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How simple can a treatment for early stuttering be? A proposed two-factor early intervention

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Declaration of Interest Statement

The author reports no conflict of interest.

Abstract

26

27 *Purpose:* In this paper we draw attention to the need for immediate intervention shortly after
28 stuttering onset. More than half of stuttering onsets occur before 3 years of age. We argue that
29 existing interventions for preschool children who stutter require varying levels of cognitive
30 engagement from children; hence, they are not suitable for children of that age. For this reason, we
31 argue, there is no clinical trials evidence for treatment efficacy with children younger than 3 years
32 of age.

33 *Conclusion:* There are many recommended parent strategies that do not require any active
34 participation from children, which, therefore, may be suitable for immediate stuttering intervention.
35 Two of these have laboratory support in their favor: parent speech rate reduction and increased
36 interturn speaker latency. Therefore, we developed a clinical protocol based on those two parent
37 strategies and showed the clinical viability of the protocol with three children who stuttered. We
38 argue that automation of our proposed treatment with lifelike AI-generated avatar clinicians will
39 make it globally viable, and a suitable target for future Phase I–IV clinical trials.

40 **Quality of life and illness burden of stuttering**

41 Stuttering occurs in all cultures and languages. Based on predominantly Western cultures,
42 Bloodstein et al. (2021) conclude that lifetime incidence is 10% with a prevalence of 1–2%. At the
43 time of writing, this prevalence suggests that 80–160 million people stutter globally. The condition
44 is associated with significant quality-of-life impairment in the range of that reported for diabetes,
45 cardiovascular disease, and HIV (Norman et al., 2024). Presumably, this is because, unlike those
46 conditions, stuttering begins during early childhood and its effects are experienced throughout the
47 lifespan. Stuttering is associated with substantive cost of illness. Norman et al. (2024) showed that
48 in direct terms, willingness to pay for effective treatment can be 2–4 times the family annual
49 income, and 61% of families report a financial strain because of an adolescent who stutters. Indirect
50 costs of illness are social, involving failure of those who stutter to attain their full occupational
51 potential, which has been shown in several cohort studies (Gerlach et al., 2018; Jacobs et al., 2025;
52 McAllister et al., 2012). Failure to attain occupational potential may be partly related to childhood
53 educational disadvantage because of stuttering (Berchiatti et al., 2020; Boyle et al., 1994; Williams
54 et al., 1969).

55 The lifetime effects of stuttering include speech-related anxiety. Social anxiety scores of those
56 who stutter are nearly a standard deviation above nonstuttering controls (Craig & Tran, 2014).
57 Compared with controls, those who stutter have greatly increased odds for social anxiety disorder
58 (Iverach et al., 2009). During childhood, 24% of 7–12-year-old children who stutter may be
59 diagnosed with social anxiety disorder in comparison to 4.6% of control children (Iverach et al.
60 2016). There is evidence that this anxiety originates early in life during the pre-school years (Briley
61 et al., 2019; McAllister, 2016; Tığrak et al., 2020). Possibly, this is a reason why quality-of-life
62 impairment has been measured during the preschool years (Norman et al., 2024).

63 **A Consensus About Early Stuttering Intervention**

64 The quality-of-life and illness burden of stuttering, and its beginnings during childhood, seem to
65 have prompted a consensus in the field that early intervention is an optimal management strategy. A
66 report of 264 speech-language pathologists (SLPs) from 10 countries indicated that they gave
67 waiting list priority to children who stutter; they prioritized childhood stuttering above all other
68 developmental speech and language disorders (McGill et al., 2021). Eighteen Australian SLPs
69 conveyed a similar perspective (Erickson et al., 2022), indicating that stuttering is “more
70 debilitating than other communication disorders with the potential for long-term consequences to be
71 more significant for clients” (p. 5). A consensus statement from participants at a conference with
72 researchers and clinicians from 29 countries established that “current evidence ... clearly tells us the
73 risks of early stuttering are certain and that they can be serious and potentially lifelong” (Lowe et
74 al., 2021, p. 9).

75 **Neuroplasticity and Early Stuttering Intervention**

76 A large body of brain imaging research shows one causal factor for stuttering to be anomalies in
77 the networking of brain regions involved with spoken language (Neef & Chang, 2024). Hence, the
78 potential for neuroplastic change to produce lasting clinical benefits has been recognized (Chang et
79 al., 2025). From a neuroscience perspective, it seems that there is a window of clinical opportunity
80 during early childhood for stuttering to resolve. That neuroscience perspective is supported by
81 randomized trials of early stuttering intervention (Sjøstrand et al., 2019). Although that evidence
82 has limitations, it documents a large effect size from early stuttering intervention (with the
83 Lidcombe Program) in relation to no-treatment controls. That effect size is associated with
84 improvements in quality of life, attitude to communication, and psychological health (De
85 Sonnevile-Koedoot et al., 2015; Woods; 2002). The clinical window during early stuttering begins
86 to close as speech-related brain networking becomes clinically intractable with advancing age
87 during childhood (Chang 2014; Neef & Chang, 2024; Shenker et al., 2023; Venkatagiri, 2005).
88 Neuroplastic change during early intervention is a commonly accepted explanation for its reported

89 success (Chang, 2014). Indeed, in the case of the Lidcombe Program, it seems that effectiveness
90 decreases markedly during late childhood (Johnson et al., 2024). Hence, the international consensus
91 about the need for early intervention is well justified in terms of a limited opportunity to prevent
92 lifetime quality-of-life and illness burden.

93 **Barriers to Intervention Immediately After Onset**

94 *Participation of children in the treatment process*

95 At present, various stages of the treatment processes of early interventions that have been studied
96 with randomized trials—the Westmead Program (Andrews et al., 2023), the Lidcombe Program
97 (Onslow et al., 2025), and RESTART-DCM (Franken et al., 2025)—require children to be involved
98 and to participate in treatment activities. The Westmead Program requires children to speak in
99 syllable-timed speech. The Lidcombe Program treatment process requires children to attend to
100 parent feedback about their speech. Likewise, for some of its treatment components, RESTART-
101 DCM requires cognitive development and cooperation from children. For example, during Phase II
102 of the treatment, procedures include Riley and Riley’s (1985) 14-step speech motor training
103 program. Children also learn variations of speech restructuring: “relaxed versus tense stuttering,
104 repetitions versus prolongations/blocks, single repetitions versus multiple, glide sounds versus
105 multiple repetitions” (Franken et al., 2025, p. 31). The Franken et al. (2025) manual also describes
106 procedures where children intentionally stutter. Other recommended early interventions that are not
107 supported by randomized trials commonly incorporate variants of speech restructuring (Kelman &
108 Nicholas, 2020; Waelkens, 2018; Yaruss et al., 2006).

109 The procedures described above require cognitive engagement from children, yet the majority of
110 stuttering onset occurs at a time when such cognitive involvement is clinically unrealistic for many
111 children. The mean age of stuttering onset has been established from two prospective cohort studies
112 to be in the range of 25–30 months (Ambrose & Yairi, 2015; Yairi, 1983; Yairi & Ambrose, 1992),
113 with a median of 31 months (Reilly et al., 2013). This means that more than half, and perhaps even

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114 the majority, of stuttering onset will occur before 3 years of age. A substantial number of those
115 onsets are as early as 18 months (Reilly et al., 2013). Considering the need for children to actively
116 participate in current treatment, it is not surprising, then, that there has been no randomized trial of
117 children younger than 3 years of age (Onslow & Lowe, 2019; Sjøstrand et al., 2019).

118 *The challenges of existing early interventions*

119 Ideally, an immediate intervention would be as simple as possible to maximize its global uptake.
120 Yet, the Lidcombe Program and RESTART-DCM are challenging treatments to administer.
121 Although the Lidcombe Program’s clinical principal is simple—parent verbal contingencies applied
122 to stutter-free speech and stuttering—the application of those principles needs to be designed
123 individually for every child and family. This presents many clinical challenges, and problem-
124 solving is a routine part of the treatment process. One publication (Van Eerdenbrugh et al., 2018)
125 detailed 124 clinical challenges that occur with the Lidcombe Program and outlined clinical
126 responses to them. RESTART-DCM is based on the demands and capacities model of early
127 stuttering (Packman et al., 2004). As such, there are more than 60 clinical procedures for the
128 clinician to consider for use with children (Onslow & Lowe, 2019). These include not interrupting
129 the children when talking, reducing the number of questions asked, speaking with a calm voice, not
130 imposing linguistic demands, and having an unhurried lifestyle.

131 *Limited speech-language pathology resources*

132 Regardless of the need and the potential benefits of immediate intervention after stuttering onset,
133 the international SLP workforce is not equipped to deal with a disorder that has a prevalence of 1–
134 2%. This has been confirmed by international government reports in the United Kingdom and
135 Australia (I CAN, & Royal College of Speech and Language Therapists, 2018; Senate Community
136 Affairs Committee Secretariat, 2014). The extent of this problem worldwide can be derived from
137 the American Speech-Language Hearing Association, the world’s largest professional SLP group,
138 which indicates that, at the time of writing, there are around 2,000 SLPs in the United States

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139 currently accepting referrals for fluency (<https://www.asha.org/profind/>; Select: “Find a SLP”;
140 search term: “fluency”; 2025, September). Although that figure is likely to be an underestimate, it
141 illustrates the extent of the problem, equating to around one SLP for every 1,700 people who stutter
142 in that country, based on a population of 340 million. Those data are for a country with well-
143 developed SLP services, but most children who stutter live in countries where the profession is
144 comparatively under-resourced. For example, Caldera et al. (2023) reported that the United States,
145 United Kingdom, and Australia have, respectively, 57.7, 35.9, and 23.7 SLPs per 10,000
146 population, but the figures for India, Malaysia, and Sri Lanka are 0.17, 0.95, and 0.44. In short, no
147 country appears to have adequate SLP resources to deal with the public health issue of treating very
148 young children who stutter.

149 **Searching for a new early intervention**

150 In summary, immediate intervention after stuttering onset has potential to influence the global
151 health issue of chronic stuttering. Yet, empirically supported interventions are not suitable for
152 children shortly after onset, who are mostly younger than 3 years, because those interventions
153 require involvement from the children and because they are clinically challenging. These problems
154 are compounded by limited SLP resources for stuttering globally. The search for a solution to these
155 problems may be found in treatments such as RESTART-DCM, which incorporate many indirect
156 strategies, as suggested by the demands and capacities model. These strategies recur in modern
157 publicly available sources of advice to parents from professional associations and health services
158 (Whelan, 2019; Whittington Health NHS Trust, 2020). These include many of the 60-plus
159 procedures in RESTART-DCM treatment, as described earlier. Most of those strategies have no
160 empirical clinical support, and one of them— reducing the number of questions asked to children—
161 has been empirically refuted (Garbarino & Bernstein Ratner, 2022). However, there is direct
162 experimental laboratory evidence that two of them may reduce early stuttering, as outlined below.

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163 *Speech rate reduction*

164 A review of five laboratory experiments where parents reduced their speech rate with children
165 who stutter concluded that reductions in stuttering severity of around 50% were observed overall
166 (Davidow et al., 2016). For example, three single-subject experiments with preschoolers confirmed
167 this effect (LaSalle, 2015), as did a study of 27 children in three laboratory sessions (Sawyer et al.,
168 2017).

169 *Increased interturn speaker latency (pausing between speaking turns)*

170 Data from experimental laboratory studies show that when parents increase their interturn
171 speaker latencies it reduces childhood stuttering. Interturn speaker latency is when a child says
172 something to a parent, the parent pauses briefly before responding (Livingston et al., 2000;
173 Winslow & Guitar, 1994). One of these experimental studies with a preschooler involved increased
174 interturn speaker latency for 15 sessions at the family dinner table over a 7-week period, with
175 results indicating that the technique was responsible for a 40–50% reduction in stuttering (Winslow
176 & Guitar, 1994).

177 **A two-factor treatment protocol**

178 Based on the data above for parent speech rate reduction and pausing between speaking turns,
179 we have designed the treatment protocol described below. In designing the protocol, we sought
180 input from an advisory group comprising a representative from Speech Pathology Australia and
181 treatment end-users (SLPs and parents of children who stutter). That input involved a 2-hour
182 informal meeting, providing user and clinician perspectives on the clinical viability of the treatment
183 and perspectives about ways to enhance compliance. Subsequently, the treatment protocol was
184 developed after extensive discussions among the authors. The research was approved by the
185 University of Technology Sydney Human Research Ethics Committee ETH23-8378.

186 Before the treatment protocol was administered, parents received a standard SLP assessment for
187 early stuttering. That assessment included exploring parent understanding of stuttering causality,

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188 dealing with any misinformation, and providing a full explanation of current knowledge about the
189 nature of early stuttering and its childhood onset. Care is taken to ensure that parents know they are
190 not responsible for the child's stuttering. The methods of the treatment protocol are presented
191 within the context of the demands and capacities model, with an explanation that two evidence-
192 based strategies would be used. Because the treatment protocol is simple, short 20-minute video
193 telehealth consultations are sufficient to administer it. The protocol does not require the child to be
194 present during clinical consultations, nor does the treatment require any active involvement from
195 the child. In fact, the child will usually not even be aware the treatment is occurring.

196 *Step 1*

197 The clinician uses role play with the parent to demonstrate reducing speech rate by around one
198 third and pausing for around half a second after each child utterance before replying. Those speech
199 changes are demonstrated regardless of the parent's usual speech rate and pausing when speaking
200 with the child. The values of one third speech rate reduction and half a second pausing were
201 determined during consultation with the advisory group (see above), guided by clinical judgement
202 about their practical feasibility.

203 *Step 2*

204 The parent uses these speaking techniques with the child twice per day for 5–10 minutes each
205 time, but only in the home environment. The parent records one of these interactions for around 5
206 minutes using a digital audio recording device such as a mobile phone. During weekly video
207 telehealth consultations, the clinician reviews a 5-minute recording of the parent implementing the
208 techniques and discusses any issues the parent may have encountered with using the techniques.

209 *Step 3*

210 When the parent is comfortable using the speaking techniques, the parent uses them as much as
211 is practicable in and outside the home environment. The parent keeps a diary of their use. During

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212 the weekly consultations, the clinician reviews the diarized information and a 5-minute recording of
213 the parent implementing the techniques outside the home environment.

214 An SLP used our trial protocol to teach the strategies to parents of three preschoolers who
215 stuttered, who were younger than 3 years of age (one parent for each child). The three parents
216 signed their consent after reading a participant information statement. None had consulted a SLP
217 previously about their child's stuttering, and none had attempted any treatment. The parents
218 successfully learned to use the simple techniques in a similar manner during a 12-week trial period.
219 Consistent with the laboratory research reviewed above, and the theoretical soundness of the
220 procedures, there was a suggestion of possible treatment effects, as shown in Figure 1. The data in
221 the figure are daily parent-assigned severity ratings using scale where 0 = *no stuttering*, 1 =
222 *extremely mild stuttering*, 10 = *extremely severe stuttering*. Child 1 was a girl (2 years 7 months)
223 with moderate–severe stuttering, whose parents reported that she had been stuttering for a couple of
224 weeks. Her observable stuttering involved mainly repetitions, with some blocks. Child 2 was a girl
225 (2 years 11 months) with moderate stuttering who had reportedly been stuttering for 6 months. Her
226 observable stuttering involved mainly repetitions, with some blocks. Child 3 was a girl (3 years 0
227 months) with mild stuttering, who had reportedly been stuttering for 8–9 months. Her observable
228 stuttering involved repetitions, prolongations, and blocks. The stuttering severity of Child 1 and
229 Child 2 improved over the 12 weeks of treatment, with trendlines suggesting continued
230 improvement toward severity rating scores of 0 (no stuttering) if the treatment continues. Possibly
231 because of a floor effect from extremely mild stuttering, Child 3 showed only slight reduction of
232 stuttering severity during the 12 weeks of treatment.

233 These suggestions of a treatment effect are theoretically consistent with a mechanism of action
234 involving neuroplastic change in response to reduced parent speech rate and increased pausing (see
235 *Neuroplasticity and Early Stuttering Intervention*, above). An alternative explanation would be that
236 reduced parent speech rate and increased pausing invoke similar speech changes in children's
237 speech, which in turn control their stuttering. On the face of it, this seems to be a plausible

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238 explanation, particularly in the case of reduced speed rate, which has long been known to reduce
239 stuttering severity (Andrews et al., 1982; Johnson et al., 1937). However, available data cast doubt
240 on such an explanation, with the bulk of studies showing no clear relationship between the speech
241 rate of parents and children who stutter (Cardman, & Ryan, 2007; Guitar & Marchinkoski, 2001;
242 Ratner, 1992; Sawyer et al., 2017; Stephenson-Opsal, & Ratner, 1988; Yaruss & Conture, 1995;
243 Zebrowski et al., 1996). In fact, two studies showed an inverse relationship (Dehqan et al., 2008;
244 Meyers & Freeman, 1985), and only one study showed a positive relationship where children's
245 speech rate decreased in response to parent speech rate decrease (LaSalle, 2015).

246

247 INSERT FIGURE 1 ABOUT HERE

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249 We propose this protocol as a basis for Phase I clinical trialling, with potential for further
250 development during Phase II–IV trial evaluation. The latter trials would establish how long a two-
251 factor treatment would take to establish treatment benefits, and they would evaluate the merits of
252 the procedure, comparing it to existing treatments and comparing it to no-treatment controls to take
253 account of variables such as natural recovery and parent speech attention. For that program of
254 research, outcome measures would include stuttering severity, social anxiety, quality of life, and
255 attitude to communication.

256 **Conclusion: Potential benefits of this two-factor early stuttering intervention**

257 *Potential automation*

258 A stuttering treatment comprising speech rate reduction and pausing between speaking turns has
259 the advantage of simplicity and that active involvement of children is not required. An additional
260 advantage to such a treatment is that its simplicity lends itself to website-based automation,
261 alleviating any demand on under-resourced global SLP healthcare services. A state-of-the-art
262 automated web version of the treatment could be constructed (Arachchi et al., 2023), with a clinical

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263 interface of lifelike AI-generated avatar SLPs. Using role play, the AI-generated avatar clinicians
264 would demonstrate how to slow the speaking rate and how to pause between speaking turns. We
265 envisage that the avatar clinicians would engage with parents using natural language processing to
266 provide guidance through the treatment. The web-based treatment would incorporate advanced
267 speech signal processing techniques to capture key speech features such as power spectrum (Molau
268 et al., 2001) and provide feedback for speech rate reduction with acoustic measures of syllables
269 spoken per second and feedback for pausing with acoustic measures of intervocalic intervals in
270 milliseconds. Fast Fourier transform and advanced filtering techniques would remove unwanted
271 noise to ensure that analyses focus correctly on the relevant speech signals. Because children who
272 stutter may have parents who stutter (Darmody et al., 2022), such feedback will need to
273 accommodate parent stuttering. Although speech signal processing is not yet fully able to recognize
274 stuttering moments, progress is being made toward that being a realistic prospect (Mujtaba &
275 Mahapatra, 2028; Shen & Zhang, 2025; Yawatkar et al., 2025).

276 The avatar clinicians would ensure that parents have learned the speaking techniques and
277 understood the acoustically analyzed outcome. This objective feedback would overcome the
278 inherent limitation of clinician perception. During Step 3 of the protocol, when parents use the
279 speaking techniques in everyday conversations with their child, they would log in to the treatment
280 site once per week and upload a 5-minute audio recording of their conversation with the child. They
281 would diarize information about their use of the techniques, and log daily severity ratings of their
282 child's stuttering. The avatar clinicians would provide feedback, recommendations, and
283 encouragement based on this information.

284 *Preventing therapist drift*

285 Therapist drift is when a clinician deviates from delivering a treatment exactly the way it was
286 designed and is manualized (Waller, 2009). This can occur intentionally or unintentionally, and may
287 involve altering or omitting core treatment components, applying techniques inconsistently, or
288 adapting a treatment to a personal style or perceived client needs. Therapist drift may occur for

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289 many reasons, such as clinical time constraints, fatigue, and burnout. During current best-practice
290 early stuttering intervention with the Lidcombe Program, therapist drift has been shown to be a
291 negative influence (Carr Swift et al., 2011). However, automation of our proposed treatment would
292 make therapist drift impossible. AI-generated avatar SLPs would provide objective and consistent
293 treatment to parents about their use of the speech techniques. Consequently, parents and children
294 globally—eventually in many languages—would have constant access to standardized health care
295 for early stuttering.

296 *Cultural transferability*

297 The simplicity of this treatment maximizes the likelihood of it being uniquely culturally
298 transferable. This would be an advance on existing early interventions that have been developed in
299 Western cultures. An example is the Lidcombe Program, which relies on parents praising children
300 for not stuttering. As such, there are reports of this aspect of it not being suitable for other cultures
301 where the idea of praising children openly can feel unnatural and inappropriate, such as in Malaysia
302 and Kuwait (Al-Khaledi et al., 2017; Vong et al., 2010). Another issue is that many non-Western
303 cultures are not open about disability, perceiving it as a source of shame that should remain private.
304 However, all current early interventions involve direct attention to the child’s speech. For example,
305 in the Lidcombe Program, parents ask the child to repeat some utterances that are stuttered, and in
306 the Westmead Program, children are encouraged to use rhythmic speech. With RESTART-DCM
307 treatment, “now and again, the parent will casually speak using the disfluencies/stutterings the child
308 makes, with the aim of lessening the child’s sensitivity to this” (Franken et al., 2025, p. 24). These
309 approaches are not universally culturally appropriate. In principle, the proposed two-factor
310 treatment of parents reducing speech rate and pausing between speaking turns potentially bypasses
311 these issues because it does not focus on children in any way, and they may not even know that it is
312 occurring.

313 **Stepped care intervention immediately after onset**

314 There is a genetic link with stuttering. Based on available genetic modelling, family aggregation
315 data, and a review of family pedigrees (Darmody et al., 2022), stuttering will occur with 60–70% of
316 children who have a first- or second-degree relative who stutters. Such children in the community
317 could be identified by family history and monitored for stuttering onset. As soon as stuttering onset
318 occurs, immediate two-factor intervention could be administered. This approach could introduce a
319 stepped-care model to early stuttering intervention. The stepped-care model provides the simplest
320 health care that is effective. Clients escalate to more resource-intensive and more expensive models
321 of health care only as needed (Bower & Gilbody, 2005). The two-factor treatment is ideal as a first
322 intervention in a stepped-care approach, particularly for an automated version. It can be used
323 immediately after stuttering onset because it requires no active involvement from the child, it
324 requires no clinician, and it is cost-free. Parents and children would escalate to the more resource-
325 intensive and costly health care with a real clinician only if stuttering persists. Should Phase I–IV
326 clinical trials support our proposed two-factor early intervention, adoption of that model by SLP
327 associations worldwide would be a significant and transformative change to practice and policy of
328 stuttering treatment. Cost-free early stuttering intervention could be made available to families
329 globally, regardless of their location or socioeconomic status, alleviating any demand on under-
330 resourced global SLP healthcare services.

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Data Availability Statement

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338 The datasets generated during and/or analyzed during the current study are available from the
339 corresponding author on reasonable request.

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572 **Captions**

573 Figure 1: Daily parent-assigned severity ratings over 12 weeks for the three children in our trial
574 protocol. The figure includes a trendline for the severity ratings.