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Efficacy of Virtual Reality Exposure Therapy for Driving Phobia: A Multiple Baseline Across-Subjects Design

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A multiple baseline across-subjects design was used to examine the efficacy of virtual reality exposure therapy (VRET) to treat driving phobia. The treatment consisted of 8 weekly graded VRET sessions. Using self-monitoring and interview measures, treatment efficacy was examined across 5 participants. Three participants had reductions in driving phobia symptoms, while there was little change in the remaining individuals. VRET did not result in an increase of actual driving frequency for any of the participants. Some gains were lost at the 1- and 3-month follow-up, particularly for the participants who showed weaker treatment responses. Four individuals completed the 1-year follow-up and their symptoms remained largely unchanged. Given the modest treatment outcome and lack of generalization to actual driving behavior, VRET may be most useful as a supplement or preparatory intervention for in vivo exposure, rather than a stand-alone intervention.

Several studies have shown that virtual reality exposure therapy (VRET) is a promising medium for administering exposure therapy for specific phobias. VRET provides controlled environments for people to be exposed to and interact with realistic computer-generated feared stimuli until the fear diminishes. A number of case studies have used VRET to treat a range of phobias including acrophobia (e.g., Rothbaum et al., 1995), flying phobia (e.g., North, North, & Coble, 1997), spider phobia (Carlin, Hoffman, & Weghorst, 1997), and claustrophobia (e.g., Botella et al., 2000). Controlled studies have shown that VRET resulted in better outcomes than wait-list comparison groups for acrophobia (Rothbaum et al., 1995) and agoraphobia (North, North, & Coble, 1996). VRET is equally effective as standard in vivo exposure in the treatment of flying phobia (Rothbaum, Hodges, Smith, Lee, & Price, 2000). Other

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recent comparative trials to treat flying phobia (Mühlberger, Herrmann, Wiedemann, Ellgring, & Pauli, 2001) and acrophobia (e.g., Emmelkamp, Bruynzeel, Drost, & van der Mast, 2001) have also found favorable results.

Although driving phobia is a relatively common and chronic condition, there has been relatively little treatment research on this disorder (e.g., Kuch, Swinson, & Kirby, 1985). However, the positive findings of VRET for other specific phobias suggest that it might be suitable for driving phobia. This treatment medium may also have specific advantages in treating this type of phobia over other exposure-based therapies. In contrast to in vivo exposure (e.g., driving on public roads), VRET provides greater standardization and control of the exposure. It may be particularly effective for repeated exposure to driving situations that are time-limited, difficult to control, and unpredictable (e.g., merging onto a freeway, driving in a rainstorm at night). Given that the treatment occurs within the clinician's office, it may also reduce safety risks and embarrassment that may be associated with in vivo driving. Furthermore, some individuals may experience such intense fear of driving that they feel unable, or refuse in vivo exposure therapy. Clients may find VRET to be a less threatening treatment than in vivo exposure, yet more realistic than imaginal exposure.

A pilot study (Wald & Taylor, 2001) used a single case (AB) design to treat an adult female with a long-standing driving phobia with VRET. The design included a 7-day baseline phase followed by 3 treatment sessions using a standardized treatment protocol. Phobic-related symptoms decreased from the pretreatment assessment, and gains were maintained at 1- and 7-month follow-up assessments. The purpose of the current study was to conduct another study on the efficacy of VRET to treat driving phobia using a multiple baseline across-subjects design. It was hypothesized that VRET would reduce driving anxiety and avoidance symptoms between pre- and posttreatment assessments. It was also expected that the participants would no longer meet *DSM-IV* criteria (American Psychiatric Association, 2000) for specific phobia, situational type (driving), following treatment. Maintenance of treatment effects was expected at 1-month, 3-month, and 1-year follow-up assessments.

Method

Participants

Inclusion criteria were as follows: (a) adults (over 18 years old) with current diagnosis of specific phobia (driving) as the primary disorder (most severe) using *DSM-IV* criteria; (b) possession of a valid driver's license and access to a motor vehicle; (c) fluency in written and spoken English; and (d) signed, informed consent. Exclusion criteria included: (a) a history of neurological, vestibular, or visual disorders; (b) high simulator sickness susceptibility as determined by the Motion History Questionnaire (Kennedy, Fowlkes, Berbaum, & Lilienthal, 1992); (c) receiving concurrent psychological treatment; and (d) taking psychotropic medication.

Participants were recruited through community and media advertisements. Ten people were given the Structured Clinical Interview for the *DSM-IV* (SCID-IV; First, Spitzer, Gibbon, & Williams, 1996). Seven individuals (P1–P7) met current criteria for specific phobia, situational type (driving). None met criteria for a concurrent disorder, except for P3, who also met criteria for panic disorder with agoraphobia (in partial remission) and alcohol dependence (in full remission). None had sought previous treatment for the driving phobia.

Out of the seven individuals who entered the study, five (P1–P5) completed the treatment. The only male participant, P6, withdrew before the pretreatment assessment was completed because he felt that the driver simulator lacked realism. The other individual (P7) withdrew after the first session, as she was not able to arrange transportation to attend the treatment sessions. The five participants (P1–P5) who completed the treatment also received 1- and 3-month follow-up assessments. Four participants (P1, P3, P4, and P5) completed the 1-year follow-up assessment.

Information about each participant's driving history (e.g., onset and development of the driving fear, driving experiences) was obtained at the pretreatment assessment using a modified version of the Driving History Interview (Ehlers, 1990). The interview results for the five participants who completed treatment are summarized below.

Participant 1. P1 was a 37-year-old married Caucasian female who worked as a nurse clinician. Onset of her driving fear began at age 16 when she was learning to drive. After obtaining her license that year, her fear of driving gradually lessened and she was able to regularly drive without significant distress. Her fear returned at age 23 when she was involved in a motor vehicle accident. She began to avoid driving after the accident and had not driven a vehicle for the past 14 years. She attributed the onset of her driving fear to "traumatic experiences," "observing others who are afraid to drive" (her mother and mother-in-law), and "having her driving skills criticized" by her father as she was learning to drive.

Participant 2. P2 was a 46-year-old married Caucasian female who worked as a bank manager. Onset of her driving fear began as she learned to drive at age 21. She began to avoid driving shortly after she received her driver's license, and has remained fearful of driving for the past 25 years. P2 had never been involved in a car accident but described a few serious "close calls." At the time of the study, she was only able to drive in a limited number of situations (e.g., familiar low-traffic volume areas). She believed that "traumatic experiences," "not enough training," and "observing others [her mother] who are afraid to drive" were the main factors that contributed to the fear onset.

Participant 3. P3 was a 57-year-old single South Asian female who worked as a salesperson. Onset of the fear began when she learned to drive at age 17, which was further exacerbated after being in two motor vehicle accidents as a passenger at ages 18 and 22. During her 20s her driving license expired and

she did not attempt to drive again until age 30. At that time, she completed several driving lessons and re-obtained her driver's permit. Her fear gradually returned over the next year after she witnessed a serious motor vehicle accident. She has since been able to drive in limited driving situations (e.g., rural areas). Approximately 3 years ago, P3 obtained employment in a position that required her to drive in the city. Gradually, her inability to drive interfered with work and she became increasingly distressed. P3 indicated that the three most important reasons that contributed to the driving fear were "traumatic experiences," "being a generally anxious person," and "information about the dangers of driving."

Participant 4. P4 was a 46-year-old married Caucasian female who was employed as a college instructor. She learned to drive at age 31 and felt moderately afraid when she first started to drive. Although the driving fear abated somewhat with practice, P4 remained very concerned about her driving skills. She rarely drove over the next several years, and by age 44, she was only able to drive in limited areas in the city. P4 believed that information about the "dangers of driving," "not enough training," and "heredity (genes)" were the primary causes of her driving fear. She reported no history of motor vehicle accident involvement.

Participant 5. P5 was a 38-year-old married Caucasian female who owned her own business. She obtained her driver's permit at age 16 and she recalled feeling quite afraid while she was learning to drive. For the next few years, P5 had limited driving opportunities and at 22 years of age, her fear was exacerbated after she was nearly involved in an accident while driving. Although she had never been involved in a motor vehicle accident, she recalled a number of other "close calls." In the few years prior to the study, P5 had driven only a few times in rural areas and was unable to drive in the city. The main causes of the fear were "not enough training," "observing others [her mother and step-mother] who are afraid to drive," and "being a generally anxious person."

Measures

SCID-IV (First et al., 1996). This interview was administered (by the author) to screen for current and lifetime Axis I diagnoses. For diagnostic accuracy, audiotapes of the interviews were independently reviewed by a clinical supervisor (a Ph.D.-level licensed clinical psychologist). A trained and experienced research assistant subsequently rated the admission interviews; the level of agreement between the author and the independent rater was 100% ($\kappa = 1.00$). To assess the diagnostic status of the driving phobia following treatment, the Specific Phobia section of the SCID-IV was readministered by telephone at the posttreatment assessment, 1-month, and 3-month follow-up assessments. The posttreatment and follow-up interviews were audiotaped and reviewed blind rated by the research assistant. The level of agreement between the author and the independent rater was 100% ($\kappa = 1.00$).

Driving History Interview (Ehlers, 1990). Information about the individuals' driving history was obtained at the pretreatment assessment using a modified version of the Driving History Interview (Ehlers, 1990). It is a semi-structured interview designed to gather information on participants' driving background and driving phobia history (e.g., driving experiences, motor vehicle accident history, driving fear history). It also asks respondents to identify the three most important factors that led to the development of their driving phobia.

Driving Diary. The Driving Diary self-monitoring form consisted of three treatment outcome measures: Main Target Phobia, Global Phobia, and Driving Frequency. The Main Target Phobia and Global Phobia items were taken from the Fear Questionnaire (Marks & Mathews, 1979). For Main Target Phobia (the phobia the individual wants treated), participants rated their degree of driving avoidance because of fear or unpleasant feelings (0 = *would not avoid it*; 8 = *always avoid it*). For General Phobia, participants rated the present overall severity of driving phobia symptoms (0 = *no phobia present*; 8 = *very severely disturbing/disabling phobia present*). For Driving Frequency, participants recorded the number of minutes of driving they completed each day. The Driving Diary was recorded daily during the baseline and treatment phases, and for a 1-week period at the posttreatment and 1- and 3-month follow-up assessments. At the 1-year follow-up, participants were asked to provide current ratings for Mean Target Phobia and Global Phobia. For Driving Frequency, they reported the average number of driving trips per week, average driving time per week, and average peak anxiety while driving.

Virtual Reality Driving Simulator

The Virtual Reality Driving Simulator (driVRI; Imago Systems Inc., 1996) consisted of a Pentium II 266 computer with 3D graphics accelerator (ASUS V700 Pro v11.01) with driver controls (steering wheel mount, gas and brake pedals). For visual display, the head tracker (IO i-glasses 640 × 480) and tracking device (Intersense Intertrax 2) provide a 360-degree horizontal field of view. A sound blaster (SC Sonic Vibes) sends audio input (e.g., traffic noise) to the head tracker earphones. For this study, six standardized scenarios were chosen to simulate a variety of driving situations (residential, urban, and highway routes), which could also be modified to simulate different driving conditions (e.g., day residential driving with rain, night urban driving with snow and ice). Each scenario took approximately 3 to 5 minutes to complete, depending on the driver's speed. The six standard routes are described below.

Rural residential route. This route consisted of a rural residential two-lane road with minimal traffic. It also included curved and straight sections, a two-way stop sign, and a traffic light intersection.

Residential route. This residential two-lane route involved slightly heavier traffic. Other features also included straight and curved sections, a stop sign, a traffic light intersection, road signs that directed the driver to turn left or right, a school zone, and a car that suddenly pulled in front of the driver.

Highway with bridge route. The route included a two-lane highway in a rural area with a bridge. Other features included light traffic, several stop signs, as well as straight and curved road sections.

Highway merging route. This route consisted of a different two-lane highway in a rural area with straight and curved sections, which eventually merged onto a four-lane highway with heavy traffic. Other components included a traffic light intersection, a road construction barricade, and route directions posted by road signs.

Urban intersections route. In this scenario, the route consisted of a two-lane road through an urban area with light traffic. It also involved driving through several traffic light and stop-sign intersections.

Urban industrial route. This route consisted of a two-lane road in an urban area with light traffic that merges into a four-lane road that takes the driver into an industrial area. Other components included stops signs, route directions posted by road signs, road construction pylons that directed the driver to change lanes, a semi-truck that pulled in front of the driver, and a pedestrian that walked onto the road in front of the driver.

Statistical Procedures

To address the limitations of using visual analysis alone in evaluating treatment efficacy in single-case research (e.g., subjectivity, inability to separate treatment effects from serially dependent data), a statistical method was also incorporated. Time series analysis methods are one of the most frequently used statistical techniques in single-case research, as they take serially dependent data into account and have less restrictive assumptions than parametric tests. In this study, the C-statistic, or simplified time series (Tyron, 1982), was used to obtain quantitative information on the trends (changes in level and direction of data points) for Driving Diary data between baseline and posttreatment (1-week probe) assessments. The C-statistic was also used to examine the stability of the baseline data. Unlike other time series methods, the C-statistic does not require a large number of data points per phase (Gorman & Allison, 1996; Krishef, 1991).

Procedures

Individuals who were interested in participating received a telephone-screening interview. Those passing the screen were invited to attend the first assessment. During that assessment, the participants provided written informed consent and the SCID-IV was administered. Individuals who met eligibility criteria and agreed to participate in the treatment subsequently attended a pretreatment assessment.

Pretreatment assessment. Participants received an orientation to the driVRI system and were asked to complete the six VR driving scenarios. Peak anxiety ratings (0 = *no anxiety*; 100 = *extreme anxiety*) and success (0 = *incomplete or partially complete*; 1 = *complete*) were recorded. Based on these results, the participants then established an exposure hierarchy by rank ordering

a range of virtual driving situations from least to most anxiety-provoking. Instructions regarding the pre-assessment questionnaires and baseline phase were given. All individuals received a copy of the Patient Manual (available from the author) that explained the format and rationale for graduated VRET (e.g., participants were told that VRET allows for gradual and repeated exposure to feared driving situations, until the fear subsides). Potential side effects (e.g., transient anxiety) and instructions for completing the Driving Diary forms were also provided in the manual. Lastly, the Driving History Interview was administered.

Baseline phase. Using a nonconcurrent baseline schedule (Watson & Workman, 1981), participants were randomly assigned to different baseline lengths (e.g., 9, 12, 15 days) and began the baseline at different time points, based upon availability for treatment. Given the long-term nature of driving phobia symptoms, it was expected that extended baseline periods would not be necessary to establish stability of the target symptoms. For various reasons (e.g., scheduling constraints, cancelled appointments, vacations), none of the participants were able to exactly adhere to their predesignated baseline lengths. The actual baseline periods for P1 to P5 were respectively 9, 7, 6, 16, and 8 days, and during that time they completed their Driving Diary each day. The C-statistic determined that the data points were horizontally stable ($p > .05$) for all participants, except for P4 on Main Target Phobia. Her baseline data for this measure showed a statistically significant trend ($p < .05$) in the positive direction (e.g., symptom improvement), and as a result, the reported statistical trend (baseline phase to posttreatment phase) should be interpreted cautiously.

Treatment phase. The treatment phase consisted of eight weekly treatment sessions of graduated VRET (50- to 60-minute sessions). Participants were encouraged to attend sessions as close to a week apart as possible. A standardized treatment protocol was used (available from the author by request). The author, a doctoral-level student, was the therapist.

Each session consisted of three main parts: (1) a review of Driving Diary forms and adverse events (driving and nondriving related) from the previous week and discussion of the session plan; (2) VR exposure; and (3) a review of the session and provision of Driving Diary forms for the following week. To minimize the risk of simulator sickness that can be associated with virtual environments (Lewis & Griffin, 1997), the exposure length during treatment was gradually increased by 5 minutes each session to a maximum of 50 minutes (e.g., 25 minutes for Treatment Session 1, 30 minutes for Treatment Session 2).

The protocol involved participants gradually progressing through the various virtual driving scenarios, based on their anxiety hierarchy ratings established at the pretreatment assessment. Participants began the exposure with the virtual driving scenario rated as the least anxiety-provoking. At the end of the scenario, participants verbally reported their peak anxiety from *no anxiety* (0) to *extreme anxiety* (100). As the scenarios were relatively brief (3 to 5

minutes in length), participants would repeat each scenario over (with no breaks) until their peak anxiety dropped to 10 or less. Once this rating was obtained, they were introduced to the next scenario on the exposure hierarchy. At each subsequent session, participants started the exposure with the last two scenarios that were practiced in the previous session. They repeated these scenarios until their reported peak anxiety dropped to 10 or less. Once this was achieved, participants proceeded to the next scenario. For the remainder of treatment, participants used this format to gradually progress through the different scenarios at their own pace.

Treatment protocol adherence. Treatment sessions were audiotaped and reviewed by the clinical supervisor. A trained research assistant reviewed three randomly chosen audiotaped treatment sessions for each participant and rated adherence to the treatment protocol. The rater reviewed a total of 15 sessions. The rater used a protocol (available from the author) to evaluate adherence to the treatment manual. The protocol included four sections: (a) checklist of required therapist behaviors; (b) checklist of permissible therapist behaviors; (c) checklist of therapist infractions from the treatment protocol; and (d) an overall treatment adherence rating (Waltz, Addis, Koerner, & Jacobson, 1993) to the treatment protocol using a 5-point Likert scale (1 = *no adherence* and 5 = *very much in adherence*). The mean overall treatment adherence rating of the 15 sessions was 4.6 (SD = 0.5).

Posttreatment assessment. One week after the last session, the Specific Phobia section of the SCID-IV was administered. Participants recorded their Driving Diary and adverse events (driving and non-driving-related) for 7 days.

1-month and 3-month follow-up assessment. Follow-up interviews using the Specific Phobia section of the SCID-IV were arranged 1 and 3 months after the last treatment session. At each assessment, participants also recorded their Driving Diary and adverse events for one week.

1-year follow-up assessment. Participants were contacted by mail one year after the last treatment session. They were asked to provide their current Main Target Phobia and Global Phobia ratings and Driving Frequency (average number of driving trips per week, average driving time per week, and average peak anxiety while driving). Four participants (P1, P3, P4, and P5) returned the forms.

Results

Table 1 presents a summary of the Driving Diary results at baseline, posttreatment, and follow-up assessments. The results from the statistical analysis are provided in Table 2.

Global Phobia

Figure 1 shows the raw data of daily Global Phobia ratings and Table 1 provides the mean scores at baseline, posttreatment, and follow-up assessments.

TABLE 1
MEAN DRIVING DIARY RESULTS AT BASELINE (BASE), POSTTREATMENT (POST), 1-MONTH (1-FU), 3-MONTH (3-FU), AND 12-MONTH (12-FU) FOLLOW-UP ASSESSMENTS

Participant	Measure	BASE	POST	1-FU	3-FU	12-FU
P1	Main target phobia	8.0	2.0	2.0	3.0	3.0
	Global phobia	6.0	1.4	2.0	3.0	3.0
	Driving frequency	0	6.4	0	0	0
P2	Main target phobia	3.7	1.9	1.0	1.9	—
	Global phobia	3.9	1.0	2.0	2.0	—
	Driving frequency	1.4	10.0	2.1	4.3	—
P3	Main target phobia	7.7	3.7	4.7	7.0	3.0
	Global phobia	7.8	3.7	5.0	6.9	3.0
	Driving frequency	0	1.7	0.9	0	21.4
P4	Main target phobia	5.4	4.0	7.0	7.0	6.0
	Global phobia	5.4	4.0	6.7	7.0	6.0
	Driving frequency	3.4	0	0	0	12.9
P5	Main target phobia	6.6	2.3	1.7	2.9	3.0
	Global phobia	5.9	1.3	1.9	2.6	2.0
	Driving frequency	0	0	1.9	2.9	8.6

Note. Main target phobia score range = 0–8; Global phobia score range = 0–8; Driving frequency = minutes per day.

TABLE 2
C-STATISTIC RESULTS OF DRIVING DIARY BETWEEN BASELINE AND POSTTREATMENT ASSESSMENTS

Participant	Measure	C-Statistic	Trend	Direction
P1	Main target phobia	0.92*	Trend evident	Positive
	Global phobia	0.91*	Trend evident	Positive
	Driving frequency	−0.04	Horizontally stable	
P2	Main target phobia	0.91*	Trend evident	Positive
	Global phobia	0.85*	Trend evident	Positive
	Driving frequency	−0.11	Horizontally stable	
P3	Main target phobia	0.69*	Trend evident	Positive
	Global phobia	0.72*	Trend evident	Positive
	Driving frequency	−0.10	Horizontally stable	
P4	Main target phobia	0.25	Horizontally stable	
	Global phobia	0.36*	Trend evident	Negative
	Driving frequency	0.34	Horizontally stable	
P5	Main target phobia	0.83*	Trend evident	Positive
	Global phobia	0.87*	Trend evident	Positive
	Driving frequency	0.00	Horizontally stable	

Note. Trend in the positive direction = change toward improved outcome. Trend was in the negative direction = change toward worse outcome.
*$p < .05$.

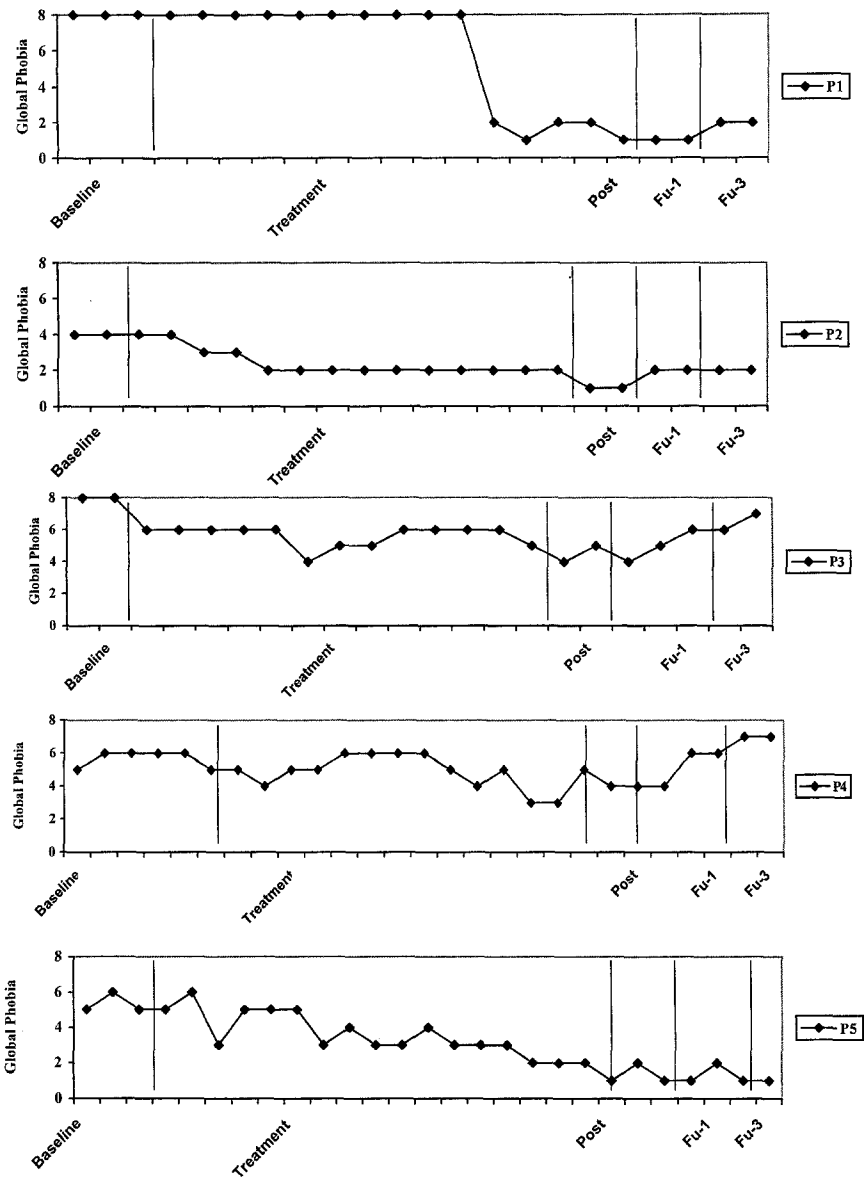

FIG. 1. Global Phobia ratings by participant. Every point corresponds to a 3-day period.

Prior to treatment, P3 ($M = 7.8, SD = 0.4$), P1 ($M = 6.0, SD = 0.0$), and P5 ($M = 5.9, SD = 0.4$) had the highest Global Phobia mean scores, and P2 had the lowest ($M = 3.9, SD = 0.4$). P1's Global Phobia ratings decreased significantly toward the end of treatment, which coincided with an increase of driving frequency during a summer vacation. Two participants (P2 and P5) showed a gradual decrease in their severity ratings, and at the posttreatment assessment their scores were quite low. Although their scores increased slightly at the follow-up assessments they remained well below their respective baseline scores. In contrast, P3 and P4 showed the least amount of change at the posttreatment assessment, and their mean scores continued to increase at 1- and 3-month follow-up assessments. The statistical method revealed statistically significant improvement ($p < .05$) between pre- and posttreatment assessments for four participants (P1, P2, P3, and P5), and a statistically significant trend ($p < .05$) in the negative direction for P4 (e.g., indication of symptom worsening).

Main Target Phobia

As shown in Table 1, in the baseline phase, P1 ($M = 8.0, SD = 0.0$), P3 ($M = 7.7, SD = 0.8$) and P5 ($M = 6.6, SD = 0.8$) had the highest mean Main Target Phobia scores, and P2 had the lowest ($M = 3.7, SD = 0.8$). Toward the end of treatment, the mean weekly ratings were noticeably lower for all participants, with P4 showing the least amount of change in the severity of self-rated driving avoidance. At the posttreatment assessment, mean ratings were lowest for P1 ($M = 2.0, SD = 1.0$), P2 ($M = 1.9, SD = 0.4$), and P5 ($M = 2.3, SD = 0.5$). At the 1- and 3-month follow-up assessments, the mean scores remained low for three participants (P1, P2, and P5), whereas P3 and P4 showed a noticeable loss of gains. The C-statistic identified that the changes between pre- and posttreatment assessments were statistically significant ($p < .05$) for four participants (P1, P2, P3, and P5). Visual data for this measure are available upon request.

Driving Frequency

Overall, there was little change in the participants' mean weekly driving frequencies across treatment (see Table 1). During the baseline, three participants (P1, P3, and P5) made no driving trips. P2 made one driving trip (10 minutes in length). P4 had the highest driving frequency mean score and she made six short trips for a total of 55 minutes. When baseline and the posttreatment assessment phases were compared, there was no marked trend of increasing mean weekly driving frequency for any of the participants, with only a slight increase of driving in P1 and P2, and these changes were not statistically significant ($p > .05$). From posttreatment to 1-month follow-up assessments, only P5 showed a slight increase in her mean driving frequency scores. In contrast, P2, P3, and P4 showed a pattern of decreasing mean driving frequency scores at the first follow-up assessment. At the subsequent assessment, the mean driving frequency continued to marginally increase for

only two participants (P2 and P5). There was no change in P1's mean driving frequency at the 1- and 3-month follow-up probes. Visual data for this measure are available upon request.

SCID-IV (Specific Phobia Section)

At the posttreatment assessment the SCID-IV indicated the driving phobia was now in partial remission, as current criteria were not fully met for three participants (P1, P2, and P5). At the 1- and 3-month follow-up assessments, the driving phobia continued to remain in partial remission for these participants. P3 and P4 still met full criteria at posttreatment and 1- and 3-month follow-up assessments.

Results From the 1-Year Follow-up Assessment

At the 1-year follow-up, P1 had no loss of gains but was not driving due to significant personal stressors unrelated to her driving fear. P3's driving avoidance and severity decreased considerably at the 1-year follow-up. On average she was driving five times a week in a rural setting but continued to avoid city driving. There was little change in P4's avoidance or severity ratings, but she indicated that she was taking driver's lessons and found this to be very helpful. P5 reported that she was making ongoing efforts to drive and her phobic symptoms remained low. On average, she was driving 1 hour a week in the city, which included a few separate trips alone with minimal anxiety.

Discussion

The primary potential advantages of using VRET for treating driving phobia lie in its ability to provide safe, controlled, and standardized driving practice. It may be a more acceptable and less-threatening treatment medium than in vivo exposure for some individuals. However, there is relatively little controlled treatment outcome research on driving phobia and no controlled studies to date have examined the efficacy of VRET for this type of phobia. The current study represents a controlled extension of a previous case report (Wald & Taylor, 2001). Treatment efficacy was examined across seven people with a *DSM-IV* diagnosis of specific phobia (situational type, driving). Five completed the treatment and two withdrew at the initial part of the treatment. The treatment resulted in a modest reduction in phobic symptoms for three participants (P1, P2, and P5) and was ineffective for the remaining two participants. None of the participants experienced improvements in their "real-life" driving frequency.

The limitations of this study include the fact that the pre-assigned baseline lengths according to a nonconcurrent baseline schedule could not be exactly adhered to because of logistical constraints (e.g., difficulties in scheduling appointments and time limitations on the research project). Despite this limitation, sufficient baseline data were collected to ensure stability of the symptoms before administering the treatment. Visual and statistical analysis determined

that the baseline data were stable (except for P4 on Main Target Phobia). The fact that symptom improvement occurred only after the treatment was implemented (see Figure 1) adds confidence to the validity of the findings. Given the chronic and long-standing nature of their driving fears, which ranged from 15 to 40 years, it was unlikely that symptom change was due to spontaneous remission. Other methodological weaknesses include the lack of psychometric data on the outcome and treatment integrity measures and unknown statistical power of the C-statistic.

Generalizability of the results to the driving phobia population is limited to other individuals with similar subject characteristics and to the particular treatment delivery conditions that were used in this study. Results cannot be extended to the entire driving phobia population, which has been shown to be a heterogeneous group of individuals. The small sample prevents extensive statistical analyses to examine predictors of treatment outcome and relationships between treatment process variables (e.g., within-session habituation, treatment delivery, nonspecific factors) and subject characteristics (e.g., driving history, driving skill). Given the preliminary nature of this study, the reasons for these treatment response variations are unclear. Rothbaum et al. (2000) noted that there is a lack of empirical research on identifying people who would most likely benefit from VRET as compared to in vivo exposure, and there is much more to be learned about the clinical applications of VRET.

Another limitation centers around the treatment delivery of VRET. At present, VRET technology is limited and expensive. The driVR represents one of the first commercially available virtual reality driving simulators for clinical and rehabilitation applications. Although the simulator consists of driver controls (e.g., steering wheel, gas and brake pedals) and software (e.g., different routes and situations) to simulate driving, it may not have rendered a sufficiently realistic exposure environment for individuals with driving phobia. One participant (P6) actually withdrew from the study at the pretreatment assessment because he felt the simulator lacked realism. Further advances to driving simulator technology, such as developing more individualized scenarios of different complexity, variety, and unpredictability, may render VRET as a more effective treatment modality on its own.

The strengths of the current study are based on the methodology that was used. The multiple baseline across-subjects design controls for several internal validity threats (e.g., history, maturation). Inclusion of other elements into the design, including a standardized treatment protocol, strict eligibility criteria, the SCID-IV, a statistical method to assess treatment change, 1-year follow-up assessments, and blind ratings of diagnostic interviews and treatment adherence, added to the methodological rigor of this study.

In terms of the clinical implications, the preliminary findings indicate that there is considerable room for improving the treatment of driving phobia. VRET should not replace in vivo exposure, but may be a helpful adjunct for some individuals. Specifically, it may be best suited as an initial treatment component, which is then followed by in vivo driving sessions. For example,

P1's primary goal for participating in the study was to be able to drive during an upcoming family vacation. During treatment, she was able to drive during her 2-week vacation and this coincided with a rapid decrease in her driving phobia symptoms. Upon returning from the trip, she felt more confident to drive in the city (for the first time in 14 years). The addition of other components such as behavioral homework assignments (e.g., driving lessons between sessions) or cognitive interventions (e.g., Sloane & Telch, 2002) may also augment treatment outcome in VRET. Incorporating regular and repeated driving practice seems to be particularly important given the skill mastery and confidence-building components that are involved in overcoming the fear of driving. It is hoped that these initial findings will lead to further research to further delineate the most effective treatment components for this relatively common yet disabling phobic disorder.

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