



Effects of Augmented Reality Exposure Therapy Combined with Cognitive Intervention on Cat Phobia

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Abstract

With the advancement of technology, augmented reality has started to appear as an option in exposure therapies. This article aims to examine the effect of ARET (augmented reality exposure therapy) in combination with cognitive intervention on cat phobia and to evaluate the clients' experiences with ARET. The study was conducted with explanatory sequential design with four participants (all women). The quantitative part of the study was conducted as a single case study. Participants were then interviewed to assess their experiences during and after ARET. Our findings suggest that ARET, used in combination with cognitive intervention, is effective in reducing cat phobia, with the exception of physical contact with a cat. ARET can also be used independently of cognitive intervention. In addition, the advantages and disadvantages of ARET assessed by the clients are also discussed. It should be ensured that ARET is widely used in therapy as an important technique that has an advantage for both clients and therapists.

Keywords Augmented reality exposure therapy · Cat phobia · Cognitive behavioral therapy · Specific phobia · Single-subject design

Introduction

Specific phobias (SP) are defined as “marked fear or anxiety about a specific object or situation” (American Psychiatric Association [APA], 2013). The lifetime prevalence rate is determined as 7.4% (Wardenaar et al., 2017) and caused impairment

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in daily functioning (Becker et al., 2007). In DSM-5, SP is defined by four types of phobias: animal phobias, natural environment phobias, blood injection-injury phobias, and situational phobias (APA, 2013) among these four types, animal phobias (or zoophobia) are among the most common phobia subtypes (Eaton et al., 2018).

Although both cognitive and behavioral interventions are used in the treatment of SP, including animal phobias, in vivo exposure is preferred as the most effective treatment (Wolitzky-Taylor et al., 2008). Exposure treatment can be imaginal as well as in vivo (Hecker, 1990). However, the rapidly expanding virtual reality (VR) and augmented reality (AR) technologies have taken their place in the field of psychology and have begun to become an important option in exposure treatment as virtual reality exposure therapy (VRET) and augmented reality exposure therapy (ARET) (Albakri et al., 2022). VR and AR technologies have been used in exposure therapy for many years. While VR was first used in acrophobia by Rothbaum et al. (1995), AR, which is a newer technology compared to VR, was first used for cockroach phobia (Botella et al., 2005).

VRET and ARET have provided solutions to the limitations of traditional exposure therapies; thus, these new technologies have become important treatment alternatives for clinicians and clients. These technologies provide a safe environment for clients, thereby increasing treatment participation among clients who are unwilling to be exposed in vivo (Botella et al., 2009). For instance, despite the prevalence of specific phobias in society, the seeking for treatment rate is known to be limited (Eaton et al., 2018). The unwillingness to face the feared situation or object in real-time may prevent phobic clients from seeking treatment (Öst, 1989). Studies have shown that phobic clients have made their treatment choices in favor of VRET rather than in vivo exposure (Garcia-Palacios et al., 2007). In addition, the technologies of VR and AR facilitate access to situations that are dangerous/difficult to experience in real life or to environments that are difficult to access together with the therapist. In addition, these technologies allow the therapists and clients to work at any time and place and clients may encounter a feared situation or object, such as a cat or an insect, without having to wait (Botella et al., 2004, 2009).

It is stated that VRET has the highest efficacy in anxiety disorders and phobias among psychiatric disorders (Ciešlik et al., 2020). However, ARET is mainly used in animal phobias; it is known to be effective in small animal phobias such as cockroaches and spiders (Suso-Ribera et al., 2019) and butterflies and moths (Abate et al., 2011). Studies show that in vivo exposure, VRET and ARET have similar treatment effects in animal phobias (Suso-Ribera et al., 2019). However, AR technology offers advantages over VR due to some of its technological features. With AR, the object of fear can be brought directly into the therapist's room without isolating the client from the real environment. Since the client is not immersed in a virtual world as in VR, it also offers the opportunity of using their own body. These features also help the user to experience reality at a higher level (Baus & Bouchard, 2014).

Given the advantages of AR over VR and the fact that previous studies have been conducted mainly on small animal phobias (Botella et al., 2005, 2010, 2016), this study aimed to investigate the effect of ARET on cat phobia. Cat phobia as a zoophobia can be defined as an intense and irrational fear from the cats and this irrational fear leads to avoidance of places and circumstances that risk being confronted

with cats (Suárez et al., 2017). A limited number of studies show that traditional exposure therapies are effective in cat phobia (Freeman & Kendrick, 1960; Öst, 1987; Watson et al., 1971, 1972). However, to the best of our knowledge, no study was found on the effectiveness of ARET.

On the other hand, although there are studies showing that adding cognitive interventions adjunctive to in vivo exposure of specific phobias increases the effect of exposure treatment, the results of studies on animal phobias show that cognitive interventions do not contribute to the effectiveness of in vivo exposure (Choy et al., 2007). Therefore, the present study initially aimed to investigate the efficacy of ARET for cat phobia combined with cognitive intervention. Parallel to the main purpose of the study, it is aimed also to assess client's experiences during and after ARET and deeply understand the effectiveness of this new technology. This study is considered important for future researchers and clinicians, as it provides an understanding of the client experience as well as an investigation of the effect of a new technology that is not yet widely used in our country.

Methods and Material

Study Design

The study was conducted with explanatory sequential design described in “which the researcher begins by conducting a quantitative phase and follows up on specific results with a subsequent qualitative phase to help explain the quantitative results” (Creswell & Plano Clark, 2018, p. 237). ARET is a relatively new technique that is not widely used among clinicians, and it is important to determine clients' experiences with this technique during the session, their views on the use of the technique, and its impact, in terms of clinician guidance. Therefore, in addition to the quantitative results, it is anticipated that the qualitative data will provide a deeper understanding of the use and impact of ARET in therapy based on clients' direct experiences.

The quantitative phase of the study was conducted as a single-case study to test the effect of ARET (Barlow & Hersen, 1984). After the quantitative phase was completed, semi-structured interviews were conducted with all participants in order to provide additional data on the quantitative results, determine their experiences during and after ARET, and obtain additional data on its effectiveness in treating cat phobia.

Participants

Participants in the study consisted of four women seeking treatment for their cat phobia ($M=26.6$, $SD=5.22$). The participants enrolled in the study were determined by the following inclusion criteria: older than 18 years old and suffering from cat phobia for at least 1 year. The diagnostic and assessment phase was carried out and videotaped by a clinical psychologist and supervised by a psychiatrist who trained in cognitive behavioral therapy. Participants who had previously received psychological support for the treatment of cat phobia, had an additional psychiatric diagnosis such as major depression and psychosis, and receiving psychiatric/psychological treatment

were excluded from the study. Participants' histories and symptoms of cat phobia are summarized below.

Participant 1 (P1) was a 21-year-old, female, university student. Her fear began after a cat scratched her hand and she feared that the cat would harm her when she was in preschool. After that when she was 8 years old, she accidentally stepped on a cat. Since then, she has been extremely worried about coming in contact with or getting near a cat. The client, who stated that she had a hard time even looking at the picture of a cat, can cry when she contacts the cat, and also said that she was afraid the cat would jump on her, scratch her, or bite her. She suffers from heart palpitations as a physical symptom and has difficulty speaking. When she meets a cat, she changes her way, does not go to cafes in open places, and does not look a cat in the eye or touch it. To pass a place with a cat, someone he trusts must hold the cat. The client meets the criteria for cat phobia.

Participant 2 (P2) is 24 years old, female, and a physiotherapist. Cat phobia started when she was 5–6 years old, but she cannot remember how it happened. Seven years ago, her fear intensified when a cat jumped on her in an open place. When she sees a cat, she always follows it with her eyes and when a cat is in a place, she leaves the location. She reported that a cat is an animal that makes sudden and unexpected movements and there is always a possibility that it can cause harm, so she feels anxious. She has experienced physical symptoms such as palpitations, sweating, and rapid breathing when she has encountered a cat. When she goes to cafes, she wants to sit inside, and when she has to sit outside, she cannot enjoy it at all. She does not go to a house where there are cats. The client, who states that her social life is very limited, meets the diagnostic criteria for cat phobia.

Participant 3 (P3) is 27 years old, female, and a university student. She cannot remember how her cat phobia began, but she states that it has existed since a very young age of about around 3 years. When she encounters a cat, she feels intense anxiety and fear, accompanied by physical symptoms such as palpitations and trembling in her hands and feet. She avoids any place where cats may be found. She stated that she cannot go to cafes in open areas, cannot pass by the trash can, or cannot walk between two cars. When she goes to a friend's house who has a cat, she locks the cat in another room. She thinks the cat will jump on her and hurt her. She states that her life is very restricted and her social environment is also uncomfortable. She meets the criteria for cat phobia.

Participants 4 (P4) is 34 years old, a woman, married, and has one child. Her phobia began when she was 7 years old when a cat jumped on her while she was disposing of the trash. She states that since then she has had problems sitting in open places and cafes. For example, when she encounters a cat in a café, she is so scared that she sometimes gets on the table. When they have to go into houses with cats, they lock the cat in another room. She states that she no longer enjoys meeting a cat in a social setting because of anxiety, and her relationship with her husband has deteriorated. When she is out and about, she needs the presence of someone she trusts. She says that people have made fun of her because she had to walk around with a cat/dog repellent device on her last vacation, and she is very uncomfortable in that situation now. The client, who suffers from symptoms such as freezing and mind-numbing in addition to physical symptoms such as palpitations, believes that the cat will jump on her and cause her harm. She meets the criteria for cat phobia.

Technical Equipment and Software

Microsoft HoloLens mixed reality glasses were used during the tests and therapy. The device, which has a 2.3-megapixel widescreen see-through camera and four environmental detection sensors, allows users to see and perceive the surroundings completely. The HoloLens camera focuses on the side the wearer is looking at. Spatial sound allows the user to hear binaural audio which can simulate spatial effects. The user virtually can perceive and locate the sound of cats during the exposure. Gaze tracking helps the user to bring application focus to whatever the user is perceiving to navigate and explore. Gesture input allows the user to use the “bloom” gesture to pull up a UI navigation menu screen. Thanks to these features, users can select the cat on the application menu and then locate the cat in a suitable place for exposure. Both the body and the basic movement of the cats were modeled using Autodesk Maya and exported in fbx format. The cats can walk, stretch their body, and meow. The user and therapist can manage these actions on the HoloLens.

Measures

Quantitative Measures

Pretreatment Assessment

Beck Depression Inventory (BDI) This scale was used to assess the presence and severity of depressive symptoms. Each item is rated on a 4-point Likert scale and each item with scores ranging from 0 to 3. The range of the total score is from 0 to 63 (Beck et al., 1961). Cronbach Alpha value of the Turkish version is 0.80 (Hisli, 1989).

State-Trait Anxiety Inventory (STAI) It contains 40 items and two separate scales named state anxiety (20 items) and trait anxiety (20 items). Each item is rated on a 4-point Likert scale (1= almost never, 4=almost always) The range of the both of scales' total score is between 20 and 80 (Spielberger et al., 1964). Cronbach Alpha of the Turkish version is 0.87 for Trait Anxiety and 0.86 for the State Anxiety Scale (Öner & Le Compte, 1983).

Treatment Assessment

DSM-5 Severity Measure for Specific Phobia (DSM-5 SMSP) It contains 10 items and is rated on a 5-point Likert Scale (0=never, 4=all of the time) The range of the total score is between 0 and 40 (Craske et al., 2013). Cronbach Alpha score of the Turkish version is 0.79. (Oztekin et al., 2017).

Subjective Units of Discomfort Scale (SUDS) Participants indicated their anxiety level on a scale rated between 1 and 10 (1=no anxiety, 10= high anxiety) (Wolpe, 1969). This measure was used at the beginning of the study and during the exposure,

and also used between all sessions and at the end of the sessions to measure anxiety levels when faced target behavior.

Igroup Presence Questionnaire (IPQ) It contains 14-item and 7-point scales ranging from “complete disagreement” (−3) to “complete agreement” (+3). The questionnaire consists of three subscales named spatial presence, involvement, and experienced realism. (Schubert, et al., 2001). Because the virtual environment is created with augmented reality, only the experienced realism subscale was used in this study to measure how realistic participants found the cat models and AR scenarios.

Qualitative Measure

Interview Form

A semi-structured interview form created by the researcher was applied to the participants. This form includes questions such as how effective ARET is in approaching the target behavior and how much their functionality has improved after therapy, experiences during ARET, and their opinions about using AR in therapy with advantages and disadvantages.

Procedure

Quantitative Phase

Before starting the development of the AR application, ethical approval was obtained from Hasan Kalyoncu University ethics committee (25.10.2019-219/77). After the development of the AR application was completed, it was announced on social media that treatment of cat phobia was carried out using the AR. Four participants who applied were involved in a two-session assessment interview before the treatment.

In the diagnostic interview held in the first session of the assessment, the existence of cat phobia, situations experienced with phobia, frequency, severity and intensity, cognitions and catastrophic interpretations, somatic symptoms, avoidance and safety behaviors, and whether there were comorbid diagnoses were assessed. In the second session of the assessment interview, the fear hierarchy and target behaviors were determined (see Table 1). At the end of the second session, the consent form was

Table 1 Target behaviors of participants

Participant	Target behavior
P1	Be in the same place such as a home, coffee with the cat
P2	Pass by the cat
P3	Sitting in an open place such as coffee, park with the cat
P4	Sitting in an open place such as coffee, park with the cat

signed, they were asked to fill in the scales for the pretreatment assessment, and sessions were concluded.

Three weeks of baseline periods was conducted after assessment sessions. After the baseline was completed, the treatment sessions were started and pretest measurement was taken before the psychoeducation. In order to understand whether the decrease in the anxiety levels of the participants was due to cognitive restructuring or ARET sessions, two participants (P1, P2) sessions were started with cognitive restructuring and others (P3, P4) were started with ARET. In order to understand whether the decrease in the anxiety levels of the participants was due to cognitive restructuring or AR sessions, it was decided to take 3-week baseline measurement between both sessions, but it was increased to 4 weeks because the session could not be started due to the restriction of pandemic.

The level of anxiety towards the target behavior was also measured every week before the started treatment, and the severity of specific phobia was measured at the end of the cognitive intervention and ARET. Post-test was applied 1 week later after the sessions were completed, and anxiety levels were measured at 2-week intervals during the 1-month and 3-month follow-up periods.

Qualitative Phase

After the follow-up period was completed, online, semi-structured interviews of approximately 20 min were held with all participants. Online interviews were recorded and transcribed by the first author.

Treatment

In the treatment sessions, the treatment protocol prepared by the researchers was applied. Treatments and measurements were carried out by the first author between May 2021 and January 2022 and supervised by the third author. The treatment phase is explained under three headings as psychoeducation, cognitive restructuring, and ARET.

Psychoeducation

The psychoeducation session included general information such as anxiety, fight-flight response, avoidance behaviors, exposure, and exposure to AR (Abramowitz et al., 2012; Ball and Otto, 1994; Baños et al., 2002). In addition to the information above, the ABC model and the relationship between emotion, thought, and behavior were explained at the beginning of the CBT session (Bilge et al., 2020).

Cognitive Intervention

Cognitive intervention sessions included cognitive reconstructing and sessions are scheduled for 1 h and three sessions per week. ABC model, automatic thoughts,

and cognitive distortions were explained in the sessions; automatic thoughts were handled with techniques such as pie slice (Türkçapar, 2009). At the end of the first two sessions, it was aimed to reinforce what was learned in the session by giving homework.

Augmented Reality Exposure Therapy (ARET)

Exposure sessions with AR were planned as 1-h and five sessions per week and started from the scenario appropriate to the fear hierarchy of the clients and the cat breed they chose (tabby and black cat). In the first session, the Igroup Presence Questionnaire was used to assess how realistic the participants found the scenarios. In each session, the client was asked how much anxiety she felt with the SUDS and was asked to score between 0 and 10 (the SUDS was graded every 5 min on average), and the scenarios were repeated until the SUDS ratings dropped to at least half. Subsequent to anxiety decreased, the next scenarios were started in accordance with the fear hierarchy.

Data Analysis

Quantitative Analysis

Visual analysis and C Statistic which was used as time series analysis method (Tyron, 1982) were used to analyze single-case study data. Visual analysis, which is an important technique in single case studies, refers to charting data for each participant and interpreting of stability and trends between or within different phases (Lane & Gast, 2014). In the study, obtained data from participants, graphed from baseline to follow-up assessment.

In C Statistic, it is examined whether interdependent measurements in a serially dependent time series data change significantly over time (Tyron, 1982). Significant results ($p < 0.05$) show the positive or negative change in measurements obtained at different times. This change is expressed with “+” when it shows improvement and with “-“ when it shows worsening. Insignificant results ($p > 0.05$) mean horizontally stable trends and mean that there is no difference between the observed measurements (Gorman & Allison, 1996). This method was used to evaluate baseline and trends for the baseline, intervention, and postassessment phases for the fear related to target behavior and severity of the specific phobia. Positive significant trends indicate decreasing fear and severity of cat phobia for all participants (Gorman & Allison, 1996).

Qualitative Analysis

Descriptive analysis was used for the qualitative dataset. In the descriptive analysis, the dataset is organized and interpreted in line with predetermined themes (Yıldırım

& Şimşek, 2018). In this regard, the dataset was transcribed and coded by the first researcher and he listed these codes under potential themes and subthemes.

Results

Quantitative Results

Pretreatment assessment data are given in Table 2; the pretreatment, treatment, post-treatment, and follow-up scores are given in Table 3. The change in anxiety levels and specific phobia severity levels between the baseline and follow-up scores of the participants was not statistically analyzed because the number of participants was small and was explained graphically through descriptive statistics.

Visual Analysis of Fear/Anxiety for Target Behaviors

It was observed that the fears related to the target behavior decreased in general and this decrease was maintained during the 3-month follow-up periods, except for one participant (P2) (see Fig. 1). The significant reduction in participants' fears occurred after ARET, regardless of whether they were involved in the CI or ARET session first.

Visual Analysis of the Severity of Specific Phobia

It was observed that the specific phobia severity levels of the participants also decreased in general, except for one participant (P2), and this decrease was maintained during the 3-month follow-up periods (see Fig. 2). Similar to the target behavior, it appears that the significant reduction in participants' severity of phobia occurs after ARET, regardless of whether they first participated in the CI or ARET session.

C-Statistic

C statistic was used to analyze the stability of the first and second baseline data, trends between baselines, treatments, and follow-up periods (Table 3 and Table 4). Tables were arranged according to study of Botella et al. (2010).

All participants' first and second baseline scores were horizontally stable for both measures ($p < .05$). In the case of P1 and P2, data obtained from SUDS—fear related to the target behavior—first baseline and post-test cognitive intervention scores showed significant trends in the positive direction ($p < .05$). For P1, second baseline and post-test after ARET ($p < .05$) and first baseline and follow-up assessment data also revealed significant trends in a positive direction ($p < .05$). Second baseline and posttest scores after ARET were horizontally stable for P2. This finding can

Table 2 Scores obtained before, during, and after the treatment

	Pre-treatment	Post-CI	Post-ARET	1 month FU	1 month FU	3 months FU	3 months FU	3 months FU	3 months FU	3 months FU
P1	SUDS	10	9	5	6	6	6	6	6	6
	DSM-5 SMSP	12	16	10	6	8	8	8	8	7
P2	SUDS	8	7	7	7	7	7	7	8	8
	DSM-5 SMSP	18	19	14	21	20	20	20	20	20
P3	SUDS	9	4	4	4	4	5	7	5	4
	DSM-5 SMSP	17	9	9	8	7	7	7	8	10
P4	SUDS	8	4	1	2	1	2	0	0	2
	DSM-5 SMSP	27	2	4	19	6	0	5	0	14

CI, cognitive intervention; DSM-5 SMSP, DSM-5 Severity Measures of Specific Phobia; FU, follow-up; Post-ARET, post-test after ARET; Post-CI, post-test after cognitive intervention; SUDS, Subjective Units of Distress Scale

Table 3 C-Statistic results of SUDS for target behavior and DSM-5 SMSP at baseline, between baseline and post treatment/follow-up period for CI onset

Participant	Measure	C-Statistic BL	Direction	Trend	C-Statistic BL	Direction	Trend	C-Statistic BL	Direction	Trend	C-Statistic BL-FU 2	Direction	Trend
P1	SUDS (Fear of Target Behavior)	0.00	Horizontal	Trend	0.733*	Positive	Horizontal	0.851*	Positive	Trend	0.962*	Positive	Trend
	Severity Measure of Specific Phobia	0.464	Horizontal	Horizontal	0.469	Horizontal	Horizontal	0.407	Horizontal	Horizontal	0.788*	Horizontal	Horizontal
P2	SUDS (Fear of Target Behavior)	0.00	Horizontal	Trend	0.854*	Positive	Horizontal	0.364	Horizontal	Horizontal	0.982*	Horizontal	Trend
	Severity Measure of Specific Phobia	0.25	Horizontal	Horizontal	0.642	Horizontal	Horizontal	0.375	Horizontal	Horizontal	0.072	Horizontal	Horizontal

Positive direction is pointed that decreasing fear related to target behavior and severity of specific phobia

BL, first baseline; 2. BL, 4 weeks baseline period after cognitive intervention; PT ARET, post-test after ARET; PT-CI, post-test after cognitive intervention; FU 2, 3 months follow-up; P, participant

* $p < .05$; ** $p < .01$

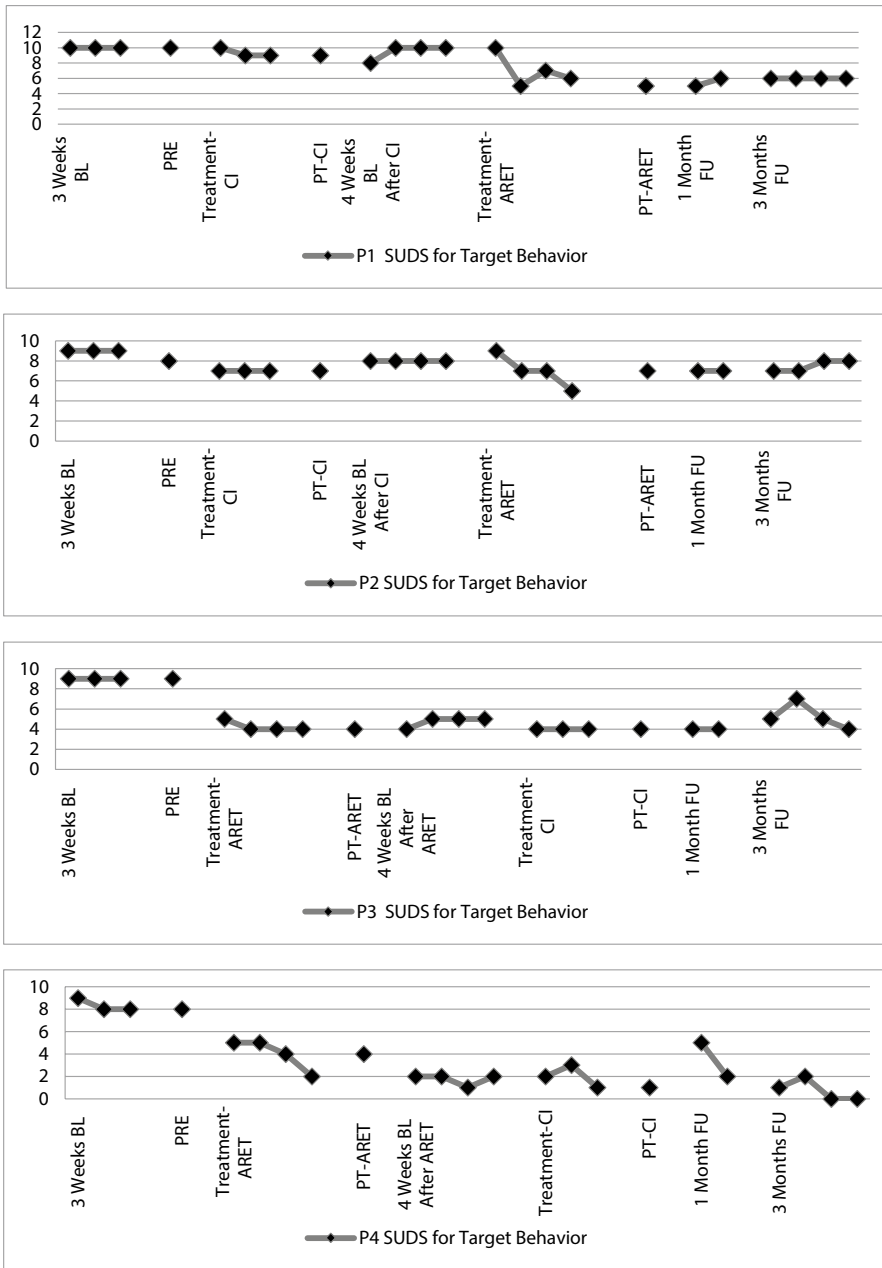


Fig. 1 Scores related to fear/anxiety about target behavior reported by participants between baseline and follow-up period. BL, baseline; CI, cognitive intervention; FU, follow-up; PRE, pretreatment; PT-ARET, post-test after ARET; PT-CI, post-test after cognitive intervention; SUDS, Subjective Units of Distress Scale

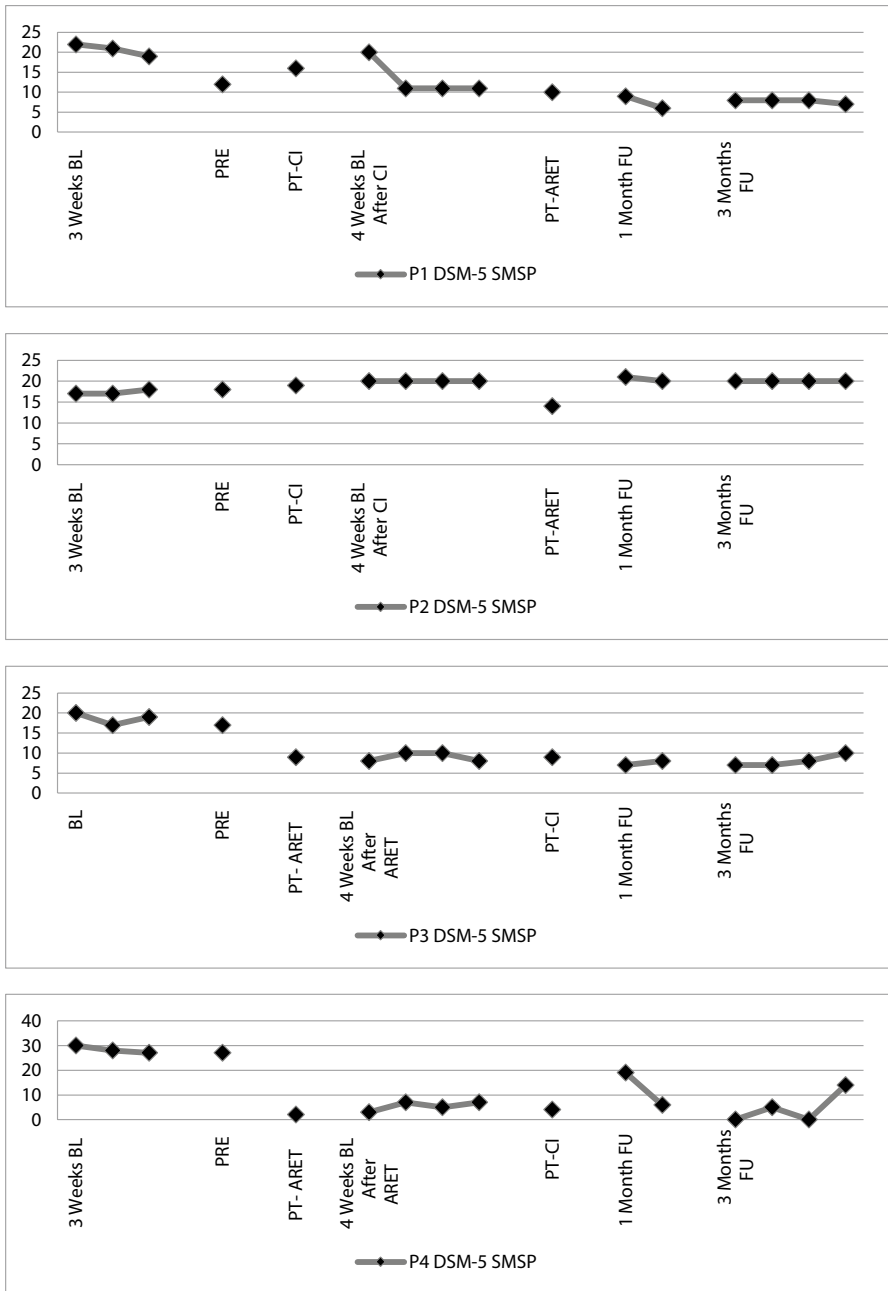


Fig. 2 Scores related to DSM-5 Measures of Severity of Specific Phobia reported by participants between baseline and follow-up period. BL, baseline; DSM-5 SMSP, DSM-5 Severity Measures of Specific Phobia; FU, follow-up; PRE, pretreatment; PT-ARET, post-test after ARET; PT-CI, post-test after cognitive intervention

be interpreted as there is no additional change after CI, although a decrease was observed during ARET according to visual analysis. However, first baseline and follow-up assessment data also revealed significant trends in a positive direction ($p < .05$).

Data obtained were severity of specific phobia baseline, treatment, and follow-up assessment scores which revealed significant positive direction for P1 ($p < .05$) and is horizontally stable for P2.

As seen in Table 3, in the case of P3 and P4, results obtained from SUDS—fear related to the target behavior—first baseline and posttest scores after ARET sessions data showed significant trends in the positive direction ($p < .05$). Second baseline and posttest scores after CI were horizontally stable for both P3 and P4. This finding can be interpreted that a significant change (decrease in fear) was revealed after ARET and there is no additional change after CI. On the other hand, first baseline and follow-up assessment data also revealed significant trends in a positive direction for P3 and P4 ($p < .05$).

The severity of specific phobia for P3 and P4 showed significant positive direction for only baseline, treatment, and follow-up assessment scores ($p < .05$).

Qualitative Results

As a result of the qualitative analysis, four main themes were determined: treatment process, treatment outcomes, and advantages and disadvantages of ARET. Themes and sub-themes related to each main theme are listed in Table 5. In addition, the statements of the participants about the themes and subthemes are given below.

Treatment Processes

This theme is about how the participants' experiences (facing with the cat) in the therapy process are similar to their real-world experiences and how they benefit from the ARET process in reaching the target behavior. This theme contains two sub-themes, realism, and factors that help achieve target behavior.

Realism Participants' experiences during ARET appear to be similar to their real-life experiences. In general, the participants stated that although they knew that they would face a virtual cat, they reacted as if they had faced a real cat. For example:

Because at that moment, I knew, yes, there was, but I was afraid when I approached because I convinced myself that it was real. If I hadn't convinced myself it was that way, I wouldn't have made any progress. ...In fact, sometimes I couldn't get too close, I was afraid, it was real, but it was a safe fact for me. (Participant 1)

Table 4 C-Statistic results of SUDS for target behavior and DSM-5 SMSP at baseline, between baseline and post-treatments/follow-up period for ARET onset

Participant	Measure	C-StatisticBL	Trend	Direction	C-StatisticBL-PT-ARET	Trend	Direction	C-Statistic2. BL-PT-CI	Trend	Direction	C-StatisticBL-FU2	Trend	Direction
P3	SUDS (Fear of Target Behavior)	0	Horizontally stable	Positive	0.836*	Trend evi- dent	Horizontally stable	0.466	Horizontally stable	Horizontally stable	0.815*	Trend evi- dent	Positive
	Severity of Specific Phobia	-0.388	Horizontally stable	Positive	0.461	Horizontally stable	Horizontally stable	-0.125	Horizontally stable	Horizontally stable	0.899*	Trend evi- dent	Positive
P4	SUDS (Fear of Target Behavior)	0.25	Horizontally stable	Positive	0.797*	Trend evi- dent	Horizontally stable	0	Horizontally stable	Horizontally stable	0.788*	Trend evi- dent	Positive
	Severity Measure of Specific Phobia	0.464	Horizontally stable	Positive	0.423	Horizontally stable	Horizontally stable	-0.289	Horizontally stable	Horizontally stable	0.654*	Trend evi- dent	Positive

Positive direction is pointed that decreasing fear related to target behavior and severity of specific phobia
 BL, first baseline; 2. BL, 4 weeks baseline period after ARET sessions; PT ARET, post-test after ARET; PT-CI, post-test after cognitive intervention, FU 2, 3 months follow-up; P, participant
 * $p < .05$; ** $p < .01$

Table 5 Themes and sub-themes

Themes	Sub-themes
Treatment process	Realism Factors that help achieve target behavior
Treatment outcome	Effects on target behavior Increased functioning
Advantages	Safe environment Increases adherence to therapy Opportunity to work whenever want Controlling feared object Getting rapid outcome Lack of touch Preparing in-vivo exposure Coexistence of virtual and real environment
Disadvantages	Cybersickness Hardware weight Realism Difficulty of use Limited scenarios Lack of remoted control

I think I felt like I had encountered a real cat because it was bothering me as it came towards me. When I first started, I thought I wouldn't be afraid, I wondered if it would have any effect on me, because I knew it was not real. But I really realized that this bothers me again, it means that I could actually find it real. ...I had such prejudice at first. (Participant 2)

At first, I said 'this is virtual glasses, not a real cat', but later on, you immersed it, you don't see it as a virtual eye. My pulse was rising, I was pulling my feet, and startling (Participant 3)

It was obvious that the first cat's (black cat) eyes were artificial. The other cat we worked with was more realistic. But still the brain perceives it as real.I think it was similar to real life, it was real, it was pretty big. (Participant 4)

Factors That Help Achieve Target Behavior *All participants stated that the most helpful factor in achieving the target behavior was exposure to a cat with AR. Two participants (P3 and P4) also stated two additional factors. First, they try to apply their experiences in the session to their daily lives. The second is that their experiences with the virtual cat shape their beliefs about what will happen or how they might react when they encounter the real cat.*

It was more effective to live and experience the moment as if the cat was there, rather than proceeding purely as a conversation. Maybe if I hadn't experienced it that way at that moment, I would have been more afraid of experiencing it

in real life. Because in the session, I was able to get closer to the cat gradually, step by step, and thus I was able to make progress in real life. (Participant 1)

I thought it might have helped because I was exposed. If we had worked differently, I probably wouldn't have been able to expose myself in real life, but since I've been exposed in the session, at least I can pass by the cat. (Participant 2)

I used to refuse to come face to face with a cat. With AR, I allowed myself to be side-by-side with a cat, exposed, and roaming very close, albeit virtually. When this happened, I experienced that nothing really happened, that the purpose was not to harm me, and these somehow worked for me and I continued in my social life. It is no different from a virtual cat, in fact, I have experienced that cats on the street will not harm me when they pass by, and that it is very normal for us to be in the same environment. (Participant 3)

There was a cat that was approaching me to step by step somehow, even though it was a simulation. It was an experience I will never forget. Actually I had a concern there at first, but every time you asked if you wanted to look a little more slowly, would you like to get a little closer, that anxiety lessened. I immediately tried to apply what I learned in sessions to my daily life: I can stay when the cat comes, I don't need to stand up, if I say go away, it can go, it won't hurt me as long as I don't step on its tail. (Participant 4)

Treatment Outcomes

Treatment outcomes were discussed under two sub-themes: The effects on target behavior and increased functioning.

Effects on Target Behavior Under this sub-theme, the effectiveness of ARET in achieving the target behavior of the participants was included. It was seen that all participants were able to perform the target behavior. However, in general, the participants continued to be distressed when contacted or touched by the cat. For example:

I'm pretty relieved. Both I and the people around me are now quite surprised when they see the change in me. Everyone is astonished that I was able to pass by a cat. I made great progress against cats, so I can say that it was perfect for me. My fear of black cats is a little higher, but it has lessened a bit. Other than that, it made a lot of difference, I didn't expect it to make that much difference, I couldn't trust myself that much. (Participant 1)

I can sit outside right now. It's okay if the cat passes by, but if it contacts directly physically, that is a problem. But normally even with that, I was jumping out of the chair. Right now, I still can't touch it, but for example, if the cat doesn't

come towards me in closed places, I can stand a little longer, I couldn't even stand in the open places normally. (Participant 2)

There were genuine positive developments, but they did not go away completely. I can be in the places where there is a cat, but I cannot make a close contact. It must be locked. (Participant 3)

For example, a cat came to our cafe recently, it was a very big cat, I said go away, I sent the cat, I closed the door. I couldn't have done this in the past. ...For example, a few months ago the weather was nice, I ate and drank very easily in an open space, there was a cat, there were kittens, but I sat and drank very easily. My anxiety goes like this: I startle when I walk under my feet in my seat, but I don't scream and stand on a table and I can continue what I'm doing. (Participant 4)

Increased Functioning After ARET, all participants stated that they were able to perform many behaviors that they could not do before (passing by a trash can, sitting in a cafe, passing by a cat, not changing their way when there is a risk of facing a cat, not thinking anymore if there is a cat while going somewhere, touching to a cat), and their functionality in their social life increased significantly. Examples of the statements of the participants are given below.

After I came here, I touched the cat a few times, but the cat was a white cat. I was in the same room with this cat I touched, we sit in the same room, and it walked around me, I didn't want it to touch me, so I gathered my feet, but I didn't feel uncomfortable when it passed under the chair. I was able to stay alone in the kitchen with the same cat again, I didn't think if it would jump on me. For example, in the past, when I was sitting in a cafe, if there was a glass pane in between us, even if a cat passing behind the pane it would bother me. I'm not that bothered by his voice anymore, for example, he comes to the corridor of the dormitory from time to time. If I heard his voice, I couldn't stay in the room calmly, I would think that if the door was opened, he would come in, but now I am not disturbed (...)I don't change my way anymore, when I see a cat, I can pass by it. Once or twice, but the cats are frightening, I'm scared, I startle naturally, but other than that, I can pass by them. When I pass by trash cans, I don't think about whether a cat can jump on me anymore. (Participant 1)

I think it has an impact on my social life. Because normally when I was sitting in a cafe, if there was a cat there, my mind was always busy with the cat and I couldn't adapt to the environment, and conversation I was in. I was either going to leave there or sit with a busy mind. At least I can establish that balance right now. Normally, when I saw him walking on the street, I would change my way, now at least when I pass by, it's not a problem for me, and my anxiety level has decreased. (Participant 2)

I used to think about whether there is a cat there when I go somewhere, now I don't think about it at all. (...) Now I can walk the roads even if there are cats. But before the therapy, I used to call my cousins and friends to see what I could do if a cat came out. For example, I go to the course, they put a food bowl for cats in front of the building, naturally there are many cats, but I can still go inside. These are huge steps for me. (...) of course, I don't want to be in the same environment with a cat, I don't prefer it, but meeting you has definitely improved my quality of life. I have stepped out of that restricted world, I feel as if I have entered a larger space. The fear was limiting everything, I feel freer (Participant 3)

Actually, from time to time, of course, I get startled. For example, as my first cat phobia came out, a cat jumped out of the trash, I was startled again, but I could continue on my way, it jumped right in front of me, but I did not run away, I did not shout. (...) At first, I do not exaggerate, if there is a cat in the environment, I would go to the table, stand on the chair, scream or if I was in lunch or dinner, I would not eat my food. Life had stopped for me. I remember right when we were working with this augmented reality, we went out with our dietitian for a morning coffee, the cat of that cafe was chasing us, for example, I kept myself calm, I didn't get up, I just remember saying the go away and it was gone. And even our dietitian was surprised. As someone who had seen my previous version, she saw the difference." (Participant 4)

Advantages of ARET

Based on their own experiences, the participants indicated that there were several advantages to the use of AR technology in therapy. These advantages were determined as sub-themes such as safe environment, increases adherence to treatment, controlling the feared animal, opportunity to work whenever want, preparation for in vivo exposure, getting a rapid outcome, and lack of touch.

Safe Environment Among the advantages of ARET, mentioned by the three participants, is that AR provides a safe environment for clients. Clients feel safe during the sessions as they have control of the cat's movements. Participants used the following statements:

I think the most important thing is safety. Knowing the cat will act to my commands gives me much confidence. If I at least know the next step, I feel comfortable and can act accordingly. (Participant 1)

I might not feel very safe if it was a real cat, but at least I can feel more secure in session. (Participant 2)

You are exposed, but you also feel safe. Otherwise, I wouldn't be able to be alone with the cat, but I think I have made a lot of progress with augmented real-

ity. In real life, I would never let a cat get this close to me. It is also an advantage that we have the opportunity to quit whenever we want. (Participant 3)

Increased Adherence to Treatment One participant stated that an essential advantage of ARET is that a safe environment increases treatment participation and used the following statement.

I can feel more confident and I think it provides for me more continuity to therapy at this point. Maybe if we had a typical therapy, I wouldn't have been able to come for so long, maybe because of my discomfort. I think I'm at a level where I can't work with a real cat myself. I would come once and not a second time, if there was a real cat. (Participant 2)

Opportunity to Work Whenever Want One participant stated that because ARET is ready to use at any time, reasons such as the client not being able to come to therapy or postponing the session will not be a problem. The participant used the following statement:

It can be applied at any time, which is an advantage. Time etc. is not a problem. For example, the person may be late for therapy or not present that day or something else. (Participant 4)

Controlling a Feared Object When working with a real cat, it is not possible to make the cat meow whenever the therapist or client want, and walks up to the desired distance. However, with ARET, it is an advantage to be able to command the cat according to the client's needs in the therapy and to be able to move the desired movements at the desired time. One participant used the following statement regarding this:

I think not every therapist or someone who works in a hospital setting can't possibly work with a real animal. Even if it works, it would be very difficult to control the real animal. Let's say you brought a real cat, it's a cat, and it might run away from you, and it may want to scratch clients all of a sudden. I think it is an advantage for us to have controllable animals here. I think it's a great invention. (Participant 4)

Getting a Rapid Outcome According to a participant's statement below, with ARET, the time to approach the real cat was shortened, which was an advantage in getting a faster outcome from the therapy.

A living cat, after all, is unpredictable what to do at that moment. For me, getting closer to a real cat step-by-step would be in very advanced sessions, but I

think augmented reality shortened the number of sessions It would have taken longer for me to get close to the cat in normal sessions. However, this way I could get closer to it in a shorter time. I think it was very economical in terms of time. (Participant 1)

Lack of Touch The fact that AR technology does not allow contact is an advantage for a client who does not like to touch animals. The participant's statement is given below:

I don't like touching animals, the absence of it, the absence of contact is an advantage for me. (Participant 3)

Preparing for In Vivo Exposure Experiences in the virtual environment with AR prepare clients for in vivo exposure. The participant's statement is as follows:

Encountering a real cat was something that prevented me from working out the phobia, but now that I'm working with augmented reality, I can work with a real cat as well, which I normally wouldn't be able to do. (Participant 2)

Coexistence of the Virtual and Real Environment The fact that AR does not isolate people from the real environment is stated as an important advantage that increases realism. One participant expressed her experience as follows:

I think the merging of real and virtual environment was very good. If it was just virtual reality, it might not be as effective. (Participant 1)

Disadvantages

The disadvantages of ARET were stated under sub-themes as cybersickness, hardware weight, the difficulty of use, realism, limited movements, and lack of remote control.

Cybersickness AR hardware causes cybersickness symptoms such as headaches and nausea in some participants. Two participants said that they experienced the following symptoms.

There was a bit of a headache. (Participant 1)

It caused headaches a lot, I don't know if it happens to everyone. I had a headache and nausea. (Participant 3)

Hardware Weight Using heavy equipment is a disadvantage for the two participants. Participants stated that:

The glasses could have been a little lighter in terms of weight. (Participant 1)

Maybe it could be a lighter pair of glasses. Something that discomforted and bothers our head. If it was something like the glasses we normally use... (Participant 4)

Difficulty of Use One participant, who stated that the difficulty of using AR technology is a disadvantage, used the following statement:

If there is a problem with the glasses at that moment, tapping a different button can be very irritating. (Participant 3)

Those touch keys and operation are not very easy, but since you professionals use it, it is not a problem. (Participant 4)

Realism According to two participants, clients' knowing that the cat they will meet is virtual and an animated cat, no matter how realistic it is, is a disadvantage for therapy.

"It seems to me that it is not a virtual environment, but I think that most people may not exhibit the behavior that they do when they meet a real cat because they know that it will be virtual." (Participant 3)

"It was obvious that the first cat's eyes (black cat) were artificial. The other cat we worked with was more real. But still the mind perceives it as real." (Participant 4)

Limited Scenarios Two participants stated that the scenarios used in the application could be enriched. For example:

A few more scenarios could have been added to the cat's movements, it was walking, it was meowing, a few other things could have been added. (Participant 1)

The cat jump and, bounces. This cat wasn't doing it, it could actually be more advantageous if it was developed a bit more. (Participant 3)

Lack of Remote Control One participant stated that it would be beneficial for ease of use to control the commands given in the application by the therapist.

For example, if there was a remote control that only the therapist uses. (Participant 4)

Discussion

The main purpose of this research is to examine the effects of ARET, which is used in combination with CI, on cat phobia. In line with this firstly, the effect of the treatment was examined experimentally, and then qualitative interviews were conducted with all the participants to examine the findings in-depth. Our findings suggest that ARET combined with CI is an important technique that increases the quality of life with effects on cat phobia (except physical contact), which has significant advantages for clients. Results indicate that fears related to the target behavior for all participants and the severity of phobia in three of four participants decreased, and this decrease was maintained during the follow-up periods.

These findings are in line with the results of studies examining the effects of advanced technologies such as AR and VR on different types of phobia (Abate et al., 2011; Gujjar et al., 2019; Juan et al., 2004; Suso-Ribera et al., 2019). Moreover, significant reductions in phobia severity and fears related to target behavior occurred after ARET sessions, regardless of whether they were involved in the CI or ARET session first for three participants. These findings support research results indicating that exposure is more effective than cognitive interventions in the treatment of phobia (Wolitzky-Taylor et al., 2008). In other words, exposure with ARET alone can be used in treatments for phobias.

The qualitative interviews support the results of the quantitative analyses. All of the participants stated that they were able to perform the target behavior they determined at the beginning of the therapy in general. However, there are some situations in which they experience difficulties. For instance, clients still worry about coming into physical contact with a cat and avoid this situation. It would seem related to the fact that AR does not allow contact as a technology. Although the clients are distressed to face some situations, after the treatment they can perform many behaviors that limited their lives before, for instance, walking by the trash, staying in the same room with a cat, passing through cars, not thinking about whether there is a cat where they go, etc. As a result, an improvement in their quality of life is observed, as well.

Remarkably, a participant (P2) whose anxiety level was not observed to decrease in quantitative analysis reported that she was able to perform the target behavior in qualitative interviews. This finding is compatible with the views of third-wave cognitive therapies in which the relationship with unwanted emotions is changed instead of interventions aimed at reducing anxiety (Hayes, 1994). For instance, it is shown that the Acceptance and Commitment Therapy intervention supported by VR for acrophobia reduces their avoidance behaviors and enables them to behave in line with their values (Çelik et al., 2020).

Exposure was the most important factor that helped reduce the severity of phobia and fear and achieve the target behavior. In other words, approaching the feared situation step by step in a safe environment is the most important factor in the effectiveness of ARET. The second factor is that some clients try to transfer what they learned during the session to their daily lives. ARET and VRET help clients to increase their self-efficacy, which makes it easier for clients to apply what they

have learned in the session in real life (Botella et al., 2009). It is thought that ARET strengthens the belief that “because of I faced with the cat in the session, I can succeed it in real life” when clients transfer their experiences during the session to their daily lives. Indeed, qualitative findings indicated that some clients experienced cognitive changes associated with the ARET session, which helped them experience encountering a real cat. Nevertheless, since cognitive interventions were used in combination and generally a remarkable change occurred after ARET, it is difficult to distinguish whether this is really due to ARET or cognitive interventions. It is desirable that future work use only ARET for cat phobia.

Determining the advantages and disadvantages of this new technology in therapy is crucial for both clinicians and clients. The safe environment provided by ARET is the most critical advantage of this research, as indicated by all of the participants. The fact that the movements of the cat are under the control of the client makes the client feel safe. The advantage of ARET in increasing treatment participation is also thought to be related to this sense of security. Indeed, studies show that participants prefer VR over in vivo exposure (Garcia-Palacios et al., 2007). All the participants who participated in the treatment stated that they did not feel ready to be in vivo exposure therapy; and therefore, they did not apply for treatment until this time. ARET was evaluated by one participant as a preparatory phase for clients who were not ready for in vivo exposure. In this regard, it is thought that AR technology will provide a big advantage in terms of increasing the applications to treatment and ensuring their continuity.

An important advantage of ARET, which is thought to be related to the sense of security, is that the client/therapist is in control of the movements of the phobic object. In this way, therapy can be performed by giving the desired commands at the desired time and place. It is difficult for a real cat to act on the commands of the therapist or clients and to adjust the distance from the client. On the other hand, in ARET, the stimulus intensity and frequency can be adjusted according to the client's needs which is a great advantage of ARET.

The fact that the clients are not isolated from the environment they are in is stated as an advantage in terms of increasing realism. In other words, this advantage of AR over VR (Baus & Bouchard, 2014) was also reported in this study. It is thought that choosing ARET instead of VRET when studying animal phobias will increase the sense of reality and thus the success of treatment. In this study, the participants stated that they experienced the sense of reality at a high level and gave similar physical, behavioral, emotional, and cognitive reactions in therapy to their experiences when encountering a real cat. In addition, although lack of physical contact in AR technology is considered a disadvantage, according to these research findings, it can be seen that it can be an advantage for clients who do not want to contact the phobic object. However, when the treatment results are considered as a whole and the clients still have trouble coming in contact with a cat, it can be said that it would be more appropriate to consider the lack of physical contact in AR technology as a disadvantage.

The disadvantages obtained from qualitative interviews can be examined in two ways: the limitations of the application used and arising of AR technology. Cybersickness, the weight of AR glasses, the difficulty of using touch commands, and the possibility of reducing realism by knowing that the cat is virtual, although perceived as realistic, are the disadvantages of AR technology. However, in the applications

to be developed, the richness of the scenarios and the therapist's ability to give the commands remotely will prevent the disadvantages arising from the application.

In summary, our findings imply that it is important for use of the ARET to become widespread in clinical practice. Depending on the client's needs and particular situations, this new technology can be used as an alternative to other therapy approaches in treating specific phobias. Furthermore, because of the advantages of this technology, it would seem the dissemination of ARET would increase the rate of patients who do not apply to the clinic because they do not want to be exposed to real animals such as cats. On the other hand, one of most important obstacles in accessing this new technology in clinical practice is expensiveness. VR would be a preferable alternative to AR in therapy because of lower costs of devices while it is thought that alternative devices of AR to be produced with the development of technology would alleviate this obstacle. However, while developing ARET applications, enriching the scenarios, providing remote control, and using graphics that will increase realism are important to minimize the other disadvantages except costs that may arise from the application.

Like previous studies, this study has strengths and limitations. The fact that this research was carried out with a mixed design helped to have in-depth knowledge of the effect of ARET and its use in therapy that strengthened the quantitative findings. In addition, to the best of our knowledge, this is the first study applied in our country. An essential limitation of this study was the small sample size. Investigations in future work need a large sample size, and an experimental study with a control group. The second limitation is the number and structure of sessions. Sessions are limited to three CI and five ARET sessions. For research on the results to be obtained in a longer or shorter time and using only ARET is desirable for future work. Thirdly, there are very basic scenarios in the ARET application. Enriching the scenarios and adding different movements to the cat will enhance the sessions. Fourthly, the inclusion of questions about the effects of cognitive interventions in qualitative interviews is another limitation. Although the decrease in the anxiety levels of the clients occurred generally after the ARET session, the effect of CI interventions on the change is not known in depth. Fifthly, coding was done only by the first researcher. The last limitations are related to the measurement tools. IPQ and SUDS have no Turkish validity and reliability. Phobia severity was evaluated only with the DSM-5 SPSM total score. Using the Behavioral Avoidance Test and evaluating changes in catastrophic thoughts about feared situations warrant for further investigation.

Conclusion

In conclusion, it can be said that ARET is a technique that reduces the severity of cat phobia, and significantly increases the quality of life by helping clients perform many behaviors that they could not accomplish before, except for contact with the cat. Moreover, it would seem only to be used as ARET without being combined with CI. Virtual and augmented reality tools are not widespread in many countries, such as Turkey, where this study took place, due to the technology's expense. However, this technological approach has many advantages compared to traditional therapies,

for both therapists and clients, and should be considered for use in numerous clinical environments.

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Declarations

Conflict of Interest The authors declare no competing interests.

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