International Journal of Speech-Language Pathology

ISSN: 1754-9507 (Print) 1754-9515 (Online) Journal homepage: www.tandfonline.com/journals/iasl20

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**To cite this article:** Birte Wiele, Susanne Cook, Erik X. Raj & Stefan Heim (2025) Long-term evaluation of psychosocial impact and stuttering severity after intensive stuttering therapy, International Journal of Speech-Language Pathology, 27:3, 450-464, DOI: 10.1080/17549507.2024.2371869

**To link to this article:** https://doi.org/10.1080/17549507.2024.2371869



Published online: 02 Sep 2024.

*International Journal of Speech-Language Pathology*, 2025; 27: 450–464



# Long-term evaluation of psychosocial impact and stuttering severity after intensive stuttering therapy

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## Abstract

*Purpose*: The purpose of this study was to assess the long-term stability of objective and subjective psychosocial improvements and fluency more than 10 years after participation in an intensive stuttering therapy camp.

*Method*: Ten former participants in intensive stuttering therapy (IST; mean age at time of intervention 14; 2 years) participated in this study. Outcomes of the IST at that time were assessed with the Stuttering Severity Instrument (SSI-3; Riley, 1994) and a questionnaire to measure the psychosocial impact of stuttering. A semi-structured video call and a general questionnaire for the long-term evaluation were used to gauge the participants' perceptions of the IST. These follow-up data were compared to the therapy outcomes reported by Cook (2011, 2013).

*Result*: Therapy effects on the severity of stuttering and psychosocial impact were stable over the follow-up period of more than 10 years. Moreover, scores for psychosocial impact and severity of stuttering further decreased from the end of the IST to the long-term evaluation. The intensive time and the periodically offered follow-up treatments were described as particularly positive by the participants.

*Conclusion*: Intensive stuttering therapy in childhood or adolescence can have a long-term positive effect on both internal and external stuttering symptoms.

**Keywords:** *stuttering; long-term evaluation/effectiveness; intensive therapy intervention in Germany; stuttering severity; psychosocial impact*

## Introduction

Stuttering is a speech fluency disorder that may not necessarily be fully resolved; symptoms in children and adolescents who still stutter after puberty are likely to persist (Johannsen, 2001; Månsson, 2000; Sandrieser & Schneider, 2015; Yairi & Ambrose, 2004, 2013). For this reason, stuttering treatment should not only be effective in the short- or medium-term but should also help people who stutter (PWS) in the long term. Furthermore, stuttering is often accompanied by relapses (Huinck et al., 2006; Wendlandt & Springer, 2009). So, long-term follow-ups after intensive therapy are recommended while short-term intensive therapies without planned refreshers are to be discouraged (Euler et al., 2009; Natke et al., 2010b; Neumann et al., 2016).

In stuttering treatment, the therapeutic approaches of fluency shaping and stuttering modification are well-established (Bothe et al., 2006; Guitar, 2014; Logan, 2022). Fluency shaping is a behavioural therapeutic method with a focus on either increasing the overall speech fluency or preventing disfluencies from occurring, by teaching a new pattern of speech using fluency-enhancing techniques such as easy onset, prolonging sounds or words, and pausing. Stuttering modification approaches, on the other hand, concentrate on directly modifying stuttering events using speech techniques such as cancellations, pullouts, and preparatory sets, which can all be done

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ISSN 1754-9507 print/ISSN 1754-9515 online © 2024 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group
Published by Taylor & Francis
DOI: 10.1080/17549507.2024.2371869

without altering fluent parts of speech (Neumann et al., 2017). An important part of the modification approach is the desensitisation towards speaking and stuttering (Cook et al. 2013; Murphy et al. 2007; Van Riper 1973).

In the literature, a combination of both fluency shaping and stuttering modification is often described as useful (Metten et al., 2007; Natke et al., 2010b; Neumann et al., 2017). Logan (2022) described combination approaches as "broad-based interventions" (p. 508) that merge more than one type of stuttering therapy approach. This blending of the two combines the advantages of the different techniques and thus allows PWS to choose what works best for them at different times, during various speaking situations. Consequently, combinations of the different methods are nowadays part of the general therapy of PWS (Guitar, 2014; Logan, 2022; Natke et al., 2010a; Prüß & Richardt, 2014; Rosenberger et al., 2007; Thum & Mayer, 2014).

The effectiveness of stuttering treatment is shown by positive outcomes and the stability of the therapy effect over time while taking the reliability of the results into account (Bloodstein & Ratner, 2008). There are many instances of evidence for adolescents and adults and the use of fluency shaping techniques, and only a small body of evidence for stutter modification and the combination of both methods (Neumann et al., 2016). Positive effects for long-term outcomes of 2 to 5 years for adolescent and adult PWS can be shown for fluency shaping (Euler et al., 2009, 2016), stutter modification (Natke et al., 2010b), and the combination of both approaches (Prüß & Richardt, 2015). Empirical studies that provide evidence of the long-term effectiveness of an intervention from childhood to adulthood could not be found at the time of the present study.

To date, there is limited, but some, evidence to support the combination of fluency shaping and stuttering modification (Baxter et al., 2016; Blomgren, 2010; Sønsterud et al. 2020), resulting in an open recommendation in the evidence-based guidelines in Germany for this approach to be taken, whenever deemed appropriate by the therapist (Neumann et al., 2016, 2017).

### *Intensive stuttering treatment*

A treatment that used the combination of two methods was the Intensive Stuttering Treatment (IST) by Cook (2011). This combination approach was based on the methods of stuttering modification according to Van Riper (1973), and fluency shaping according to Herziger (2003). The treatment took place once a year between 2001 and 2011 during a 3-week summer camp (main camp). Several diverse summer camp experiences exist that are specifically designed for children and adolescents who stutter (Byrd et al., 2016) and are associated with significant reductions in the overall adverse impact of stuttering (Herring et al., 2022).

After the 3-week summer camp concluded, additional refresher meetings took place with a duration between 3–6 days, three times a year. It was recommended to participate in the refresher meetings for at least 1 year following the initial IST. Some participants chose to attend these refresher meetings for more than 1 year. The extended refresher meetings help to mitigate possible relapses during the intensive therapy period and it ensures the stability of the therapy effects. The quality and duration of refresher meetings, as well as relapse management, represent a necessary component of high-quality stuttering therapy (Natke et al., 2010a, 2010b; Neumann et al., 2016; Prüß & Richardt, 2015; Sandrieser & Schneider, 2015; Wendlandt & Springer, 2009).

Children, adolescents, and young adults between 9 and 20 years of age participated in the group intervention. The IST was meant to be an addition to weekly stuttering therapies, which usually take place on a weekly or biweekly basis. The holistic and experientially oriented approach of the 3-week summer camp is sometimes difficult to achieve in weekly therapy sessions, and it often helps children and adolescents to find a community of other PWS. The intensive therapy took place in Hessen, Germany, and children, adolescents, and young adults from all over the country participated. Each day consisted of three therapy sessions with all participants and two therapy sessions specific to different age groups, with about seven participants per group. During the 3 weeks of intensive therapy, the phases of stuttering identification, desensitisation, and modification were addressed and a workshop for parents took place.

### *Aim of the study*

Previous studies had already demonstrated the effectiveness of the IST with short- and medium-term therapy effects related to a positive change in the internal (psychosocial impact) and external (stuttering severity) stuttering symptoms (Cook, 2011, 2013; Cook et al., 2013; Metten et al., 2007; Rosenberger et al., 2007). The treatment effects in the outcome parameters mentioned above remained stable 4 months after the end of the IST. However, there is a lack of studies on the long-term evaluation of the IST according to Cook (2011). The 2008–2009 cohort of the IST has been evaluated for short- and medium-term effects related to external and internal stuttering symptoms, and this data was used as a baseline for the present study.

The following questions were evaluated:

- Do the participants show descriptive changes (a) in the psychosocial impact and (b) in stuttering severity as a result of the IST from pre-test 2008 (T1) to follow-up 2019 (T4)?

- Were the improvements (a and b) from the first follow-up (four months after the end of therapy, T3) to the long-term follow-up (T4, 10 years after the initial data collection) observable over that long period?
- What subjective therapy outcomes do the participants describe?

## Method

### *Design and data basis*

The present study was approved by the ethics committee of the medical faculty at the RWTH Aachen University in Germany. The basis for the present long-term evaluation was the study by Cook (2011). The data from the study by Cook (2011) was collected in a pre-post-test design with follow-up after 4 months (see Figure 1). The data collection occurred during the IST 2008–2009. Cook's study (2011) included a total of 64 German-speaking children who stutter (CWS) aged 9;0–20;3 years ($M = 13;9$ years, $SD = 2;10$ years). The data were collected at two different therapy locations: (a) intensive therapy intervention in Germany in 2008 and 2009 and (b) intensive therapy intervention in Austria in 2009.

The 2019 follow-up study included all participants who had therapy in Germany. In 2008, 30 CWS (20 boys, 10 girls) aged between 9;0 and 18;6 years ($M = 13;10$ years, $SD = 2;9$ years) participated in the IST. In 2009, 14 CWS (nine boys, five girls) aged between 10;2 and 20;3 years ($M = 14;3$ years, $SD = 3;2$ years) participated in the IST.

For a subgroup of 22 participants from 2008 to 2009 (16 boys, six girls) the following data were available: Stuttering severity measured with the Stuttering Severity Instrument–Third Edition (SSI-3) before the intervention (T1), after the intervention (T2), and 4 months later (T3), as well as psychosocial impact measured with the speech questionnaire (Fragebogen zum Sprechen; FzS) at T1 and T3. For this reason, the comparison of the data from 2011 for 22 participants was compared with those from 2019. All children and adolescents were officially diagnosed with stuttering. These participants either participated in the 3-week main intervention during 2008–2009 or participated in the 1-week refresher course, having participated in one of the previous main interventions. In addition, all participants of the IST had already been in a weekly stuttering intervention before, in parallel, and/or afterward.

This influencing factor was already shown in the previous studies by Metten et al. (2007) as well as Rosenberger et al. (2007), and should be considered when interpreting the therapy results. At the time of initial testing, the psychosocial impact was evaluated with the FzS (Cook, 2013) and the severity of stuttering with the SSI-3 (Riley, 1994). An overview of the quantitative and qualitative data of Cook (2011) is presented in Table I. The psychosocial impact was not determined for the post-test (T2). Previous studies have already shown that the psychosocial impact does not change directly after therapy (Cook, 2011; Rosenberger et al., 2007). A possible reason might be that it takes time to adapt learned techniques as well as changes in self-esteem and self-convictions in everyday life (Cook, 2011; Rosenberger et al., 2007).

Data on the pre-test (T1), post-test (T2), and 4-month follow-up (T3) was acquired by Cook (2011) to demonstrate the change in stuttering severity. For this reason, only a comparison was made between the data from T1 and T3 for the long-term follow-up (T4, 10 years after the initial data collection). For the long-term evaluation of the IST by Cook (2011), a follow-up test (T4) was conducted with two survey dates. At the first point in time, the participants received the questionnaires listed in Instruments including written instructions. At the second time of the survey, a 60-minute semi-structured interview was conducted via video call on the program Cyph (Lester & Boehm, 2018) with the participants. For organisational reasons, the interviews were not conducted at a fixed time of

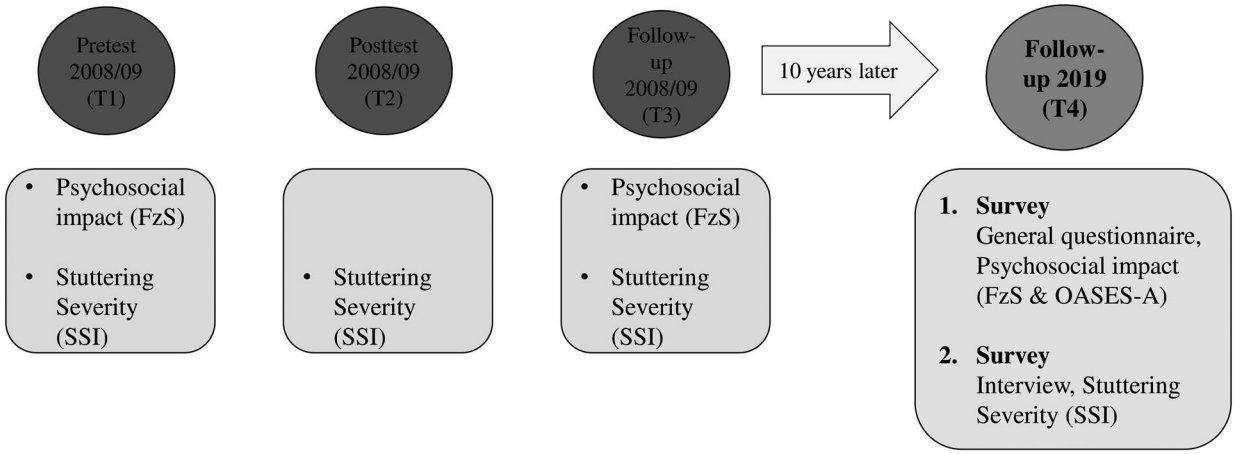


Figure 1. Design: data basis T1–T3 (Cook, 2011) and follow-up study T4.
*Note.* FzS = speech questionnaire (Cook, 2013); SSI = Stuttering Severity Instrument 3 and 4 (Riley, 1994, 2009); OASES-A = Overall Assessment of the Speaker's Experience of Stuttering (Yaruss & Quesal, 2016).

Table I. Data is based on the study by Cook (2011) for the present follow-up study.

| | FzS T1 (07/07/2008) | FzS T2 (25/07/2008) | FzS T3 (14/11/2008) | SSI-3 T1 (07/07/2008) | SSI-3 T2 (25/07/2008) | SSI-3 T3 (14/11/2008) |
|---|---|---|---|---|---|---|
| Mean | 87.3 | Not specified | 75.8 | 28.8 | 18.6 | 19.1 |
| *SD* | 17.47 | Not specified | 20.64 | 7.89 | 10.56 | 10.10 |
| Severity level | Moderate to severe | Not specified | Moderate | Severe | Mild to moderate | Moderate |
| Minimum | 56 | Not specified | 37 | 11 | 0 | 0 |
| Maximum | 124 | Not specified | 121 | 50 | 41 | 43 |

Survey of psychosocial impact with the speech questionnaire (FzS; Cook, 2013) and measurement of stuttering severity with the Stuttering Severity Instrument–Third Edition (SSI-3; Riley, 1994) for $n = 22$ at the time of testing (T).

Table II. Participants' data on main camp and follow-up treatments.

| Participant | Age | Gender | Main camp | Follow-up treatment | Duration in camp | Age in main camp |
|---|---|---|---|---|---|---|
| 1 | 27 | Female | 2005 | 2006–2011 | 6 | 13 |
| 2 | 28 | Male | 2008 | 2009–2011 | 3 | 17 |
| 3 | 28 | Female | 2008 | 2009 | 1 | 18 |
| 4 | 26 | Female | 2002 | 2006–2011 | 6 | 9 |
| 5 | 30 | Female | 2009 | 2010–2011 | 2 | 20 |
| 6 | 23 | Male | 2006 | 2007–2009 | 3 | 9 |
| 7 | 27 | Male | 2008 | 2009–2011 | 3 | 17 |
| 8 | 30 | Male | 2004 | 2005–2010 | 6 | 16 |
| 9 | 27 | Female | 2004 | 2005–2009 | 5 | 12 |
| 10 | 21 | Female | 2009 | 2010–2011 | 2 | 11 |

*Note*. Duration in camp in years.

day. All participants were questioned and interviewed within 3 months. The questionnaires were sent out as well as returned in February and March 2019. Interviews were conducted in April and May 2019. For consistently reporting the follow-up results, the test date was set for April 2019.

### *Participants*

Participants of the IST could join a private Facebook group, founded by a former participant as an initiative to stay in touch after the intensive therapy concluded in 2011. This group had 52 members. The former participants of the IST were first informed about the study by the second author via the Facebook group. If they were interested in the study, participants contacted the first author and received the information letter via email.

All participants who received an intervention during the period from 2008-2009 and participated in the original study (Cook 2011) with data collection on T1, T2, and T3 were eligible to participate. The necessary inclusion criteria were collected via a self-report by the interested participants. Participation in the study was voluntary. A total of 10 former participants (four men and six women) of the IST between 2008 and 2009 took part in the follow-up study.

Five of the ten participants were in the 3-week main camp from 2008 to 2009. The other five participants took part in a follow-up week having participated in the 3-week main camp in one of the previous years (see Table II). The sample consisted of young adults aged between 21;8 and 30;11 years ($M = 26;7$ years, $SD = 2;8$ years), who were individuals aged between 9;0 and 20;0 years ($M = 14;2$ years, $SD = 3;9$ years) at the time of the intervention. The ages given refer to the participation in the main camp. A total of five former children between 9;0 and 13;0 years and five former adolescents and young adults between 16;0 and 20;0 years participated in the study.

All participants had further speech therapy after the 3-week main camp. This included the selective follow-up treatment of the IST until 2011. These follow-ups were attended by the 10 participants on average 3;7 years ($SD = 1;8$ years; minimum = 1 year, maximum = 6 years) after the end of the main camp. It should be noted that the IST took place for the last time in 2011, which is why the participants had no further opportunity to participate in the follow-up treatments. Three participants reported further speech therapy treatment outside the IST. One of these three participants attended another intensive stuttering therapy experience, with a focus on breathing techniques, 2 years after finishing the IST. Also, another one of these three participants attended regular weekly speech therapy to generalise strategies introduced during the IST for 3 years in his childhood, and then for 2 years as a university student. Lastly, the third participant attended weekly speech therapy at the time of this study. The focus of this therapy was on improving the overall verbal skills, specifically during job interviews.

### *Instruments*

#### *General questionnaire for long-term evaluation*

To collect qualitative data on the IST and other interventions, a general questionnaire for long-term evaluation was devised (Wiele, 2019; see Appendix A). The questionnaire was designed by the retrospective

study by Euler et al. (2014). In that study, German PWS were asked about the completion of stuttering therapies with 10 open and one closed question. The first part of the general questionnaire contained five open questions about the IST. These questions were used to collect information about the main 3-week intervention, follow-up treatments, modification techniques, and the participants' perception of the IST. The second part of the questionnaire contained four questions to determine the further path of life-related to stuttering. These questions were used to collect information about further interventions, the use of learned techniques, and the severity of stuttering.

*Instruments to measure the psychosocial impact of stuttering*

For the long-term evaluation of the psychosocial impact, the FzS of Cook (2013) was administered, as was already done in the original study by Cook (2011). The FzS is a paper and pencil test that consists of 27 questions with a six-level, Likert-type response scale from "strongly agree" to "strongly disagree." All the questions relate to the four dimensions specified in the International Classification of Functioning, Disability and Health, more commonly known as the ICF (World Health Organization, 2001): body functions, personal factors, activity and participation, and environmental factors. The questionnaire covers the following aspects: (a) attitudes towards stuttering, (b) feelings when stuttering, (c) different speaking situations, and (d) the influence of stuttering on different areas of life. A total score between 27 and 162 can be achieved, where lower values indicate milder psychosocial impact and higher values represent the stronger psychosocial impact of stuttering on the life of the PWS. A raw score of 27 to 32 indicates that there is no psychosocial impact of stuttering. The FzS is a valid and reliable instrument for recording the psychosocial impact of stuttering on children and adolescents aged 8;0 to 17;11 years (Cook, 2013).

The score obtained on the FzS provides a severity rating ranging from very mild to very severe, which reflects the psychosocial impact of stuttering on the person's life. In the present study, participants were now young adults. For this reason, the following two items were formally adapted to adulthood: Item C3, "it is hard for me to talk to adults," was modified to "it is difficult for me to speak to authoritative persons" and item D2, "my ability to succeed at school is not influenced by my stuttering," was modified to "my ability to succeed professionally is not influenced by my stuttering." Furthermore, the questionnaire Overall Assessment of the Speaker's Experience of Stuttering–Adult (OASES-A) by Yaruss and Quesal (2016) was used for the criterion validity of the FzS for adults. At the time of Cook's (2011) study, there was no German version of the OASES for children and adolescents. The OASES-A was included in the study to ensure that the FzS is also meaningful for young adults. The two questionnaires are considered comparable (Neumann et al., 2016; Zückner, 2017).

*Semi-structured interview*

To assess the severity of stuttering, a semi-structured interview was conducted via video call (see Appendix B). The browser-based program Cyph (Lester & Boehm, 2018) was selected with the security of personal data and user-friendliness in mind. Video calls were successfully used in previous studies as a setting for the collection of qualitative and quantitative data from PWS (Irani et al., 2012; Sedgwick & Spiers, 2009). Krouwel et al. (2019) assessed differences between in-person and video-call interview methods and concluded that both methods were comparable from a qualitative perspective. During the video call, the participants could see the interviewer and themselves on the desktop. In addition to the video call, it was possible to write in a chat. At the beginning of the interview, the participants were given an overview. The interview had the following structure: introduction of the first author and the participant (warm-up), 15 open factual and emotional questions, the reading text Berlin (see Appendix C), and finally questions on self-assessment of speaking based on the questionnaire Clinical Use of Self Reports (CUSR) by Riley (2009).

Moreover, the participants were asked about their subjective perception of the IST. The questions in the semi-structured interview were open and dialogue-oriented (Helfferich, 2011), with the interviewer asking follow-up questions. Additionally, follow-up questions were asked about the information provided by the participants in the general questionnaire for long-term evaluation (Wiele, 2019) to specify the answers regarding the IST and possible follow-up interventions. The participants were encouraged to talk, in detail, about each question. The catalogue of questions (see Appendix B) was designed by the case history of stuttering clients from the manual for the intensive modification of the stuttering program from Zückner (2014). The questions refer to demographic data such as educational background, family history, personal history of stuttering, and therapies. Other open-ended questions asked about hobbies, the last vacation, and a most recent movie or book. The interview lasted between 50 and 70 minutes and was conducted by the first author. All interviews were recorded on audio and video, and transcribed afterwards.

*Instrument to measure stuttering severity*

In the original study of Cook (2011), the SSI-3 (Riley, 1994) was used to determine the severity of stuttering because this was the most recent version, at that time. For the present study, the SSI-4 (Riley, 2009) was used. The German translation by

Sandrieser and Schneider (2015) was used to evaluate the speech samples. The SSI measures the frequency of symptoms, the duration of the three longest symptoms, and physical concomitant behaviour, and combines them into an overall score. According to Riley (2009), the SSI is a reliable (retest reliability and inter-rater reliability) and valid instrument that can be used in clinical work, as well as for research purposes if the guidelines in the manual are followed and the examiners are sufficiently trained.

Davidow and Scott (2017) observed generally lower reliability for the evaluation with the SSI-4 about the subareas, the total score, as well as the stuttering severity than Riley (2009). The authors suspect that the "multitasking nature of the instrument" (Davidow & Scott, 2017, p. 1117), i.e. simultaneous evaluation of frequency, duration, and physical behaviour, place too high demands on the examiner to be able to pay equal attention to all areas. To ensure the reliability of the evaluation with the SSI-4, as well as the objectivity of the first author's rating, a second rater was included in this study. The second rater was a qualified speech-language pathologist with over 20 years of clinical expertise in the field of fluency disorders. The spontaneous speech was analysed and evaluated according to the guidelines in Riley's (2009) manual. The validation of the instrument was carried out based on English-speaking individuals. However, Sandrieser & Schneider (2015) stated that it is acceptable to use Riley's norms, as it is not a language-bound test.

The SSI-4 also includes the CUSR questionnaire for self-assessment of stuttering for adults aged 18 years and older (Riley, 2009). The CUSR is not standardised and has no normative scores. A total of eight questions of the CUSR were used for this study: two questions on representativeness (one about the speech sample and one about stuttering compared to everyday life), as well as six questions on subjective self-assessment of speaking, stuttering, avoidance behaviour, the naturalness of speaking, and control of stuttering. The main purpose of the six questions was to check the comparison of self-assessment of stuttering severity to the raters. This was an intentional decision because this is a one-time survey of spontaneous speech, and it is known that stuttering can fluctuate strongly in phases (Constantino et al., 2016). The questions were answered on a 10-level rating scale (1 = positive value to 10 = negative value). Overall, a total score of 60 can be achieved. A higher score on the six questions of the CUSR indicates a more critical self-assessment of stuttering.

### *Procedure*

The data in the general questionnaire for long-term evaluation (Wiele, 2019) were evaluated qualitatively. The following data were used to describe the sample: age, gender, time of therapy in the main camp, use of follow-up treatments, total time of the IST including follow-up treatments, age at the 3-week intervention, and completion of further interventions. To survey the participants' perception of the IST, categories were developed from the answers to the open-ended questions on therapy satisfaction. The following six categories were established based on the responses: desensitisation, modification techniques, group support, setting of the therapy, periodic follow-up treatments, as well as the possibility of helping as an assistant. The information provided by the participants was assigned to these six categories.

The standardised questionnaires, FzS (Cook, 2013) and OASES-A (Yaruss & Quesal, 2016), were evaluated per participant according to the method of the respective procedure.

The evaluation of the symptoms (differentiation of stuttered and non-stuttered syllables) was performed according to the guidelines of the SSI-4 manual (Riley, 2009). In the analysis of spontaneous speech, the modification techniques such as melodious speech were counted as fluently spoken syllables. Controlled stuttering, as demonstrated using stuttering modification techniques, was counted as a stuttered syllable according to the guidelines in Riley's (2009) manual. To determine the severity of stuttering, three questions during the semi-structured interview were evaluated. The parts to be analysed were distributed over the interview time so that spontaneous speech was assessed in the first (after 10 min), middle (after 25 min), and last interview section (after 50 min). Thus, the variability of stuttering that can occur due to the unknown interviewer and the setting of the video call was taken into account (Irani et al., 2012; Natke et al. 2010a). To ensure comparability and objectivity of the speech samples, the following three open-ended questions of the interview were analysed: "tell me something about your hobbies," "describe your stuttering symptoms," and "tell me something about your last book, film, or vacation." The selection of questions was based on Cook's (2011) study. To determine the severity of stuttering for the follow-up (T4), three video recording parts with 250 syllables each (a total of 600–750 syllables, depending on the participant's narrative) of the interview, as well as the reading text Berlin (at the end of the interview, with 234 syllables), were analysed for each participant with the SSI-4. The interview, which served to determine the severity of stuttering, could not be conducted with one participant because of technical reasons.

Subsequently, a group comparison of the psychosocial impact with $n = 10$ and the stuttering severity with $n = 9$ was carried out on the data from Cook (2011), $n = 22$.

### *Data analysis*

As a result of the small sample size, the data were analysed descriptively. A further statistical analysis is provided in Appendix D. The two questionnaires, FzS

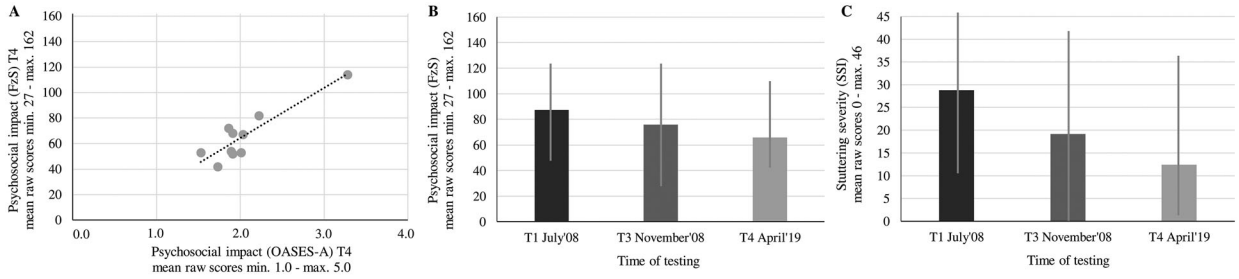


Figure 2. (A) Comparison of the results in both questionnaires for each participant: the psychosocial impact of stuttering in the FzS (Cook, 2013) and in the OASES-A (Yaruss & Quesal, 2016). (B) Group comparison of the mean psychosocial impact of stuttering in FzS (Cook, 2013) at the three test points. T1 and T3 data basis of Cook (2011). T4 survey for follow-up by Researcher 1. (C) Group comparison of the mean severity of stuttering in SSI (Riley, 2009, 1994) at the three test points. T1 and T3 data basis of Cook (2011). T4 survey for follow-up by Researcher 1.

Table III. Comparison of the results at T4 in SSI-4 (Riley, 2009) of the two raters.

| P | SP %SS (1R) | SP %SS (2R) | SP RS (1R) | SP RS (2R) | R %SS (1R) | R %SS (2R) | R RS (1R) | R RS (2R) | DLS RS (1R) | DLS RS (2R) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.75 | 1.65 | 3 | 3 | 0.00 | 0.00 | 0 | 0 | 2 | 2 |
| 2 | 0.55 | 0.47 | 2 | 0 | 0.43 | 0.62 | 0 | 2 | 2 | 2 |
| 3 | 11.45 | 13.02 | 7 | 8 | 5.13 | 5.13 | 6 | 6 | 14 | 14 |
| 4 | 0.15 | 0.00 | 0 | 0 | 0.00 | 0.00 | 0 | 0 | 2 | 0 |
| 5 | 2.25 | 2.17 | 3 | 3 | 0.00 | 0.00 | 0 | 0 | 6 | 6 |
| 6 | 1.74 | 1.38 | 3 | 2 | 1.28 | 0.85 | 2 | 2 | 4 | 4 |
| 7 | – | – | – | – | – | – | – | – | – | – |
| 8 | 1.07 | 0.67 | 2 | 2 | 0.00 | 0.00 | 0 | 0 | 4 | 4 |
| 9 | 0.27 | 0.19 | 0 | 0 | 0.00 | 0.00 | 0 | 0 | 2 | 2 |
| 10 | 2.39 | 2.37 | 3 | 3 | 4.11 | 3.85 | 5 | 5 | 12 | 12 |

*Note*. For technical reasons, the interview to assess stuttering severity with Participant 7 could not be conducted.
P = participant; SP = spontaneous speech; %SS = percentage of stuttered syllables; R = reading; DLS = duration of the three longest symptoms; RS = raw score; 1R = first rater; 2R = second rater.

(Cook, 2013) and OASES-A (Yaruss & Quesal, 2016), were used to assess the psychosocial impact of stuttering. The former participants had been children or adolescents at the time of the intervention in the original study by Cook (2011) but were adults at the time of the present long-term follow-up. As the FzS only provides normative data for children and adolescents, but not for adults, different tests of psychosocial impact with their corresponding normative values had to be applied at the two time points. The OASES-A measures the psychosocial impact caused by stuttering in the everyday life of a stuttering person, similar to the FzS.

The comparison of the results in both questionnaires shows a similar severity of the psychosocial impact—see Figure 2(A). The FzS would therefore also be meaningful for the adult participants, related to this follow-up study. In both questionnaires, the participants showed a mean severity rating of mild to moderate psychosocial impact (FzS: $M = 65.7$, i.e. mild to moderate; OASES-A: $M = 2.0$, i.e. mild to moderate). A further statistical analysis is provided in Appendix D.

Additional analysis: A second rater also assessed the spontaneous speech (three parts with 250 syllables of the interview, as well as the reading text Berlin with 234 syllables) to ensure the reliability of the evaluation with the SSI-4, as well as the independence of the first author (see Table III). The evaluation of the frequency of symptoms in spontaneous speech as well as reading (first part), and the duration of the three longest symptoms (second part) was carried out using the audio track of the video call because of data protection reasons. There was only an agreement from the participants that the first rater was allowed to see the person on the video. For this reason, the evaluation of the physical concomitant behaviour (third part) could not be carried out by the second rater. To compare the results of the two raters, the scores per test part were used in the SSI-4 test form. A further statistical analysis with the rank correlation coefficient $\tau$ according to Kendall to determine the inter-rater correlation is provided in Appendix D.

Furthermore, the total score of the six questions was used in the CUSR for self-assessment of stuttering and in the SSI-4 for external assessment of stuttering. The comparison of the two raw scores was used to check the representativeness of the collected speech samples.

## Result

### *Psychosocial impact FzS*

To determine the psychosocial impact of stuttering for the follow-up (T4), the raw scores in FzS were averaged for the participants ($n = 10$). The mean psychosocial impact measured with the FzS for the three test times (T1, T3, and T4) is shown in Figure 2(B).

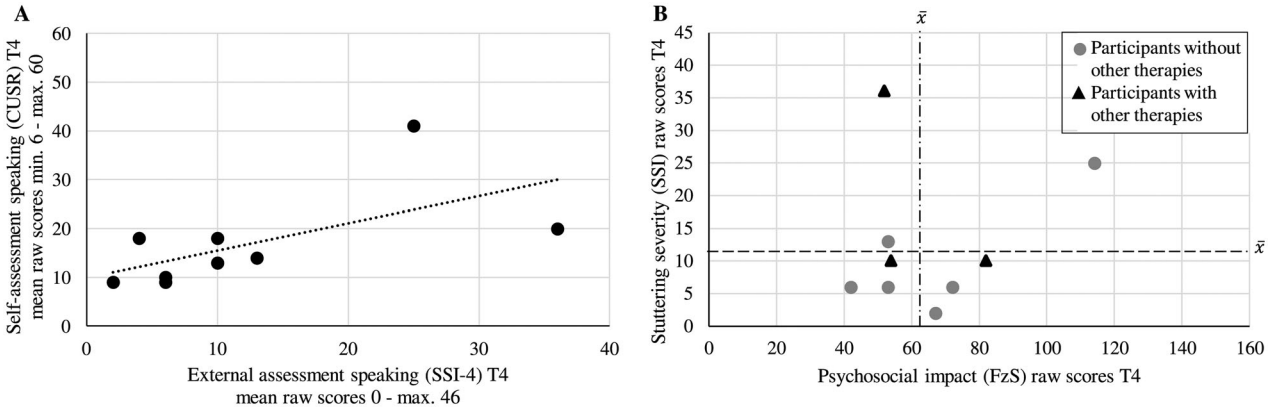


Figure 3. (A) Comparison of results on self-assessment of speaking and stuttering in the CUSR (Riley, 2009) and external assessment of speaking and stuttering in the SSI-4 (Riley, 2009) for the participants. (B) Comparison of the participants with and without additional therapies.

Table 4. Participants' perception of the intensive stuttering therapy according to the participants' statements.

| Categories | Participants' statements |
|---|---|
| 1. Desensitisation | Dancing (perception exercises), in vivo exercises ("hardening"), stuttering together, self-confidence, courage, self-awareness, accepting and respecting stuttering |
| 2. Modification techniques | Safety, control |
| 3. Group support | Other PWS of the same age (small groups/peers), new friends, group identity, human interaction, solidarity |
| 4. Setting of the IST | Intensive therapy, group therapy, atmosphere of summer camp, fun, exchange, classification of stuttering severity, getting out of everyday life, motivation |
| 5. Periodic follow-up treatments | Strengthening for everyday life, seeing friends again, "emergency plan," refreshment, individual therapy, feedback from outsiders, motivation boost |
| 6. Possibility to help as an assistant | Appreciation, support other participants |

*Note.* The categories (response options) were not given to the participants. PWS = a person who stutters; IST = intensive stuttering therapy.

The data basis for T1 and T3 of psychosocial impact can be found in Table I. The mean psychosocial impact of stuttering was a raw score of 65.7 ($SD = 20.69$) for the long-term follow-up (T4). The mean severity of psychosocial impact was mild to moderate, with a minimum raw score of 42.0 (severity = very mild to mild) and a maximum raw score of 114.0 (severity = very severe).

The raw scores of the psychosocial impact decrease from T1 to T4, as well as from T3 to T4. Before starting the IST, the participants had an average of moderate to severe psychosocial impact of stuttering. Four months after the end of therapy, the participants had a moderate psychosocial impact of stuttering. At T4, the mean psychosocial impact was mild to moderate.

### *Stuttering severity SSI*

To determine the severity of stuttering for the follow-up (T4), three video recording parts with 250 syllables of the interview as well as the reading text Berlin with 234 syllables were analysed for each participant ($n = 9$[1]) using the SSI-4 of Riley (2009). The mean score of stuttering severity in SSI for the three test points (T1, T3, and T4) are shown in Figure 2(C). For the long-term follow-up (T4), the mean severity of stuttering was a raw score of 12.4 ($SD = 11.11$). The mean stuttering severity was very mild, with a minimum raw score of 2.0 (no severity) and a maximum raw score of 36.0 (very severe). The data T1 and T3 of Cook (2011) on the severity of stuttering at that time are also listed in Table I. The raw scores of the severity of stuttering decrease from T1 to T4, as well as from T3 to T4. Before starting the IST, the participants had an average of severe stuttering severity. Four months after the end of therapy, the participants had a moderate stuttering severity. At T4, the mean stuttering severity was very mild.

Additional analysis: The second rater assessed the spontaneous speech samples to ensure the sustainability of the SSI-4 results and the independence of the first author. The results for spontaneous speech and reading (first part of the SSI-4), as well as for the duration of the three longest symptoms (second part of the SSI-4) of the two raters are shown in Table III. The two raters rated spontaneous speech and raw score identically for six of nine participants. For reading, the raters rated eight of nine participants the same. The two raters rated the duration of the three longest symptoms the same for eight of nine participants.

Furthermore, after the interview participants were asked to give their self-assessment of speaking and stuttering. Eight of the nine participants rated the spontaneous speech during the interview as representative. One participant felt his stuttering was less than

in everyday life. The comparison of the self-assessment of stuttering using six questions in CUSR and the external assessment in SSI-4 showed comparable results (see Figure 3[A]).

The comparison of the psychosocial impact of stuttering and stuttering severity for all participants with and without additional therapies is shown in Figure 3(B). Three participants mentioned that they had received further weekly and/or intensive therapies by the time of the 2019 follow-up study.

### *Participants' perception of the IST*

Participants were asked about their retrospective perception of the IST with one question in the general questionnaire for long-term evaluation (Wiele, 2019) and one open question, with further requests, during the semi-structured interview. All ten participants stated that they considered the IST to be helpful. Based on the answers of the participants, categories were formed as described in Instruments to be able to make statements for helpful therapy content for the entire group. In Table IV, the participants' statements on their perception of the IST were assigned to six categories. Most of the mentions were made for the category group support. A total of nine participants stated group support as helpful. According to the participants, this included getting to know other same-age peers who stutter, making new friends, solidarity, human interaction, and the resulting "group identity." The positive categories of desensitisation, modification techniques, and periodical follow-up treatments were mentioned by eight participants.

In the area of desensitisation, the participants described the positive use of perception exercises as helpful, such as dancing in a circle; the in-vivo exercises for open stuttering as well as for desensitising; and the resulting self-confidence, courage, self-belief, and acceptance of stuttering. Eight participants described the learning of modification techniques as useful because, according to them, it gave them confidence in speaking and control over stuttering. The positive perception of periodic follow-up treatments was also mentioned by the participants. Within the follow-up treatment, the participants considered the refreshment of the therapy content, the reunion with friends for exchange, and the development of an individual "emergency plan"[2] in individual therapies as helpful.

According to their statements, the participants felt strengthened and motivated for everyday life by the follow-up treatment. In addition, they provided information on the positive use of feedback from outsiders (therapists as well as other participants) on their symptoms. Six participants mentioned the framework of the therapy as positive. According to the participants, the intensive time enabled them to directly practise and apply what they had learned. Furthermore, the participants stated that the therapy was experienced as reinforcement within the group and enabled them to classify their stuttering severity. In contrast, two of the six participants explained that the therapy within the large group was not as effective as in the small group, as well as in the individual therapy during follow-up treatment. One of the two participants further described the exercises within the large group as stressful and burdensome. Nevertheless, the atmosphere of the 3-week summer camp enabled the participants to get out of their everyday lives, have fun, exchange experiences with other children who stutter, and gain motivation, according to six participants. Four participants stated that they had helped as assistants during subsequent summer camps and described these experiences as appreciative and motivating. In addition, the participants shared that it helped them to openly deal with stuttering and to support other participants.

## Discussion

The aim of this study was to demonstrate a long-term therapy effect as well as a stabilisation of the therapy effect related to the impact and the severity of stuttering after attending the IST in 2008–2009. This was done by semi-structured interviews and two questionnaires.

### *Long-term stability of the intervention effect*

In previous studies, the short- and medium-term effectiveness could be proven in relation to a significant reduction of psychosocial impact and stuttering severity by the IST (Cook, 2011, 2013; Metten et al., 2007; Rosenberger et al., 2007). Within the present follow-up study, a long-term positive therapy effect, as well as the stabilisation of the therapy effect, was now demonstrated for 10 former participants of the IST-group 2008–2009.

In the long-term evaluation of the therapy, the participants showed, on average, a lower psychosocial impact of their stuttering and a lower stuttering severity than before the therapy. Furthermore, a long-term stabilisation of the therapy could be shown. The results of the average psychosocial impact measured with the FzS and the stuttering severity measured with the SSI-4 of the participants decreased even further. The measured effect of stabilisation is to be seen as the summary of past interventions, as well as follow-up treatment, as already explained in Design and data basis, and does not alone reflect the stabilisation of the therapy effect of the IST. This fact should be considered for long-term planning interventions.

According to Rosenberger et al. (2007) the IST served as a useful supplement to weekly stuttering therapy, which usually took place once a week. The further decrease of the psychosocial impact, as well as the stuttering severity to T4, may have been caused by the follow-up treatment of the IST or further interventions. On the other hand, the positive attitude towards stuttering already in childhood and adolescence may have led to a further decrease of the psychosocial impact in adulthood by integrating the positive handling of stuttering in everyday life over

time (Cook, 2011). The same could be assumed for the severity of stuttering.

Learning the modification techniques at a young age may enable an automated handling and execution of the techniques later in life. During the interviews, seven participants stated a positive perception of modification techniques. The term modification techniques include stuttering modification, as well as fluency shaping. Of the 10 participants, three no longer used techniques, four used one, and three used a combination of two techniques. This resulted in utilisation rates for the techniques of shortened slow motion, prolongation (40%), soft voice onset (30%), pullout (20%), and melodious speech (10%) from the entire group. Further information on the techniques learned and the techniques still used by these participants can be found in Appendix E. The use of these techniques was confirmed in the analysis of the spontaneous speech parts. The use of the modification techniques related to fluency shaping was counted as fluent speech (Sandrieser & Schneider, 2015), which ultimately led to a lower average degree of frequency of symptoms. The results indicate that early development of a positive attitude towards stuttering can positively influence living with speech fluency disorder in adulthood.

Comparable decreases in stuttering severity (percent of stuttered syllables) and psychosocial impact measured by OASES (emotion parameter) at a 2-year follow-up after therapy were reported in the study by Euler et al. (2016) on the approach of fluency shaping. The effect was strong from the pre-test to the follow-up after 2 years. For the post-test after intensive stuttering modification therapy, also large effects related to the reduction of negative feelings about stuttering were reported by Natke et al. (2010a, 2010b). The authors reported a slight increase in values at the first follow-up after 1 year and a renewed reduction of negative feelings from the first to the second year (follow-up) after intensive stuttering modification therapy, with a medium effect (Natke et al., 2010a, 2010b). A similarly large effect from the pre-test to follow-up after 5 years related to the reduction of stuttered syllables was reported by the combined therapy approach for adults according to Boberg & Kully (1985; Langevin et al., 2010). Thus, the results of the present study on the combined intensive therapy approach by Cook (2011) were in the range reported for stuttering therapies for adolescent and adult PWS (Bloodstein & Ratner, 2008; Euler et al., 2016; Langevin et al., 2010; Natke et al., 2010a, 2010b).

### *Participants' perception of the IST*

Treatments that, apart from modification techniques, also include exercises in the group and practise a transfer to everyday situations were described as effective (Bothe et al., 2006; Euler et al., 2014). Furthermore, there are indications that intensive stuttering therapies are possibly more effective than weekly stuttering therapies (Bothe et al., 2006). Eight out of ten participants stated that the different modification techniques and the individualised therapy were experienced as positive. This could be a direct benefit of the combination of modification and fluency shaping, which enabled the participants to choose the strategy that worked best for them in any given situation. The majority of participants stated the support of the group and the intensive time as subjective positive perceptions. These therapy components may have influenced the effectiveness of the therapy. Based on the information provided by the participants, younger children should already be allowed to experience group support, for example, in group therapy or when participating in individual treatment through self-help groups. According to the respondents, they found the support of peers within the small groups to be particularly helpful. The IST provided a framework in which the children and adolescents could practise and consolidate the content of the therapy over several days in a row. With the help of the periodical follow-up treatments, the therapy content could be refreshed and, according to the participants, helped to motivate and strengthen them for everyday life as proposed in the German evidence-based guideline (Neumann et al., 2016).

This suggestion is in line with the American Speech-Language-Hearing Association's (ASHA, 2022) recommendation of a programed follow-up intervention to aid generalisation, and to deal with possible setbacks as put forth in the clinical guideline for fluency disorders by Pertijs et al. (2014). While the follow-up treatment is usually a fixed component in intensive stuttering therapies, it is little established in weekly stuttering therapy (Wendlandt & Springer, 2009).

### *Limitations*

The results presented should be considered in the context of long-term evaluation studies and under the following limitations of the study. The statements of the results refer to a one-time follow-up of the psychosocial impact and the severity of stuttering. Phased fluctuations of stuttering cannot be taken into account; a baseline of measurements could minimise the fluctuations. At the time of the study, hardly any published studies on the long-term evaluation of combined intensive therapy from childhood to adulthood could be found. In addition, the use of the FzS for adults should be carried out with a larger sample to make reliable statements on the quality criteria (validity and reliability), and to standardise the questionnaire. For the long-term evaluation of the IST, a follow-up study was conducted for the first time. For well-founded statements on long-term efficacy several measuring points should be carried out, such as at annual intervals after the intervention. Furthermore, no control group was included in the study, so non-specific

therapy effects cannot be excluded. Second, the rather small sample size of $n = 10$ should be considered. For this reason, the choice was made to refrain from reporting inference statistics in this manuscript but provide the corresponding statistical information in Appendix D for the sake of comparability with other studies. Another possible limitation could be the expanded age range of the original participant group, with one participant being 20 years old at the time. In addition, results could be skewed, as participants who experienced positive outcomes in the initial IST may have been more likely to take part in the follow-up study. In this case, a generalisation to the total population of PWS with the intervention of combined approaches would only be possible to a limited extent—but even so, for these participants, long-term stability of the intervention could be shown.

Moreover, aspects within the evaluation of the follow-up study should be considered given possible limitations. Distortions of the long-term therapy effect cannot be excluded due to the use of additional therapies by three of the participants. Nevertheless, it can be seen in Figure 3(B) that the three participants with additional therapies are in different quadrants. A possible bias of the therapy effect is therefore less likely.

The measured long-term therapy effect should be regarded as the summary of past interventions as well as follow-up treatments, and does not alone reflect the stabilisation of the therapy effect of the IST. However, follow-up treatments are recommended in the clinical guidelines for fluency disorders (Neumann et al., 2016; Pertijs et al., 2014), and a positive therapy effect could be measured. Also, the IST was indicated as a supplement to weekly stuttering therapies (Rosenberger et al., 2007). In the present study, the influence of the follow-up treatments within the IST on the stabilisation of the therapy was not considered, and could be evaluated by repeating measurements before and after a follow-up.

## Conclusion

Based on the limited evidence and the open recommendation of the combination approaches of stuttering modification and speech restructuring for stuttering children and adolescents in the evidence-based guideline for speech fluency disorders (Neumann et al., 2016), a long-term evaluation of combined IST by Cook (2011) was conducted. In previous studies, the effectiveness of the IST as well as a short-term stabilisation of the therapy effect were already evaluated for a reduction of the psychosocial impact in FzS and the severity of stuttering in SSI-3 (Cook, 2011, 2013; Metten et al., 2007; Rosenberger et al., 2007).

In the present study, 10 former participants, who were young adults at the time of the follow-up study, were shown to have a stabilisation of the therapy effect for the aforementioned therapy outcome. The results of the present study based on the IST were in the range reported in other studies for intensive stuttering therapies (Bloodstein & Ratner, 2008; Euler et al., 2016; Langevin et al., 2010; Natke et al., 2010a, 2010b). The follow-up treatments within the IST were used by the participants on average 3–7 years after the end of the main 3-week intervention. The stabilisation of the therapy effect was possibly positively influenced by the follow-up treatments. This was evidence of the positive impact of after-treatment concepts integrated into stuttering therapies.

The periodic follow-up treatments were also described as particularly helpful in the retrospective survey of the participant's perceptions of the therapy. The fact that participants utilised the availability of follow-up treatments to generalise learned techniques is an additional positive outcome.

Further studies should investigate the influence of follow-up treatments to stabilise the therapy effect with repeated measurement times. In the future, a comparison of individual and group therapy should be carried out to examine the possible influence of the group setting on the therapy process in a more differentiated way. In addition, a comparison of PWS with and without intensive interventions in childhood or adolescence could provide information about the therapy effect in adulthood. Finally, the available results of the follow-up study should be supported by further long-term findings on combined approaches. Intensive stuttering therapy in childhood or adolescence can have a long-term positive effect on both internal and external stuttering symptoms. The knowledge gained from this study and the limitations identified can serve as a basis for planning evidence-based studies. To further strengthen the evidence, controlled randomised therapy studies on combined approaches with larger samples should be conducted and published.

## Notes

1. For technical reasons, a video call including the interview to determine the severity of stuttering could not be carried out.
2. Measures for self-help in case of relapse, such as increase of stuttering severity, loss of control, fear of speaking, and/or shame (Sandrieser & Schneider, 2015).

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## Appendix A: General questionnaire long-term evaluation of psychosocial impact and stuttering severity after an intensive stuttering therapy

Name:
Date:
Date of Birth:
Gender:

Please fill out the general questionnaire as well as possible. For questions you cannot or do not want to answer, please draw a line to indicate that you have read the question and then move on to the next question. Please remember what the current status is.

**Questions about Summer Camp Hessen (intensive stuttering therapy; IST)**

| Questions | Answers |
|---|---|
| Which year did you attend the main camp (3 weeks of intensive therapy)? | |
| What speaking technique(s) did you learn? | |
| Do you still use a learned speaking technique? If yes, which one? | |
| Did you find the therapy at summer camp helpful? Yes/No and why? | Yes [ ] No [ ] |
| Do you remember your stuttering severity rate at the time of the summer camp? Explanation:<br>• Quantitative: numerical value between6–40<br>• Qualitative: very mild to very severe | Before therapy:<br>After therapy:<br>Four months after therapy: |
| Do you remember your results on the psychosocial impact of stuttering? Explanation:<br>• Quantitative: numerical value between27–162<br>• Qualitative: very mild to very severe | Before therapy:<br>After therapy:<br>Four months after therapy: |

**Questions about further therapies**

| | |
|---|---|
| Have you had any other weekly speech therapy after the summer camp? If yes, what kind of therapy and for how long? | Yes [ ] No [ ] |
| Did you use any other intensive stuttering therapy after the summer camp? If yes, which one and why? Did this type of therapy help you? If yes, why? | Yes [ ] No [ ]<br>Yes [ ] No [ ] |
| Do you currently use a speaking technique independent of where you learned it? If yes, which one? | Yes [ ] No [ ] |
| How would you rate your current stuttering? | Controllable [ ]<br>Not controllable [ ]<br>Very mild [ ]<br>Mild [ ]<br>Moderate [ ]<br>Severe [ ]<br>Very severe [ ]<br>Please make a cross at controllable/not controllable as well as at a severity level. |

**Thank you very much!**

Below you will find the other questionnaires. Please keep in mind how you are currently feeling or speaking when answering.

## Appendix B: Semi-structured interview

**Factual and emotional questions**

**Warm-up**
Introduction of the investigator
Introduction of the participant

**Spontaneous speech Phase 1:** (evaluate 250 syllables)
**Leisure time**
Tell me something about your hobbies/leisure activities
Why are you doing this?

**Personal questions:**
Socioeconomic situation
Describe your educational and professional career
Sociofamily situation
Describe your family
Probing questions: Who did you live with? Who are you currently living with?

**Spontaneous speech Phase 2:** (evaluate 250 syllables)
**Stuttering Symptoms**
Describe your stuttering symptoms to me

Occurrence and course of stuttering
How did you experience the therapy at that time?
What was your takeaway from that therapy? Techniques, open/relaxed stuttering, self-confidence, network
Why did you take part in the therapy intervention?
What were the reactions of your social circle (of those around you)?
What therapies did you attend after the "Sommercamp?" If yes, what did you learn there?
Current status?
Triggering (initiating?)/maintaining factors
With whom or in which situations does your stutter increase: Family, contacts, leisure time, occupation
Personal reactions to stuttering events and avoidance behaviour
Which strategies do you use to compensate for stuttering?
How would you rate the effectiveness of these strategies?
Do you avoid stuttering? If yes, how?

**Spontaneous speech Phase 3:** (evaluate 250 syllables)
**Retell**
Tell me about your last book/movie/vacation
What was it, where, with whom, action

Reading text: Berlin (Cook, 2011)
Free choice of how to read
Reading without speech techniques
Reading with speech techniques

**Assessment of the interview on speaking, on a rating scale from 1 to 10 based on the questionnaire, Clinical Use of Self-Reports (CUSR; Riley, 2009).**

## Appendix C: Reading text Berlin (Cook, 2011)

Lesetext Berlin © Susanne Cook
Berlin ist Hauptstadt und Regierungssitz der Bundesrepublik Deutschland. Mit über 3 Millionen Einwohnern ist Berlin die bevölkerungsreichste Stadt Deutschlands und nach Einwohnern die zweitgrößte Stadt in der europäischen Union. Während seiner Geschichte wurde Berlin mehrfach Hauptstadt deutscher Staaten, wie beispielsweise des Deutschen Reiches oder der DDR, jedoch hier nur der Ostteil der Stadt.
Seit der Wiedervereinigung im Jahr 1990 ist Berlin gesamtdeutsche Hauptstadt und löste damit Bonn als Hauptstadt ab.
Berlin ist ein bedeutendes Zentrum der Politik, Medien, Kultur und Wissenschaft in Europa. Die Metropole ist ein wichtiger Verkehrsknotenpunkt und eine der meistbesuchten Städte des Kontinents. Berlin zieht mit seinen Attraktionen viele Besucher an und ist nach London und Paris das bevorzugte Reiseziel innerhalb Europas.

234 syllables, 115 words

## Appendix D: Statistical analysis

Given the small sample size, statistical inferences aimed at testing the generalisation of the observed effects in the sample to the population might be invalid and misleading. Therefore, the statistical analyses were not placed in the body text of the manuscript. Still, to provide the interested reader who might want to compare (with all precautions) the outcomes of the statistical analyses with other findings reported in the literature, we decided to place them in this appendix, without any strong claim for the validity of the results in the entire population.

The statistical analysis was carried out using SPSS Statistics 25. Overall, a significance threshold of $p \leq 0.05$ (one-tailed) was applied. To verify the long-term therapy effect, as well as the stabilisation of the therapy effect by the IST, the mean value data (T4) of the FzS (Cook, 2013) and the SSI-4 (Riley, 2009) were compared with the mean values of the data of Cook (2011; T1, T3) using the one-sample $t$ test.

### *FzS and OASES-a*

To assess the comparability of these two tests and thus the validity of a longitudinal comparison within and between the two scales, the criterion validity was tested to compare a new test with already validated tests that capture the same or similar characteristics. The OASES-A measures the psychosocial impact caused by stuttering in the everyday life of a stuttering person, similar to the FzS. Using the rank correlation coefficient $\tau$ according to Kendall of the overall results of the FzS and OASES-A, the criteria validity of the FzS was checked. Because of the slightly right-skewed distribution of the data and the comparatively small sample size, Kendall's tau was calculated. The rank correlation according to Kendall reacts robustly to outliers and can be used for small sample sizes (Bortz & Lienert, 2008). According to Bortz & Lienert (2008), the value of the rank correlation is slightly smaller compared to the Pearson correlation coefficient. The tests are considered comparable if there is no significant difference ($p \leq 0.05$).

The FzS would therefore also be meaningful for the adult participants. The Kendall correlation between the two total raw scores of the questionnaires FzS and OASES-A showed a medium positive correlation ($\tau = 0.477$; $p = 0.029$).

### *Psychosocial impact FzS*

To determine the psychosocial impact of stuttering for the follow-up (T4), the raw scores in FzS were averaged for the participants ($n = 10$). The data basis for T1 and T3 of psychosocial impact can be found in Table I. The mean psychosocial impact of stuttering was a raw score of 65.7 ($SD = 20.69$) for the long-term follow-up (T4). The mean severity of psychosocial impact was mild to moderate, with a minimum raw score of 42.0 (severity = very mild to mild) and a maximum raw score of 114.0 (severity = very severe).

The psychosocial impact of stuttering was significantly lower for the follow-up T4 than before the intervention T1, $t(9) = -3.304$, one-tailed, $p = 0.005$. The effect size was $d' = 1.169$, which according to Cohen (1988) corresponds to a large effect. Furthermore, there was no significant increase in

psychosocial impact since the end of the IST for long-term follow-up (T4), but a trend towards a further decrease in psychosocial impact, $t$ (9) = −1.546, one-tailed, $p = 0.078$. The effect size was $d' = 0.491$, which corresponds to a small effect (Cohen, 1988).

### *Stuttering severity SSI*

To determine the severity of stuttering for the follow-up (T4), three video recording parts with 250 syllables of the interview as well as the reading text Berlin with 234 syllables were analysed by each participant ($n = 9$) using the SSI-4 of Riley (2009). For the long-term follow-up (T4) the mean severity of stuttering was a raw score of 12.4 ($SD = 11.11$). The mean stuttering severity was very mild, with a minimum raw score of 2.0 (no severity) and a maximum raw score of 36.0 (very severe). The data T1 and T3 of Cook (2011) on the severity of stuttering at that time are also listed in Table AI.

The severity of stuttering for the follow-up (T4) was significantly lower than before the IST (T1), see Figure 2(C), $t$ (8) = −4.407, $p = 0.001$. The effect size was $d' = 1.836$, which corresponds to a large effect (Cohen, 1988). The stuttering severity did not increase significantly from T3 to T4. There was a trend towards a further decrease in stuttering severity, $t$ (8) = −1.807, $p = 0.054$. The effect size was d' = 0.645, which corresponds to a medium effect (Cohen, 1988).

### *Additional analysis*

To compare the inter-rater reliability (degree of agreement between the assessment results for different raters), the scores per test part were used in the SSI-4 test form. The rank correlation coefficient $\tau$ according to Kendall was used to determine the inter-rater correlation between the evaluations.

There was high inter-rater reliability between the first author and the second rater, as shown by a positive significant correlation between the frequency of the symptoms in the spontaneous speech[1] as well as in the reading[2] ($^1\tau = 0.877$, $p = 0.002$, $^2\tau = 0.873$, $p = 0.003$). Also, a strongly positive significant correlation was shown for the match in the duration of the three longest symptoms ($\tau = 0.952$, $p = 0.001$).

Furthermore, the total score of the six questions was used in the CUSR for self-assessment of stuttering and in the SSI-4 for external assessment of stuttering. To check a correlation between the two variables, the rank correlation coefficient $\tau$ according to Kendall was calculated. With the help of the mentioned correlation, the representative status of the collected speech samples was checked.

Eight of the nine participants rated the spontaneous speech during the interview as representative. One participant felt his stuttering was less than in everyday life. The comparison of the self-assessment of stuttering using six questions in CUSR and the external assessment in SSI-4 showed a medium-strong positive significant correlation ($\tau = 0.588$, $p = 0.017$).

## Appendix E: Modification techniques

Table AI. Learned and used techniques of the participants at T4.

| Participants | Learned techniques | Used techniques |
|---|---|---|
| 1 | Shortened slow motion/prolongation, soft voice onset, melodious speech | No |
| 2 | Shortened slow motion/prolongation, pullout | No |
| 3 | Shortened slow motion/prolongation, pullout | Shortened slow motion/prolongation |
| 4 | Soft voice onset | Soft voice onset |
| 5 | Shortened slow motion/prolongation | Shortened slow motion/prolongation |
| 6 | Soft voice onset, pullout, shortened slow motion/prolongation | Soft voice onset, pullout |
| 7 | Pullout | No |
| 8 | Soft voice onset, pullout | Soft voice onset, pullout |
| 9 | Shortened slow motion/prolongation, melodious speech | Shortened slow motion/prolongation, melodious speech |
| 10 | Pullout, shortened slow motion/prolongation | Shortened slow motion/prolongation |

*Note*. The term modification techniques include stutter modification as well as fluency shaping.