eEnvironments: A systematic literature review”

APPROACH (DETAILED)

Given this empirical background, we specified our research question as follows: “How does presence in VR affect performance across varying task contexts?”. To answer this research question, a systematic literature review (SLR) was conducted as informed by PRISMA standards (Moher et al., 2015; Shamseer et al., 2015; cf. Higgins et al., 2023) and related guidance (e.g., Briner & Denyer, 2012). We ensured alignment between our research question (RQ) and search query by adapting the CIMO framework (Denyer & Tranfield, 2009; see also Table 1) to specify our keywords for the search query (see Table 1). In the iterative refinement of the search query and corresponding inclusion/exclusion criteria, we opted to use a textually literal approach (i.e., textualism; Eskridge, 1989) to manage the scope of work within this saturated literature. This meant that our search and analysis of source records was constrained to references to constructs of interest (e.g., VR), as written, without making interpretations of the validity of term usage by the originating authors (e.g. does this intervention qualify as VR?; see McGowin et al., 2025). This constraint allowed us to be comprehensive through parsimony. The search query was executed in Google Scholar to ensure coverage of a range of scholarly works (e.g., journal articles, conference proceedings, technical reports), given the prominence of these other sources in relevant disciplines, including human factors, engineering, and computer science (e.g., Lisée et al., 2008; Purnell, 2021). The search was executed in February 2026.

Table S1

Research question and keywords within adapted CIMO framework

Research Question: How does presence in VR affect performance across varying task contexts?					
Context	Intervention	Mechanism	Outcome	Study Design	Time
“Training” OR “opera*”	“virtual reality”	“presence”	“performance” AND “effect size”	“compar*”	2016+

In total, ~342 source records were identified. At the time of submission, 342 records had been identified, with screening and analysis ongoing; full reporting to be included in the final paper. Inclusion and exclusion criteria were matched against each other and the CIMO framework, and related to:

- Study Context (i.e., studies involving human learning/training or operations; not solely studies of user experience or entertainment)
- Intervention (i.e., use of VR reported in at least one study condition)
- Mechanism (i.e., presence reported as at least one study variable)
- Outcomes: performance (i.e., performance reported through at least one study variable, during/after use of VR), and effect size ([i.e., reported statistics relevant to effect size reported (e.g., r , d , F , t , or M and SD)
- Study Design: comparison (i.e., any explicit comparison between two or more conditions), participant demographics (i.e., adult populations), originality (i.e., inclusion of original empirical data; no re-publications or duplications)
- Time (i.e., publications within the last 10 years; 2016+)
- Other: source language (i.e., English language), and availability (e.g., studies publicly accessible to authors through available channels)

To manage scope/time, authors were not contacted for studies that examined the appropriate variables but did not include sufficient statistical information to determine effect size. Determinations of inclusion, qualitative coding of sources, and reviews of statistical data were conducted by three researchers.

Analysis Framework: Task Context

The proposed analysis framework, as described in the extended abstract submission, was visualized in Table 2. This framework delineated task context into four dimensions: task structure, task purpose, task domain, and event structure. Additional considerations were given to the type of reported presence construct, as well as categorization of any multimodal sensory modalities beyond the visual modality which were explicitly mediated through the VR intervention.

Table S2

Proposed analysis framework for task context

Variable	Category	Definition
Presence Concept	Physical Presence	Presence operationally defined & measured as physical/spatial presence.
	Other/Unspecified	Presence not operationalized, or operationally defined & measured other than physical/spatial (e.g., plausibility illusion, etc.)
	Unspecified	Presence not operationally defined.
Task Structure	Exploratory	Task primarily structured as exploration of an environment.
	Narrative	Task primarily structured as story/narrative of events.
	Procedural	Task primarily structured as sequential order of steps.
	Operational	Task primarily structured as manipulation/control of tool.
	Other/Mixed	Primary/dominant task structure does not justifiably align with framework.
Task Purpose	Training/Lab	Task involves emulated/laboratory context.
	Operations/Field	Task involves real-world, real-time operational context.
Task Domain	Affective	Task primarily concerns interpersonal or intrapersonal task objective.
	Physical	Task primarily concerns a psychomotor or perceptual task objective.
	Cognitive	Task primarily concerns a cognitive (i.e., abstract) or metacognitive task objective.
	Mixed (Physical & Cognitive)	Task combines psychomotor/perceptual activities with cognitive processing, such that it it cannot be fully classified as purely physical or purely cognitive..
	Mixed (Affective & Cognitive)	Task combines interpersonal/intrapersonal activities with cognitive processing, such that it cannot be fully classified as purely affective or purely cognitive.
	Mixed (Affective & Physical)	Task combines interpersonal/intrapersonal activities with psychomotor/perceptual activities, such that it cannot be fully classified as purely affective or purely physical.
Events Structure	Continuous	Task events occur continuously (e.g., in real time).
	Discrete	Task events occur discretely, sequentially, or are frequently interrupted.
	Other/Mixed	Task events not discernibly structured as either continuous or discrete.
Sensory Modality (Supplemental)	Auditory	System display involving auditory or speech output.
	Haptic	System display involving haptic, tactile, or motor output.
	Other	System display involves other sensory input or output (e.g., olfactory).