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The effect of technology assisted therapy for intellectually and visually impaired adults suffering from separation anxiety: Conquering the fear

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ABSTRACT

Persons with an intellectual disability (ID) are at risk of developing separation anxiety (SA) and, if left untreated, this can be a risk factor for the development of psychopathology. The effects of an intervention, namely technology assisted therapy for SA (TTSA), were examined on the SA, challenging behavior, psychosocial functioning, and quality of life (QOL) experienced by moderate to mild intellectually and visually disabled adults. This study aimed to determine whether TTSA reduces SA and challenging behavior in persons with ID and visual impairment, and if this results in increased psychosocial functioning and QOL. A pre-experimental within-group design with randomized multiple baselines and staggered intervention start-points was used (n = 6). The variables were monitored with standardized instruments. The frequencies of each participant's use of the technology and the frequency and intensity of their behavior were recorded over time. Results indicate that the SA and challenging behavior experienced by the participants decreased significantly and their psychosocial functioning and QOL increased significantly. The conclusions are that TTSA has the potential to be a valid intervention to address SA in adults with visual and moderate to mild IDs.

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KEYWORDS
cognitive impairment; communication; developmental disability; psychosocial functioning; quality of life; separation anxiety; technology; visual impairment

Introduction

Persons with an intellectual disability (ID) are at risk of developing separation anxiety (SA; Emerson, 2003; Emerson & Hatton, 2007). This can be explained by insecure attachment relationships, which are more often found among people with ID than among their normally developed peers (Clegg & Sheard, 2002). The limited cognitive skills characteristic of ID is identified by Janssen, Schuengel, and Stolk (2002) as a risk factor for the development of an insecure attachment relationship in this population. An insecure attachment relationship, in turn, might put this population at risk for developing psychopathology, including SA (Greenberg, 1999). The limited cognitive skills typically found in persons with ID are developmental delays regarding object and person permanence, and identifying and selecting attachment behavior to suit the situation (Cassidy, 1999). A visual impairment may cause a delay in this cognitive development, resulting in the development of object permanence being delayed by up to 10 months (Bals, Gringhuis, Moonen, & Van Woudenberg, 2002; Rogers & Pulchalski, 1988). Limitations regarding these cognitive skills may thus cause persons with ID and a visual impairment to function in a nearly fixed condition of separation distress (Janssen et al., 2002). SA is up to four times more prevalent among children and adolescents with ID compared to those without ID (Emerson, 2003; Emerson & Hatton, 2007) and, if left untreated, it can be a risk factor for the development of comorbid psychopathology later in life (Greenberg, 1999). However, little research has been done on the treatment of SA among persons with ID, and even less on the treatment of persons with ID with a comorbid visual impairment (Hagopian & Jennet, 2008).

Research indicates that existing therapy techniques for treating anxiety can be applied to persons with ID (Didden et al., 2012; Hagopian & Jennet, 2008), but these focus primarily on phobic disorders, while treatments for other anxiety disorders are not as profusely considered (Hagopian & Jennet, 2008). Relaxation and desensitization methods were found to be effective in reducing symptoms of anxiety and phobias, but emphasize the lack of intervention methods for complex phobias and general anxiety disorders (Didden et al., 2012). The lack of intervention methods specifically aimed at addressing anxiety in persons with ID motivated the current study.

Anxiety in persons with ID can be associated with challenging behavior (Pruijssers, Van Meijel, Maaskant, Nijssen, & Van Achterberg, 2012) and attachment-based therapy methods might be useful in treating this phenomena (Sterkenburg, Janssen, & Schuengel, 2008). Furthermore, a negative association between challenging behavior and attachment behavior in persons with ID has been found, while the positive association between the security of an attachment relationship and the

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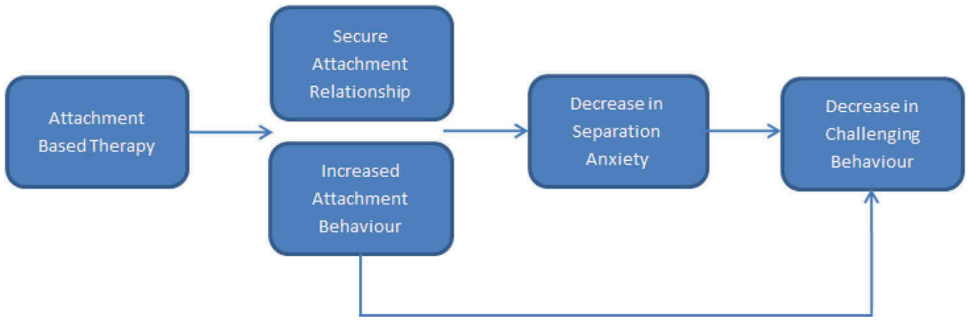


Figure 1. Indication of the relationship between key constructs.

attachment behavior exhibited by persons with ID is emphasized (De Schipper & Schuengel, 2010). It is known that insecure attachment relationships increase the risk of developing SA (Greenberg, 1999). It can thus be reasoned that a secure attachment relationship and attachment-based therapy may contribute to secure attachment behavior, which will in turn decrease challenging behavior (aggressive and intrusive behavior) and SA experienced by the person with ID (see Figure 1).

Insecure attachment relationships (Berlin, Cassidy, & Appleyard, 2008) and psychopathology (Ansell, Sanislow, McGlashdan, & Grilo, 2007; Rodriguez, Bruce, Pagano, & Keller, 2005) including anxiety disorders (Ansell et al., 2007; Beard, Weisberg, & Keller, 2010; D'Avanzato et al., 2013; Essau, Lewinsohn, Olaya, & Seeley, 2014) can impair psychosocial functioning and quality of life (QOL). Therefore, the aim of treatment should no longer be to only alleviate symptoms, but also to increase psychosocial functioning and QOL (Caldirola et al., 2014; Moitra et al., 2014). Rodriguez and colleagues (2005) reinforced this argument by demonstrating that poor psychosocial functioning significantly increases the risk of relapse in recovered persons who suffered from anxiety. The current study therefore aimed to address SA and challenging behavior through the use of an attachment theory-based intervention to increase the psychosocial functioning and QOL of persons with ID.

Various studies demonstrated the possibility of successfully incorporating the use of technology into education (Davidson, 2012), skill attainment, learning, and task management (Mechling, 2011). However, research to date regarding the application of electronic technologies in intervention methods for persons with ID is merely preliminary (Mechling, 2011). Further research is thus needed to explore the benefits of technology for the ID population (Scherer, 2012). A systematic review reported five studies using mobile technology to teach cognitive concepts such as daily living skills, vocational skills, safety skills, time perception, and imagination (Den Brok & Sterkenburg, 2015). Two of these studies showed effective teaching of emotion concepts through the use of mobile technology. They also reported that advanced technologies such as virtual reality were used effectively to facilitate the attainment of cognitive and emotion concepts. Thus, it follows that advanced technology might contribute to the learning of an abstract concept such as person permanence, although this has not been studied before.

This study intended to determine the efficacy of technology assisted therapy for SA (TTSA) in lowering SA and challenging behavior in persons with ID and a visual impairment. The main aim of the study was to determine whether SA levels experienced and challenging behavior exhibited by the participants decreased throughout the therapy, and whether this reduction had an influence on the psychosocial functioning and QOL of the participants.

Methods

Design

A pre-experimental ($AB_1C_1B_2C_2D$) within-group design with multiple baselines and staggered intervention start-points was used. Phase A was preceded by a 2-week training period, during which the participants were introduced to the technology. During phase A, the participants used the iPhone without receiving any response. During phase B_1, the participants sent messages and received an automatic response from a computer. The duration of this phase varied between 11 and 21 days. During Phase C_1, the computer response was replaced by a response from the caregiver. In addition, all exchanged messages were discussed during the subsequent meeting between the caregiver and participant according to a set protocol. This intervention phase continued for 3 weeks. Phases B and C were repeated (B_2 and C_2) for 3 weeks each. At the beginning of phase D, the participants returned the iPhones and a follow-up discussion was facilitated with the participants regarding their experience of the intervention, while the caregivers conveyed their perceptions by completing a questionnaire. The total time frame of the six phases was 17 to 18 weeks. This $AB_1C_1B_2C_2D$ design was implemented to determine whether only technology is needed to obtain success, or whether the caregivers' involvement is crucial to optimize the effect of the intervention. These results were reported by Jonker, Sterkenburg, and Van Rensburg (2015). In the current study, we examine the effect of TTSA over time, from the first intervention phase (B) to the follow-up 3 weeks after the treatment ended (D).

Randomized multiple-baselines with staggered intervention start-points were used. To determine the start-point of the intervention phase, a randomized phase start-point model was used. When a multiple baseline design is used to measure standards, a minimum of six phases must be included, each with a minimum of five data points (Kratochwill et al., 2012). A random selection from points 8–21 determined the start-point of the intervention phase. Thus, 14 potential start-points could be identified. To increase randomization, the randomized phase start-point model was repeated to determine

three final phase start-points (blocks). To ensure a staggered design, the number of measure points in the B-phase of each block differed with at least four measure points compared to the other blocks (Bulté & Onghena, 2009). The start-point in the intervention phase of block two could therefore be initiated from measure point 12 onward. Likewise, the intervention phase (C_1) of block three might have started from measure point 16 onward. By means of the randomized procedure, it was decided that the B_1 phase would last 10 days for block one, 15 days for block two, and 20 days for block three. The first three participants were randomly assigned to a block each. Participants 4 to 6 were then allocated using the same procedure. Refer to Table 1 for an illustration of the staggered design.

Participants

The sample consisted of six adults with visual and IDs who reside in group homes at an organization in the Netherlands and were purposively selected. The inclusion criteria specified that participants had to be older than 18 years, have a moderate to mild ID (IQ between 40 and 70) with a visual impairment according to the World Health Organization (World Health Organization, 1980) standards, experience SA in the absence of the caregiver, and be physically able to operate a mobile phone. Potential participants who were deaf and/or presented with autism were excluded. Although SA therapies are more commonly developed for children, this study specifically included adults only as there are no known therapies available for this population. The participants' demographical information is listed in Table 2. General complaints brought on by SA include physical symptoms (headaches, abdominal pain, back pain), nervousness, nightmares, behavioral problems, diminished social contact, and excessive worrying, especially that something will happen to the caregiver causing them not to return. All the caregivers who participated in the study were well-trained to provide specialized care.

All the participants agreed to partake in this study by providing informed consent. Medical ethical approval for the study was acquired from the Vrije University Medical Centre Medical-Ethical Review Board (NL33646.029.11).

Intervention

TTSA addresses SA by teaching the participants the concept of person permanence through repetition and by providing a secure base and safe haven for the participant. The treatment combined the use of a specifically adjusted mobile phone (iPhone touch) with face-to-face communication. The mobile phone was adapted in such a way that it enabled optimal utilization of the technology by the target group. A simple, downloadable application (app) made it possible for the participants to send fixed messages regarding their moods to their caregiver when they were physically apart from each other. These conveyed the emotions happy, sad, angry, and anxious, with an option to ask for help. On each account where a participant sent a message, he/she chose the applicable option that corresponded with his/her emotion and selected it by tapping on the screen. An audible prompt asked the participant to confirm their message before it was sent. The participant either approved or cancelled the message. The caregivers responded to messages with a fixed message on a similar device. For example, if the participant sent the message "I am sad," the caregiver replied with the corresponding option "you are sad," thus acknowledging the sender's emotion. During subsequent meetings between the participant and caregiver, each exchanged message was discussed according to an attachment-based protocol (Jonker et al., 2015). The protocol was based on the Circle of Security (Marvin, Cooper, Hoffman, & Powell, 2002), in which the caregivers received training to react in such a way that a secure attachment relationship is stimulated. For a more in-depth description of the intervention method, refer to Jonker and colleagues (2015). A child lock function prevented the participant from accidentally exiting the app, while for visually impaired participants, a pouch fitted with Braille words indicated the message options alongside the screen options.

Measures and procedure

Participants were identified for possible inclusion in the study by confirming a diagnosis of SA. First, potential participants' files were examined for behavior indicating SA. The psychopathology inventory for mentally retarded adults (PIMRA) was conducted to assess anxiety and to confirm the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV) criteria for SA. Participants were invited to take part in the study following a clinical diagnostic assessment by experienced therapists working in the field of ID verifying their ID diagnosis.

The effect of the intervention was determined by monitoring the changes in levels of (separation) anxiety, challenging behavior, psychological functioning, social functioning, and QOL by administering a battery of standardized instruments

Table 1. Randomized multiple-baseline blocked phase-order randomly paired with 21 time periods, and 14 C_1 potential start-points.

		Time period																				
Participant	Block	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	C_1*	C_1	C_1	C_1	C_1	C_1	C_1							
4	1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	C_1	C_1	C_1	C_1	C_1	C_1	C_1							
2	2	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	C_1*	C_1	C_1	C_1	C_1	C_1	C_1			
5	2	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	C_1	C_1	C_1	C_1	C_1	C_1	C_1			
3	3	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	C_1*	C_1	C_1	C_1	C_1	C_1
6	3	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	B_1	C_1	C_1	C_1	C_1	C_1	C_1

Notes. Potential C_1 start-points are between time periods 8 and 21 inclusive. *Randomly selected start-point. B_1: Intervention phase 1; C_1: Intervention phase 2.

Table 2. Characteristics of the six participants.

Participant	Sex	Age	Living and working environment	Visual impairment	Mobility
1	Male	27	• Resides in group home during the week. • Spends weekends with family. • Delivers mail during the day. • Needs constant supervision.	Visually impaired	Bound to wheelchair - spasticity
2	Male	50	• Resides in a group home. • Works as paper shredder 3 days per week. • Attends day time activities 2 days per week. • No constant supervision needed. • Substitute caregivers used during study due to sick leave taken by full-time caregivers.	Visually impaired	Mobile
3	Male	48	• Resides in a group home. • Works 5 days per week (bicycle maintenance). • No constant supervision needed.	Visually impaired	Mobile
4	Male	56	• Resides in a group home. • Works 5 days a week (logging). • No constant supervision needed. • Ill during study period.	Visually impaired	Mobile
5	Male	53	• Resides in a group home. • Works 4 days a week (cleaning). • No constant supervision needed.	Differentiate only between light and dark	Mobile
6	Female	38	• Resides in a group home. • Works 5 days a week (industrial). • Constant supervision.	Blind	Mobile

at the end of each phase in the intervention. These were administered by an independent researcher. The frequency of each type of message was recorded for each participant throughout the intervention. The professional caregivers in the participants' residential homes were instructed to record the frequency and intensity of the behavior of the participants (e.g., distress, behavioral problems, clinging behavior, anxiety) while the participants were at home and at work. A web-based computerized data collection system, Qualtrics, was used for the daily reporting of challenging behavior. This took approximately 5 minutes and the caregivers were notified by a computerized reminder to record the behavior.

Standardized instruments

Adult behavior checklist for ages 18–59 (ABCL)

The anxious/depressed, aggressive behavior, intrusive, and withdrawn syndrome scales were used to measure the changes in SA, challenging behavior and loneliness. The ABCL was found to be a reliable and valid measure for the assessment of psychopathology in persons with mild ID (Tenneij & Koot, 2007).

Brief symptom inventory (BSI)

The BSI total scale was used to measure psychosocial functioning, and the anxiety subscale measured changes in SA symptoms. The BSI total scale internal consistency and the anxiety subscale internal consistency are α = 0.96 and α = 0.82, respectively (Wieland, Wardenaar, Fontein, & Zitman, 2012).

PIMRA

The anxiety subscale of the PIMRA was completed. The internal consistency for the anxiety scale was found to be α = 0.63, which is considered to be a modest to adequate internal consistency (Van Minnen, Savelsberg, & Hoogduin, 1994).

IDQOL

The IDQOL, with a 5-point Likert-type scale, measures QOL in persons with ID and presents an adequate internal consistency (α = 0.86; Hoekman, Douma, Kersten, Schuurman, & Koopman, 2001).

Data analysis

Non-parametric Friedman tests were used to compare the results of the various instruments at different time points for each participant. Then, a meta-analysis according to Fisher's method (De Weerth & Van Geert, 2002) was completed for each questionnaire by combining the *p*-values of the non-parametric Friedman tests, respectively. A natural logarithm was calculated for each *p*-value. The chi-squared deviation was determined by multiplying the sum of the natural logarithms by –2. The number of *p*-values multiplied by 2 was used as the degrees of freedom. *P*-values of <0.005 were substituted with 0.01 to avoid the possibility of grounding the significance on only the one *p*-value. In cases where the change in the variable was not in the anticipated direction, the *p*-value was replaced with 0.5 (Birnbaum, 1955; De Weerth & Van Geert, 2002). It was hypothesized that the result would show an overall decrease in SA levels and challenging behavior, with an increase in psychosocial functioning and QOL.

To account for missing scores on the questionnaires, the mean of the scores adjacent to the missing value were calculated and imputed. In the case where two or more scores from a single item were missing, the item was removed from the results. Questions enquiring about employment were excluded as well

as those that upset certain participants such as enquiries about death and suicide.

Non-parametric Friedman tests were used to test the frequency of the various messages sent. These scores were meta-analytically combined according to Fisher's method (De Weerth & Van Geert, 2002). The authors hypothesized that the frequency of anxious, sad, and angry messages would decrease, while the frequency of happy messages would increase or remain stable. The frequency of the help messages was expected to decrease or stay constant. All messages sent were inspected visually to identify outliers. One single data point was considered to be an outlier as it indicated that a single message option was repetitively sent in a short time frame, and was altered into a missing value.

The various behavior options in the list used for the daily observations of behavior in the residential homes and work environment of the participants were grouped according to SA behavior, challenging behavior, and positive behavior. SA behavior included stress, anxiety, and clinging behavior. The frequency and intensity of these behaviors were recorded daily.

Results

Anxiety

The SA experienced by the participants decreased significantly throughout the intervention (see Figure 2). The Fisher's combination of p-values showed a significant decrease on the PIMRA anxiety subscale (combined χ^2 deviation = 25.45, $p < 0.025$). The meta-analytically combined p-value results for the anxiety subscale of the BSI (combined χ^2 deviation = 25.34, $p < 0.025$) showed a significant decrease over time. The combined result of the Friedman test p-values on the ABCL-caregiver anxiety subscale showed a significant decrease in anxiety (combined χ^2 deviation = 31.8, $p < 0.005$). Table 3 shows the mean scores and χ^2 -values of the PIMRA and BSI, while Table 4 shows the mean scores and χ^2-values of the ABCL. The combined result of the Friedman test for the frequency of anxiety messages sent showed a significant decrease during the course of the intervention (combined χ^2 deviation = 36.89, $p < 0.001$).

The frequency of the anxiety behavior observed by the caregivers decreased for four participants (participants 3, 4,

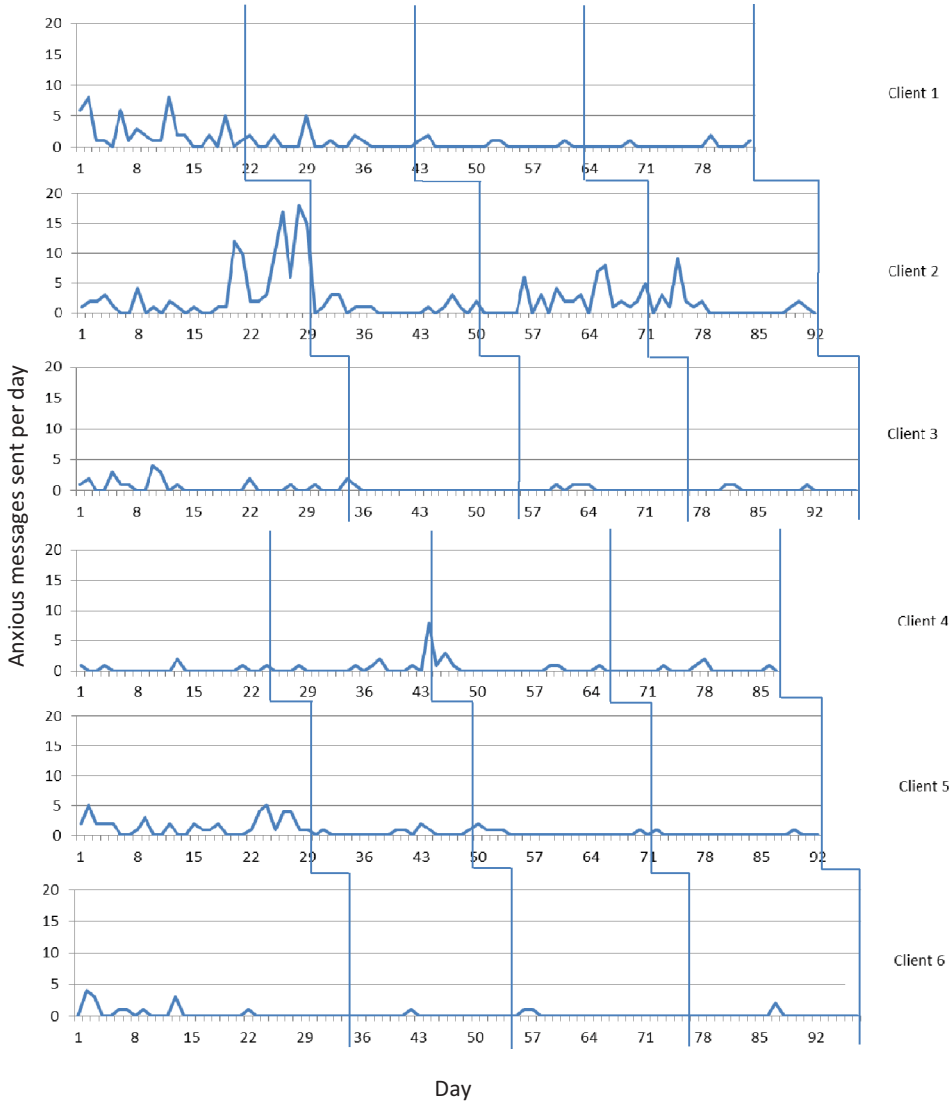


Figure 2. Anxious messages sent per day per client.

Table 3. Mean and standard deviation (*SD*) of the anxiety levels at the start and end of the intervention.

Instrument	Participant	First phase of intervention mean (*SD*)	Last phase of intervention mean (*SD*)	χ^2 (*df*)
BSI anxiety subscale[a]	1	2.5 (1.05)	4.0 (0.0)	19.35 (6)
	2	2.5 (1.05)	3.0 (0.0)	5.45 (6)
	3	2.33 (1.03)	3.00 (0.89)	8.19 (6)
	4	1.33 (0.52)	2.5 (0.84)	20.43 (6)**
	5	3.17 (0.98)	3.33 (1.52)	4.78 (6)
	6	2.00 (1.55)	1.83 (1.33)	13.36 (6)*
PIMRA total scale[b]	1	1.43 (0.53)	1.43 (0.53)	8.4 (6)
	2	1.57 (0.53)	1.71 (0.49)	3.82 (6)
	3	1.57 (0.53)	1.43 (0.53)	12.00 (6)
	4	2.00 (0.00)	2.00 (0.00)	20.9 (6)**
	5	1.43 (0.53)	1.29 (0.49)	6.55 (6)
	6	1.86 (0.38)	1.43 (0.53)	9.93 (6)

Notes. [a]$n = 6$; [b]$n = 7$. BSI: High scores indicate decreased anxiety; PIMRA: Low scores indicate decreased anxiety. For the Friedman meta-analysis: when there was a decrease in the BSI anxiety subscale score, the results of the *p*-value was replaced with 0.5; and when there was an increase in the PIMRA total scale score, the results of the *p*-value was replaced with 0.5. *$p < 0.05$; **$p < 0.005$.

Table 4. Mean and standard deviation (*SD*) of the anxiety levels at the start and end of the intervention for the ABCL-caregiver anxiety subscale.

Participant	First phase of intervention mean (*SD*)	Last phase of intervention mean (*SD*)	χ^2 (*df* 6, $n = 14$)
1	1.36 (0.74)	0.71 (0.61)	17.56**
2	1.36 (0.50)	1.43 (0.65)	26.3**
3	0.71 (0.61)	0.64 (0.50)	10.57
4	1.93 (0.27)	2.00 (0.00)	55.20**
5	0.79 (0.58)	0.50 (0.65)	7.96
6	0.64 (0.74)	1.14 (0.77)	16.52*

Notes. Low scores indicate decreased anxiety. For the Friedman meta-analysis: when there was an increase in the ABCL-caregiver anxiety subscale score, the results of the *p*-value was replaced with 0.5. *$p < 0.05$; **$p < 0.005$.

5, and 6) in the living environment and three participants (participants 3, 4, and 6) at work. For three of the participants (participants 3, 4, and 5), the intensity of anxious behavior (stress, anxiety, and clinging behavior) showed a decrease in the living environment; and for three participants (participants 3, 4, and 6), the results showed a decrease in the working environment.

Challenging behavior

The challenging behavior exhibited by the participants during the intervention also showed a significant decrease. The combined *p*-values of the non-parametric Friedman test on the total scale of the ABCL-caregiver questionnaire showed significantly less challenging behavior from the start to the end of therapy (combined χ^2 deviation = 34.89, $p < 0.001$). A similar result was found in the combined non-parametric Friedman results of the ABCL-caregiver aggressive subscale (combined χ^2 deviation = 50.12, $p < 0.001$), as well as in the combined non-parametric Friedman results of the ABCL-caregiver intrusive subscale (combined χ^2 deviation = 39.86, $p < 0.001$). Apart from participant 2, all the participants showed a decrease in the frequency of angry messages sent as indicated by the non-parametric Friedman test. A meta analysis of these results showed that angry messages were sent significantly less as therapy progressed (combined χ^2 deviation = 29.37, $p < 0.005$).

Psychosocial functioning and QOL

Psychological functioning increased significantly, as indicated by the combined non-parametric Friedman test results on the BSI total scale (combined χ^2 deviation = 55.26, $p < 0.001$). The Friedman test results of the ABCL-caregiver withdrawn scale, when meta-analytically combined, showed a significant increase in social functioning (combined χ^2 deviation = 26.11, $p < 0.025$). The combined non-parametric Friedman test result for the ABCL-friends questionnaire used for social functioning did not indicate a significant change. Excluding participant 2, all the participants sent less sad messages as therapy progressed. The non-parametric Friedman test results combined showed a significant decrease (combined χ^2 deviation = 24.97, $p < 0.025$).

QOL measurements increased significantly, as indicated by the combined Friedman results for the IDQOL total scale (combined χ^2 deviation = 48.46, $p < 0.001$). The combined Friedman test results on the frequency of happy messages sent indicated a significant increase in such messages throughout the intervention period (combined χ^2 deviation = 23.96, $p < 0.005$). Lastly, the Friedman test on the messages asking for help showed a significant decrease throughout the intervention (combined χ^2 deviation = 31.74, $p < 0.005$).

Discussion

The results of this research indicate that TTSA indeed has the potential to be considered a valid intervention to address SA in adults with visual and moderate to mild ID, and introduces the possibility of using technology to teach abstract concepts such as person permanence.

Mixed results were found for participant 2 with decreased anxiety indicated by one questionnaire as well as the daily messages sent, while the other measures show an increase in anxiety. Unfortunately, his regular caregivers were not available throughout the intervention, which might have introduced bias. The daily observations recorded by the caregivers showed less frequent and intense anxiety behavior for three participants. However, being a subjective rating, the larger number of caregivers rating behavior might have led to inconsistent results. The combined results of the six

participants indicate an overall decrease in anxiety, which demonstrate promising prospects for the treatment of SA in this population in the context of a dearth of existing research. The combined results for the complete battery of instruments used to measure challenging behavior also showed a significant decrease as therapy progressed. These results concur with other studies, which found that challenging behavior in persons with ID decreased when an attachment-based intervention was applied (De Schipper & Schuengel, 2010; Sterkenburg et al., 2008).

The increase in social functioning, the decrease in sad messages sent, the increase in happy messages sent, and the decrease in both SA experienced and challenging behavior exhibited by the participants due to TTSA reduced the risk of them experiencing diminished psychosocial functioning and improved QOL. Four questions regarding the participants' friends did not yield significant results, which can be explained by the time frame of the intervention being too short to measure change in this domain. The results indicative of the increased psychosocial functioning and QOL are, however, overwhelming, and it can thus be concluded that TTSA, by successfully decreasing (separation) anxiety and challenging behavior, can increase the psychosocial functioning and QOL of persons with ID.

Mobile technology proves to hold many benefits for the user (Davidson, 2012; Stock, Davies, Wehmeyer, & Palmer, 2008), and it is therefore important to further examine the possibilities of mobile technology in the treatment of persons with ID (Scherer, 2012). It is furthermore noteworthy that this is, to our knowledge, the only study—together with Jonker and colleaues (2015)—which explored the inclusion of technology in the treatment of SA in persons with ID. It thus stands to reason that more research in this field is necessary.

Davidson (2012) found that, as with any other consumer of technological devices, the participants in her study were more inclined to use the technology for music, films, and games than for learning purposes. Keeping the participant engaged in the therapeutic application of the device poses a challenge for future technologically-based interventions.

Limitations

Although the software for this technology was specially developed and the hardware adapted for the ID population, the high number of cancelled messages can indicate that the participants frequently made errors. Further research needs to be conducted into the reason for this to optimize the technology for the target group. The standardized instruments measuring anxiety in this study is designed to measure overall anxiety levels, while TTSA aims to decrease specifically SA. To our knowledge, no instrument dedicated to measuring SA is available. In spite of this limitation, the results are able to show a decrease in anxiety.

Insecure attachments and limited cognitive skills specifically related to the development of object and person permanence give rise to SA in persons with ID. Although this research shows the positive influence of TTSA on the anxiety experienced by the participant, its influence on the attachment relationship itself and whether it addresses cognitive skill such as person/object permanence is unknown. Further research into these secondary aims is needed to confirm the theoretical underpinnings of TTSA.

The long-term effects of the intervention could not be established due to the time frame of the study. However, the authors are confident that the participants did not become dependent on the device, as shown by the fact that none of the participants requested to use the technology after the final phase of the intervention. This points to the possibility of TTSA working on a level beyond the technology itself, and may provide insight into latent functions of the therapy method.

Conclusion

It is acknowledged that while the hypothesis posited at the outset of this research was confirmed by the preliminary results, further research on larger sample sizes is necessary to confirm the results and to determine the long-term sustainability of the intervention effects. Nevertheless, in pursuit of advocating the cause of a vulnerable population, the authors wish to raise the imbalance of resources spent on developing smartphone technologies for the mainstream population compared to the available technologies suitable for the ID population.

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