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Case Report

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Effects of Virtual Reality Exposure Therapy on Obsessive-Compulsive Symptoms and Associated Metacognitive Processes in Contamination OCD: A Single-Case Experimental Study

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Abstract

Thought–action fusion (TAF) and diminished memory confidence are core metacognitive mechanisms that maintain contamination-related obsessive-compulsive disorder (OCD) and can impede inhibitory learning during exposure-based treatment. Although exposure and response prevention (ERP) remains the gold-standard intervention, practical, motivational, and logistical barriers frequently limit its delivery. Virtual reality exposure therapy (VRET) offers a controllable, office-based, and potentially more acceptable alternative, yet its capacity to modify these specific cognitive processes has rarely been examined with experimental rigor.

This concurrent multiple-baseline single-case experimental study evaluated a theory-driven, eight-session VRET protocol in three adult women with DSM-5 contamination OCD. Graded 360-degree real-world kitchen and bathroom environments were combined with active behavioral tasks, multisensory cues, in-session cognitive restructuring of TAF beliefs, and strict response prevention. Outcomes included the Thought–Action Fusion Scale, a computerized recognition-based memory-confidence task, washing frequency, reassurance-seeking, and clinician-rated OCD severity (Y-BOCS).

Visual inspection, percentage of non-overlapping data, reliable-change indices, and percentage improvement demonstrated immediate, substantial, and clinically meaningful reductions in washing and reassurance-seeking that were maintained at one-month follow-up (post-treatment improvement 53–80 %). Changes in TAF were heterogeneous yet clinically notable in one participant; memory-confidence gains were more limited. The protocol was highly acceptable, with full completion and no adverse events.

Findings provide preliminary experimental evidence that a carefully designed VRET protocol can produce robust behavioral change and feasible targeting of TAF within an ERP framework. The results highlight both the promise of mechanism-focused virtual exposure for contamination OCD and the need for larger controlled trials to optimize metacognitive outcomes and establish generalizability.

Keywords: Contamination obsessive–compulsive disorder; Virtual reality exposure therapy (VRET); Exposure and response prevention (ERP); Thought–action fusion; Memory confidence.

Introduction

Obsessive-Compulsive Disorder (OCD) is a potentially debilitating neuropsychiatric condition characterized by recurrent, intrusive, and unwanted thoughts, images, or urges (obsessions) that cause marked anxiety or distress, accompanied by repetitive behaviors or mental acts (compulsions) performed in an attempt to neutralize the obsessions or prevent feared outcomes[1].performed to reduce distress or prevent feared outcomes Considering the relatively high lifetime prevalence of obsessive-compulsive disorder (OCD) and its recognition as one of the foremost contributors to chronic disability worldwide, the necessity for efficacious and appropriate treatment is readily apparent[2].

Among the core dysfunctional beliefs in obsessive-compulsive disorder, two metacognitive constructs play a pivotal role: Thought-Action Fusion (TAF) and Memory Confidence. TAF refers to the mistaken belief that merely having a particular thought raises the probability of a related event occurring (likelihood TAF), or that entertaining an immoral thought is morally equivalent to actually performing the act (moral TAF). This cognitive distortion frequently drives individuals to engage in mental or behavioral rituals aimed at "preventing" imagined disasters[3]. Similarly, reduced Memory Confidence—especially pronounced in the checking subtype—leads patients to repeatedly verify actions they have already performed correctly, because they distrust their own recollection. These two processes not only intensify symptom severity but also impede the acquisition of new inhibitory learning during exposure-based therapy[4].

Although the effectiveness of Exposure and Response Prevention (ERP) in treating OCD is well established, this approach is still not fully utilized. Several factors related to both patients and therapists contribute to this underuse[5]. From the therapist's perspective, ERP can be highly time-consuming and present practical difficulties, such as the need for longer or more frequent sessions and the organization of in vivo exposures[6]. Furthermore, many therapists report that conducting exposure is stressful for them; they do not feel sufficiently safe, fear patients' reactions, and worry about potentially harming the patient.[7]. According to Maltby and Tolin, even among therapists who identify themselves as following a cognitive-behavioral approach, the actual implementation of evidence-based treatments such as ERP remains limited, with utilization rates staying below 50%[6). On the patient side, many individuals fear exposure, lack sufficient motivation, prefer self-guided exposure, and/or encounter logistical difficulties. It has been estimated that approximately 25% of patients with OCD refuse ERP[8]. In addition to the practical challenges and time constraints faced by therapists, patients' fears represent another major barrier to the implementation of ERP[9]. Virtual reality (VR) is a computer-generated simulation that allows real-time interaction with the environment. It provides patients with a supportive and safe setting, thereby fostering greater self-efficacy[10]. Consequently, Virtual Reality Exposure Therapy (VRET) is frequently regarded as a promising or advantageous alternative to in vivo or imaginal exposure in certain contexts. This is primarily due to its potential to enhance patient acceptance and lower refusal rates, rather than being universally superior[11]. Incorporating virtual reality into psychotherapy provides substantial benefits. These include practical advantages such as the ability to customize environments and scenarios, precise control over the exposure process, and the convenience of conducting therapy sessions within the therapist's office[12].

By utilizing virtual reality, therapists can customize the virtual environment to align precisely with each patient's specific fears. They can then provide guidance and support while continuously monitoring the patient's progress within that virtual setting[13].Furthermore, the interactive nature of virtual reality enables the creation of standardized, controlled, and replicable exposure environments. These features enhance the therapeutic process by ensuring consistent delivery of exposure tasks, minimizing dependence on the patient's imagination or the therapist's

improvisation, and allowing the safe practice of challenging situations. As a result, such capabilities may reduce barriers to treatment access and improve overall efficiency[9, 10].

Virtual Reality Exposure Therapy (VRET) for anxiety disorders has been extensively researched and has demonstrated efficacy for specific phobias, social anxiety disorder, posttraumatic stress disorder, and panic disorder, as evidenced by a meta-analysis of 30 studies on VRET[14].

This study explores the effects of Virtual Reality Exposure Therapy (VRET) on two core metacognitive mechanisms in OCD—Thought–Action Fusion (TAF) and Memory Confidence—as well as on obsessive-compulsive symptoms, using a multiple-baseline single-case experimental design. While previous VRET research has primarily focused on general symptom reduction, fewer studies have examined its potential impact on these specific cognitive processes. By using controlled 360-degree virtual environments designed to provoke contamination-related fears, the present study aimed to investigate whether VRET can influence TAF, Memory Confidence, and symptom severity in individuals with contamination-related OCD. Given the preliminary nature of this investigation and the limited sample, the study also examined the feasibility and individual response patterns to this approach.

Method

Participants

Three adult women with a primary diagnosis of contamination-type obsessive-compulsive disorder (OCD) according to DSM-5 criteria participated in this study. Participants were recruited through purposive sampling from psychological and psychiatric clinics in Maragheh, Iran. Diagnosis was confirmed by a licensed psychologist through clinical interview. The exclusive inclusion of participants with contamination symptoms was based on the design of the VR scenarios (kitchen and bathroom environments). However, this homogeneous sample limits the generalizability of the findings, particularly to checking-related OCD, where deficits in Memory Confidence are typically more pronounced. The use of three participants is consistent with methodological standards for multiple-baseline single-case experimental designs.

Inclusion Criteria included: age 18–50 years, minimum high school education, no concurrent psychological or pharmacological treatment, and absence of sensory, neurological, or severe medical conditions.

Exclusion Criteria included comorbid psychiatric disorders, high suicide risk, and unwillingness to continue participation. Participants received no financial incentives. Personal identifying information was removed prior to analysis, and all data were stored in encrypted electronic files accessible only to the research team.

Table 1. Demographic Characteristics of Participants

Participant	Age	Marital Status	Education	Occupation	Approximate Duration of OCD
1	35	Married	Bachelor's	Homemaker	3 years
2	24	Single	Master's	Student	2 years
3	30	Married	Bachelor's	Teacher	2 years

Design

A concurrent multiple-baseline design across participants with continuous assessment was employed. This single-case experimental design allows for the evaluation of intervention effects while each participant serves as her own control (Kazdin, 1992). Participants entered the baseline phase at staggered intervals, followed by the treatment phase, post-treatment, and one-month follow-up assessments.

Measures

Primary Outcome Measures

Thought-Action Fusion Scale (TAFS): The Thought–Action Fusion Scale is a 14-item self-report questionnaire designed to assess two core dimensions of thought–action fusion: likelihood TAF (the belief that having a particular thought increases the probability of a related event occurring) and moral TAF (the belief that having an immoral thought is morally equivalent to performing the corresponding action). Items are rated on a Likert-type scale, with higher scores indicating stronger TAF beliefs. The scale has demonstrated adequate internal consistency and construct validity in both clinical and non-clinical samples[15].

Memory Confidence Task: Memory Confidence was assessed using a computerized recognition task consisting of 60 neutral words. Following a study phase, participants completed a recognition test in which they indicated whether each word had been previously presented and subsequently rated their confidence in each judgment on a continuous scale ranging from 0% (no confidence) to 100% (complete confidence). Mean confidence ratings for correctly recognized items served as the primary index of memory confidence.

Yale-Brown Obsessive Compulsive Scale (Y-BOCS): The Yale–Brown Obsessive Compulsive Scale is a clinician-administered, semi-structured interview that provides a gold-standard measure of OCD symptom severity independent of the specific content of obsessions or compulsions. The scale comprises 10 items (five assessing obsessions and five assessing compulsions), each rated from 0 (no symptoms) to 4 (extreme symptoms), yielding a total score ranging from 0 to 40. Separate subscale scores for obsessions and compulsions can also be derived. The Y-BOCS has excellent inter-rater reliability, internal consistency, and sensitivity to treatment-related change [16].

Secondary Outcome Measures

Reassurance Seeking Questionnaire (ReSQ). The Reassurance Seeking Questionnaire is a multidimensional self-report instrument developed to assess the frequency, sources, processes, and emotional consequences of reassurance-seeking behaviours. It evaluates both interpersonal (e.g., seeking reassurance from others) and intrapersonal (e.g., self-reassurance) forms of the behaviour, which are particularly relevant to the maintenance of obsessive-compulsive symptoms. Higher scores indicate more frequent or intense reassurance-seeking[17] .

Stroop Color-Word Test (Computerized). A computerized version of the classic Stroop Color-Word Test was administered to assess response inhibition and selective attention. Participants were required to name the ink colour of colour-words presented under congruent and incongruent conditions. The primary performance indices were reaction time and error rate on incongruent trials, reflecting the degree of cognitive interference and inhibitory control[18].

Wisconsin Card Sorting Test (WCST, Computerized). Cognitive flexibility was measured using a computerized version of the Wisconsin Card Sorting Test. Participants were required to sort cards according to changing classification rules (colour, form, or number) that were not explicitly stated and shifted without warning. Key outcome variables included the number of categories completed, perseverative errors, and non-perseverative errors, which provide indices of set-shifting ability and cognitive flexibility [19].

Virtual Reality Equipment

- Samsung Gear 360 Camera (2015) for recording 360-degree real-world footage.
- Samsung Gear VR Headset (2017) for immersive stimulus presentation.

Procedure

The Virtual Reality Exposure Therapy (VRET) protocol was developed to specifically target Thought–Action Fusion and Memory Confidence within an exposure and response prevention (ERP) framework. The protocol consisted of two preparatory sessions and eight active treatment sessions, delivered weekly.

Preparatory Sessions (1–2) focused on psychoeducation regarding OCD maintenance mechanisms (with emphasis on TAF and low memory confidence), the rationale for ERP, development of individualized fear hierarchies, and familiarization with the VR system in a neutral environment.

Active Treatment Sessions (3–8) involved graded exposure using 360-degree real-world video recordings of kitchen and bathroom settings at three escalating levels of contamination. To strengthen targeting of the primary mechanisms, participants engaged in active tasks (e.g., searching for a hidden key), sensory augmentation (unpleasant odors and

damp materials) was applied, and in-session cognitive restructuring directly addressed TAF beliefs and memory-related doubts. Exposure continued until a meaningful reduction in Subjective Units of Distress (SUDS; 0–100) was achieved. Strict response prevention was maintained throughout.

Table 2. Overview of the VRET Protocol

Session	Goal	VR Environment & Key Activities
1–2	Psychoeducation & familiarization	Neutral room + hierarchy development
3	Mild exposure	Kitchen – Level 1
4	Moderate exposure	Kitchen – Level 2
5	Severe exposure + TAF focus	Kitchen – Level 3 + key search & sensory cues
6	Mild bathroom exposure	Bathroom – Level 1
7	Moderate bathroom exposure	Bathroom – Level 2
8	Severe exposure + Memory Confidence	Bathroom – Level 3 + targeted cognitive work

Assessments were conducted at three weekly baseline points, during treatment, immediately post-treatment, and at one-month follow-up.



Figure 1. Neutral Environment



figurer2. Kitchen Contamination Level



Figure 3. Contamination Levels in Restrom

Ethical Considerations

This study was approved by the institutional ethics committee and conducted in accordance with the ethical standards of the American Psychological Association and the Iranian Organization of Psychology and Counseling. Written informed consent was obtained from all participants. Participants were informed of the voluntary nature of participation, their right to withdraw at any time, and measures taken to ensure confidentiality.

The results of this single-case experimental study are presented below. Three female patients with contamination-type obsessive-compulsive disorder completed the targeted Virtual Reality Exposure Therapy (VRET) protocol. Data analysis combined visual inspection of graphed data with quantitative indices including the Reliable Change Index (RCI), percentage of improvement, non-overlap (PND), trend/level stability, and the Conservative Dual Criteria method (Fisher et al., 2003). This study was approved by the Research Ethics Committee of the University of Tabriz, Iran (Ethics Code: IR.TABRIZU.REC.1403.087). Informed consent was obtained from all participants, and all procedures complied with the Declaration of Helsinki.

Content Validity of the VRET Protocol

The protocol demonstrated strong content validity. As shown in Table 2, all components received high CVI values (≥ .83) from six experts, exceeding the acceptable threshold of .79.

Table 3. Content Validity Index (CVI) for Main Components of the VRET Protocol

Item	Component	Experts Rating 3 or 4 (out of 6)	CVI	Status
1	VR scenario design based on triggers	6	1.00	Acceptable
2	Therapist-controlled stimulus intensity	5	.83	Acceptable
3	Response prevention instructions	6	1.00	Acceptable
4	Session duration and structure	5	.83	Acceptable

Effects on Behavioral Symptoms (Washing and Reassurance-Seeking)

All three participants showed substantial and clinically meaningful reductions in behavioral symptoms. As illustrated in Figures 4 and 5 and summarized in Tables 3, washing frequency and reassurance-seeking behaviors decreased markedly from stable baseline levels. Visual analysis revealed immediate shifts in level and trend upon staggered intervention introduction, with high non-overlap (PND frequently 100%) and low overlap between phases. RCI values exceeded the reliable change threshold (1.96) for most comparisons. Percentage improvement ranged from 53% to 80% at post-treatment and remained stable or continued to improve at follow-up. These changes met criteria for clinically significant improvement.

Figures 4 and 5 illustrate changes in washing frequency and reassurance-seeking behaviors across the baseline, intervention, and follow-up phases for all three participants. During baseline, both behavioral measures remained relatively stable with little variability, indicating the absence of spontaneous improvement. Following the staggered introduction of the VRET intervention, all participants demonstrated an immediate reduction in both washing and reassurance-seeking behaviors, accompanied by a clear downward trend throughout the intervention phase. The magnitude of improvement was greatest for Participant 3 in washing behavior and for Participant 2 in reassurance-seeking. Improvements were generally maintained during the follow-up phase, with little overlap between baseline and intervention data, supporting the clinical effectiveness and maintenance of treatment gains.

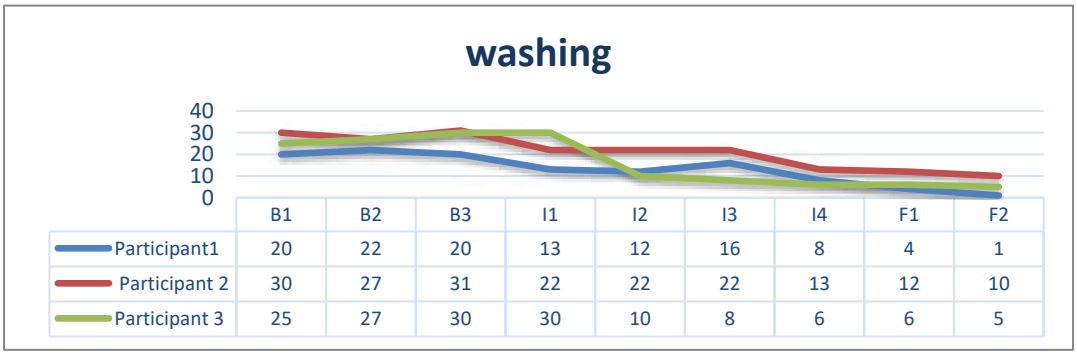


Figure 4. Trends in washing symptoms across participants during baseline, intervention, and follow-up.

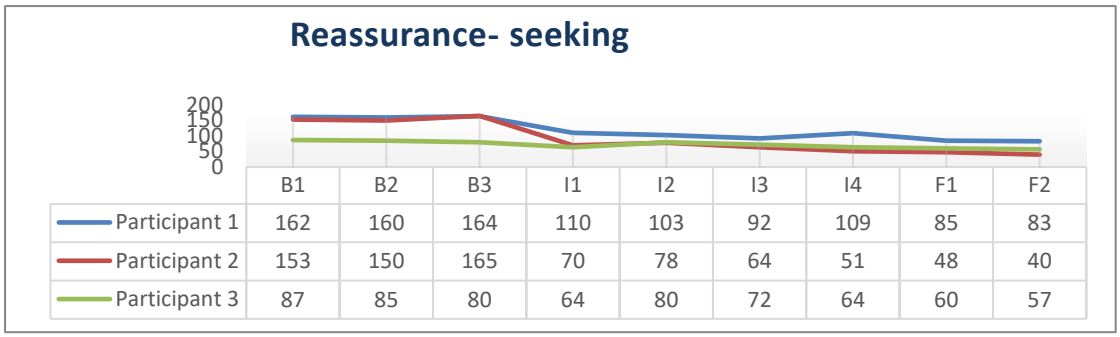


Figure 5. Trends in reassurance-seeking behaviors across participants during baseline, intervention, and follow-up

Table 4. Summary of Changes in Behavioral Symptoms (Washing and Reassurance-Seeking)

Participant	Variable	Baseline Mean	Intervention Mean	Follow-up Mean	% Improvement (Post)	% Improvement (Follow-up)	RCI (Post)
1	Washing	20.67	12.25	12.50	60%	95%	11.21
1	Reassurance-Seeking	162	103.50	97.00	53.33%	49%	3.16
2	Washing	29.33	19.75	16.83	58%	68%	11.76
2	Reassurance-Seeking	156	65.75	58.50	69.09%	75.75%	4.03
3	Washing	27.33	13.50	10.83	80%	83%	8.25
3	Reassurance-Seeking	84	70.00	66.17	20%	28.75%	3.21

Effects on Cognitive Variables (Response Inhibition and Psychological Flexibility)

Improvements were observed in response inhibition and cognitive flexibility, as shown in Table 4 and Figures 6–7. Changes were generally positive, with reduced interference on the Stroop task and fewer perseverative errors on the WCST. Visual and quantitative analyses supported moderate to strong intervention effects in most cases. Figures 6 and 7 present changes in response inhibition and psychological flexibility across participants over the three study phases. Overall, participants showed gradual improvements following the introduction of the intervention. Performance on the response inhibition task improved, as reflected by reduced interference scores, while psychological flexibility demonstrated an increasing trend during the intervention and follow-up phases. Compared with the behavioral outcomes, changes in these cognitive variables were more gradual and showed greater individual variability. Nevertheless, visual inspection indicated positive changes in level and trend after treatment initiation, with most gains remaining stable at follow-up.

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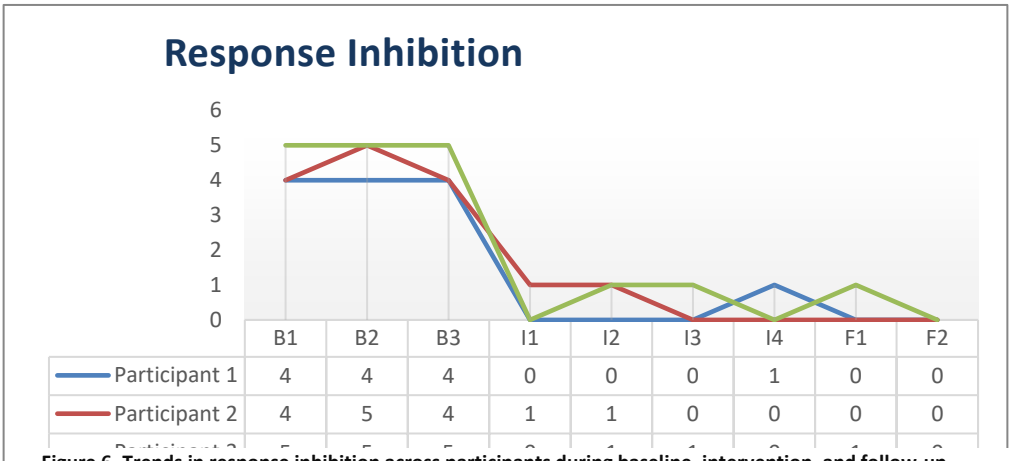
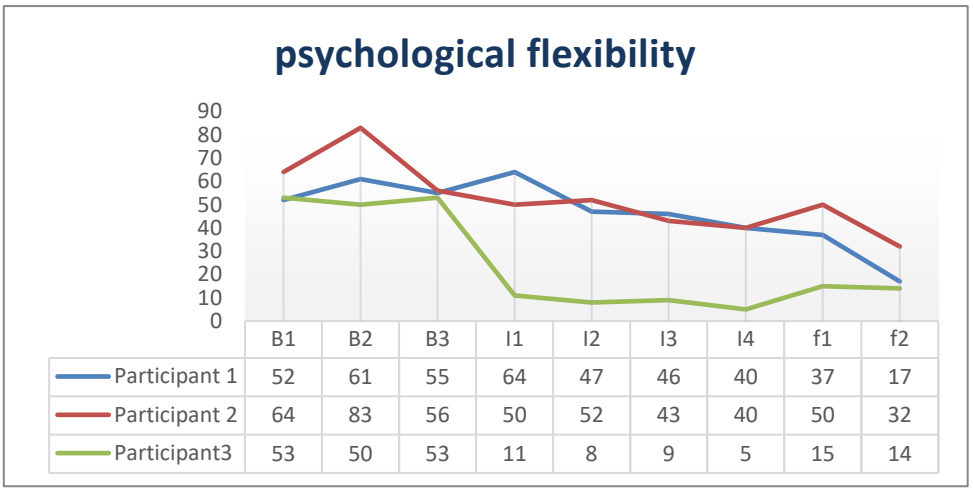


Figure 6. Trends in response inhibition across participants during baseline, intervention, and follow-up



	B1	B2	B3	I1	I2	I3	I4	f1	f2
Participant 1	52	61	55	64	47	46	40	37	17
Participant 2	64	83	56	50	52	43	40	50	32
Participant3	53	50	53	11	8	9	5	15	14

Figure 7. Trends in psychological flexibility across participants during baseline, intervention, and follow-up

Effects on Metacognitive Variables (Thought–Action Fusion and Memory Confidence)

Changes in the primary metacognitive variables were mixed and generally modest. Thought–Action Fusion showed variable reductions across participants. The most noticeable decrease was observed in Participant 3 (approximately 47% improvement at post-treatment), whereas Participants 1 and 2 demonstrated smaller or minimal changes. Improvements in Memory Confidence were limited and inconsistent; in some cases, scores remained stable or slightly declined at follow-up. Overall, while the VRET protocol produced clear reductions in behavioral symptoms (washing and reassurance-seeking), its specific effects on TAF and Memory Confidence were less robust and more variable across individuals. Figures 8 and 9 illustrate changes in Thought–Action Fusion and Memory Confidence during baseline, intervention, and follow-up. In contrast to the behavioral outcomes, changes in metacognitive variables were less consistent across participants. Participant 3 demonstrated the largest reduction in Thought–Audction Fusion, whereas Participants 1 and 2 showed smaller improvements. Memory Confidence exhibited only modest changes, with relatively stable scores across phases and slight fluctuations during follow-up. Overall, visual inspection suggests that the intervention exerted a stronger effect on behavioral symptoms than on metacognitive processes.

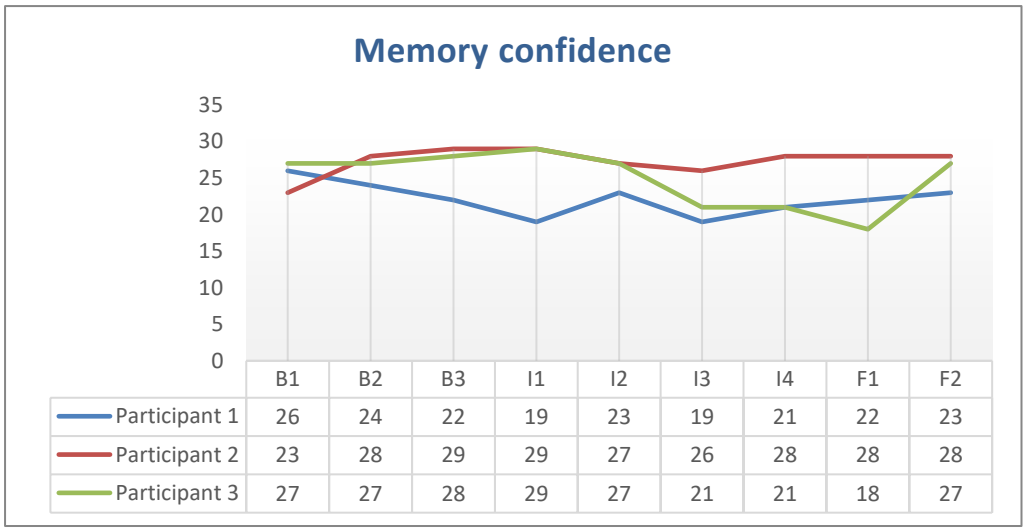


Figure 8. Trends in memory confidence across participants during baseline, intervention, and follow-up

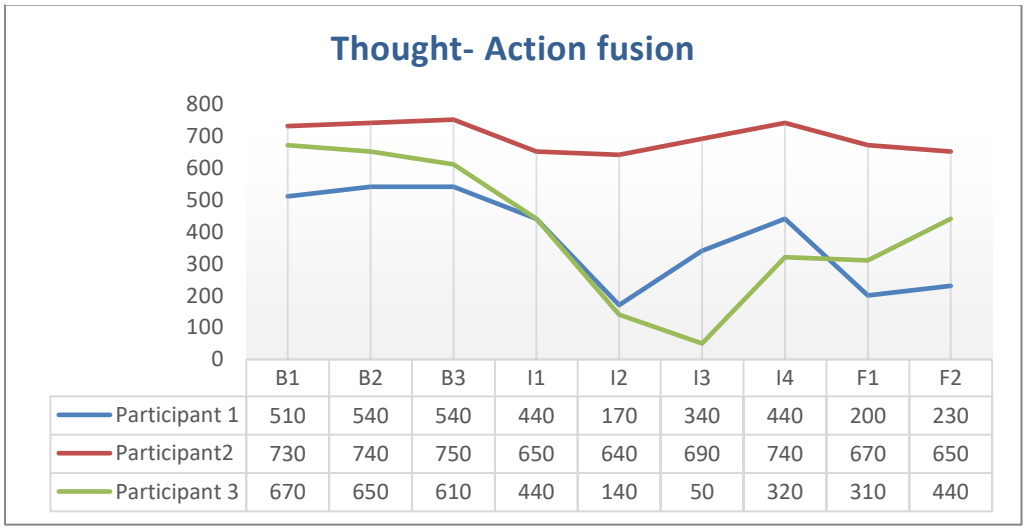


Figure 9. Trends in Thought–Action Fusion across participants during baseline, intervention, and follow-up

Table 5. Summary of Changes in Metacognitive Variables (TAF and Memory Confidence)

Participant	Variable	Baseline Mean	Intervention Mean	Follow-up Mean	% Improvement (Post)	% Improvement (Follow-up)	RCI (Post)
1	Thought-Action Fusion	530	347.50	215	18%	57%	1.58
1	Memory Confidence	24	20.50	22.50	4%	-4% (slight decline)	1.25
2	Thought-Action Fusion	740	680	660	1%	13%	0.44
2	Memory Confidence	26.67	27.50	28	3.45%	3.45%	1.67
3	Thought-Action Fusion	643.33	237.50	375	47%	28%	2.84
3	Memory Confidence	27.33	24.50	22.50	25%	3.57%	4.00

Overall Clinical Significance and Acceptability

Using Jacobson's Reliable Change Index (RCI)and percentage improvement criteria, clinically meaningful reductions were observed primarily in behavioral symptoms (washing and reassurance-seeking) across participants. Changes in Thought–Action Fusion and Memory Confidence were more limited and variable. Treatment effects on behavioral outcomes were largely stable at one-month follow-up. All participants completed the protocol and reported good acceptability of the VR format, with no significant adverse effects.

In summary, the VRET protocol produced clear reductions in behavioral symptoms and OCD severity, with targeted improvements in Thought–Action Fusion and Memory Confidence. The multiple-baseline design provided strong evidence of intervention effects.

Discussion

The findings of the present study indicate that a targeted protocol of virtual reality exposure therapy (VRET) delivered within an exposure and response prevention (ERP) framework produced clinically meaningful and sustained reductions in behavioral symptoms—specifically washing frequency and reassurance-seeking behaviors—as well as in overall obsessive-compulsive symptom severity. These improvements were supported by quantitative indices, including reliable change index (RCI) values exceeding the established threshold for reliable change, post-treatment improvement rates ranging from 53% to 80%, and maintenance or further gains at one-month follow-up. Visual analyses further corroborated the effects through immediate shifts in level and trend following intervention onset, with percentage of non-overlapping data (PND) frequently reaching 100%.

These outcomes are consistent with the growing body of evidence demonstrating the efficacy of VRET for the contamination subtype of OCD. Prior work has shown that immersive 360-degree virtual environments can successfully elicit contamination-related anxiety and disgust, generate moderate-to-adequate levels of presence, and facilitate symptom reduction .[20, 21]TAF reductions were heterogeneous: Participant 3 showed a marked decrease (~47% at post-treatment), while changes in Participants 1 and 2 were modest or minimal. This pattern aligns with metacognitive models of OCD, in which fusion beliefs (likelihood and moral TAF) lead patients to treat intrusive thoughts as dangerous or morally equivalent to actions, thereby maintaining the disorder[22] .Both traditional ERP and virtual-reality exposure can challenge these beliefs by demonstrating that thoughts alone neither cause feared events nor carry moral weight [23, 24]. In the present study, graded virtual exposure in kitchen and bathroom environments, combined with in-session restructuring of TAF beliefs, active tasks, and sensory cues, likely supported inhibitory learning and belief change.

Recent evidence confirms that ERP reduces TAF[25] and that ACT-based approaches further promote cognitive defusion[26]. The limited and variable TAF change observed here may reflect the brief eight-session protocol, the focus on physical rather than mental/moral contamination, and individual differences in baseline severity. Metacognitive shifts can also lag behind behavioral gains[25]. Larger samples and longer follow-ups are needed to clarify whether VRET can systematically target TAF or requires stronger integration with metacognitive techniques.

changes in Memory Confidence were modest, variable across participants, and in some cases showed a slight decline at the one-month follow-up assessment. This pattern is theoretically informative. Reduced cognitive confidence, particularly distrust of one's own memory, is a well-established feature of obsessive-compulsive disorder and tends to be most prominent in individuals with primary checking symptoms, although it is not confined to this subtype [27, 28]. Experimental studies have demonstrated that the act of repeated checking itself can diminish memory confidence by decreasing the vividness and perceptual detail of recollections[29, 30].

In the present study, the exclusive inclusion of participants with contamination-related symptoms (rather than checking symptoms) may have limited the centrality of Memory Confidence as a maintaining mechanism. In addition, the VRET protocol focused primarily on graded exposure to contamination-related cues and response prevention of washing behaviours, rather than on repeated verification of actions or reality-monitoring exercises that more directly target memory distrust. The computerized recognition task that employed neutral words may also have offered limited ecological validity for capturing changes relevant to contamination concerns. Collectively, these design and sample characteristics are likely to have constrained the magnitude of observable change in this particular metacognitive variable.

Limitations: Several limitations should be considered when interpreting the findings. First, the small sample size (N = 3) and the inclusion of only female participants with contamination-type OCD substantially restrict the generalizability of the results. Second, Memory Confidence is theoretically more relevant to checking subtypes of OCD; therefore, the limited changes observed in this variable may partly reflect the characteristics of the sample rather than the ineffectiveness of the protocol. Third, the follow-up period was limited to one month, preventing conclusions about longer-term maintenance of treatment gains. Fourth, the use of 360-degree real-world video, while offering good ecological validity, provides less interactivity and experimental control compared with fully computer-generated virtual environments. Finally, the absence of a comparison condition does not allow direct evaluation of the relative efficacy of this approach compared with standard in vivo ERP. Future studies with larger and more diverse samples, longer follow-up periods, and controlled comparison conditions are needed.

Conclusion: This preliminary single-case experimental study provides initial support for the use of Virtual Reality Exposure Therapy in reducing behavioral symptoms of contamination-related OCD. However, its effects on Thought–Action Fusion and Memory Confidence were mixed and limited. The findings suggest that while VRET may be a feasible and acceptable approach for targeting compulsive behaviors, further research with larger and more diverse samples is needed to clarify its potential for modifying specific metacognitive mechanisms in OCD.

Ethics approval: This study was approved by the Research Ethics Committee of the University of Tabriz, Iran (Ethics Code: IR.TABRIZU.REC.1403.087). Informed consent was obtained from all participants, and all procedures complied with the Declaration of Helsinki.

Consent for Publication: All authors are agreed to submit and publish this manuscript.

Consent to participate: Written Informed consent was obtained from all individual participants

included in the study. Consent to publish the author affirms that human research participants provided informed consent for publication of this study.

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