

1 **The psychological and social consequences of single-sided deafness in**  
2 **adulthood**

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26 **Abstract**

27 **Objectives:** This study examined the subjective psychological and social effects of highly  
28 asymmetric hearing loss (single-sided deafness) in adults.

29 **Design:** Three group interviews were conducted using the critical incidence technique and  
30 analysed using an inductive thematic analysis.

31 **Study sample:** Eight adults with a clinical diagnosis of a moderately-severe hearing loss or  
32 greater in one ear and normal or near-normal hearing in the other ear.

33 **Results:** A range of functional hearing difficulties associated with single-sided deafness  
34 including impaired speech in background noise and reduced spatial awareness were reported  
35 to affect social and psychological well-being. Social consequences of single-sided deafness  
36 resulted from activity limitations and participation restrictions including withdrawal from and  
37 within situations. Participants reported psychological effects including worrying about losing  
38 the hearing in their other ear, embarrassment related to the social stigma attached to hearing  
39 loss, and reduced confidence and belief in their abilities to participate.

40 **Conclusions:** Single-sided deafness can be associated with many negative consequences.  
41 Counselling may help overcome the psychological consequences of hearing loss regardless of  
42 whether technological support such as a hearing aid is prescribed. The audiological  
43 management of these individuals should support the development of listening strategies and  
44 set appropriate expectations for participation in everyday listening situations.

45

46 **Key Words:** unilateral hearing loss; unilateral deafness; single-sided deafness; SSD; hearing  
47 function; listening difficulties; psychosocial impact; critical incidence technique

48

49

## 50 **Introduction**

51 Single-sided deafness (SSD) refers to a highly asymmetric unilateral hearing loss. An  
52 international consensus statement has defined SSD as a ‘severe-to-profound’ hearing loss in  
53 one ear (pure-tone average threshold  $\geq 60$  dB HL) and normal or near-normal hearing in the  
54 other ear (pure-tone average threshold  $< 30$  dB HL) (Vincent et al, 2015). The prevalence of  
55 SSD has been estimated to be about 1% of the general population (Davis, 1995). SSD is  
56 often associated with sudden onset sensorineural hearing loss, the incidence of which is  
57 approximately 20 cases per 100,000 inhabitants per year in developed countries (Byl, 1984).  
58 The incidence of SSD in the United Kingdom has been estimated to be between 7000-9000  
59 new cases per year based on available data (Baguley et al, 2006).

60

61 While access to one well-functioning ear allows individuals with SSD to appear largely  
62 unimpaired in the confines of a quiet room, their lack of access to two functioning ears can  
63 lead to a clinically-significant degree of audiological disability in everyday life (Choissoine-  
64 Kerdel et al, 2000; Dwyer et al, 2014; Iwasaki et al, 2013; Newman et al, 1997). The loss  
65 of hearing in one ear severely disrupts the spatial aspects of hearing (Douglas et al,  
66 2007) and impairs the ability to understand speech in the presence of background noise  
67 (Hawley et al, 2004; Welsh et al, 2004). It can be difficult to restore access to sound in  
68 the impaired ear through amplification using conventional devices such as a high-  
69 powered acoustic hearing aid due to the sensorineural nature and extent of the hearing  
70 loss in these individuals (Valente et al, 2015). The current standard of care for SSD in  
71 the United Kingdom is the contralateral routing of signals (CROS) aid (Kitterick et al,  
72 2014), a device which reroutes sound from the side of the impaired ear to the hearing ear  
73 for the benefit of speech understanding in noise (Arndt et al, 2011; Arndt et al, 2017;

74 Busk et al, 2014; Hol et al, 2010; Lin et al, 2006; Niparko et al, 2003; Ryu et al, 2015).  
75 A similar effect can be achieved using a bone-conduction hearing device (BCHD)  
76 (Desmet et al, 2012; Finbow et al, 2015; Kompis et al, 2017; Newman et al, 2010; Saliba  
77 et al, 2011; Schröder et al, 2010; Wesarg et al, 2013) with the potential for even better  
78 benefits to speech perception and sound quality compared to CROS devices (Kitterick et  
79 al, 2016). Cochlear implantation has the additional benefits of restoring access to  
80 binaural cues that underpin speech perception in noise and sound localisation (Arndt et  
81 al, 2011; Arndt et al, 2017; Finke et al, 2017b; Hassepass et al, 2016; Jacob et al, 2011;  
82 Mertens et al, 2015; Távora-Vieira, 2015; Vermiere and Van de Heyning, 2009), which  
83 longitudinal studies have shown to be sustained over the long term (>10 years) (Arndt et al,  
84 2017).

85

86 The functional consequences of SSD have been associated with a range of psychological and  
87 social consequences. For example, individuals with SSD can report increased stress levels  
88 related to their need to seek out optimal positions within social settings in order to  
89 maximise their ability to hear and participate (Hansson, 1993, cited in Wie et al, 2010).  
90 As a result, individuals with SSD can report feeling excluded from social situations (Wie  
91 et al, 2010) and perceive their social life to be restricted by their hearing loss  
92 (Subramaniam et al, 2005), leading to high levels of hearing handicap (Dwyer et al,  
93 2014; Iwasaki et al, 2013). Numerous studies have demonstrated that rerouting sounds  
94 between the ears using CROS or BCHD significantly reduces the perceived difficulties  
95 with listening in everyday life thereby improving hearing-specific quality of life (Busk et  
96 al, 2014; Finbow et al, 2015; Hol et al, 2010; Kompis et al, 2017; Lin et al, 2006;  
97 Niparko et al, 2003; Ryu et al, 2015; Schröder et al, 2010; Wazen et al, 2003). However,  
98 some studies have suggested that there can be increased aversion to loud sounds with the

99 use of CROS devices (Lin et al, 2006). Cochlear implantation has also been associated  
100 with benefits to hearing-specific quality of life, with the additional benefit of reduced  
101 difficulty with identifying the location of sound sources, navigating everyday  
102 environments and tinnitus relief (Arndt et al, 2011; Arndt et al, 2017; Finke et al, 2017a;  
103 Härkönen et al, 2015; Mertens et al, 2015; Ramos et al, 2015; Távora-Vieira et al, 2015;  
104 Van de Heyning et al, 2008). Arndt et al (2011) also demonstrated that cochlear  
105 implantation can have broader benefits on health related quality of life as measured by  
106 the Health Utilities Index Mark 3. However, cost-benefit analyses are still needed to  
107 assess whether the size of these broader benefits are sufficient to justify the costs of  
108 cochlear implantation (Kitterick et al., 2015). These analyses will need to be conducted  
109 from a specific perspective as costs will vary across countries, healthcare systems, and  
110 funding models (private versus publicly funded).

111  
112 Previous studies have primarily used self-report questionnaire instruments to both  
113 characterise the burden that SSD places on the individuals and the benefits that devices can  
114 have on quality of life. Examples include the Monaural Auditory Capacity Assessment Scale  
115 (MACAS) (McLeod et al, 2008), the Speech Spatial and Qualities of Hearing Scale (SSQ)  
116 (Gatehouse & Noble, 2004), and the Auditory Profile of Hearing Aid Benefit (APHAB) (Cox  
117 and Alexander, 1995). While these instruments are efficient to administer and straightforward  
118 to analyse, it is possible that the use of closed questions places limits on the breadth and  
119 depth of the information gathered (McColl et al, 2001; O’Cathain & Thomas, 2004).

120 Qualitative methodologies can be particularly powerful when seeking to capture the full  
121 range of difficulties and consequences associated with a health condition (Flanagan, 1954).

122 Very few studies have applied qualitative methods to explore the consequences of SSD.

123 Giolas & Wark (1967) use a method called the Critical Incident Technique (CIT) to generate

124 discussions around the situations that patients themselves recalled as being problematic as  
125 a result of their hearing loss. The results helped enumerate the many ways in which SSD  
126 imposes functional limitations on the individual, largely through impairments to speech  
127 understanding in noise and the ability to localise sounds. However, to date the psychological  
128 and social consequences that SSD imposes have not been explored or characterised in the  
129 same level of detail that qualitative methodologies can provide.

130

131 The aim of the present study was to address this gap in the literature by conducting an in-  
132 depth qualitative investigation of the psychological and social consequences of SSD on  
133 everyday life. As there may be distinct differences between short and longer-term  
134 consequences of unilateral hearing loss, particularly where its onset is sudden (Sano, 2013),  
135 the current study focussed on the longer-term consequences in those who had lived with SSD  
136 for at least a year. By using the CIT method, the study was able to explore the full extent of  
137 these consequences and provide insight into both the situations in which they arise and the  
138 impacts they have on the individual. The study also gathered information on the strategies  
139 that are developed to cope with these consequences and to enable continued participation in  
140 everyday life. The results increase our understanding of the overall health and well-being of  
141 adults with SSD.

142

## 143 **Materials and Methods**

### 144 **Sampling and recruitment**

145 Participants had a clinical diagnosis of a sensorineural highly asymmetric unilateral hearing  
146 loss (single-sided deafness) for a period of at least 12 months, defined as a pure-tone average  
147 of  $\geq 60$  dB HL with at least two thresholds  $\geq 65$  dB HL at 1, 2, or 4 kHz in one ear and an

148 average threshold of  $\leq 30$  dB HL in their other ear. Participants had to confirm by self-report  
149 that their hearing loss had not changed in severity within the last 12 months.

150

151 Participants were recruited through the NIHR Nottingham Hearing Biomedical Research Unit  
152 participant database via email or postal invitation specifically for the purpose of this study.

153 Advertisements were also placed in the Audiology services and Ear, Nose and Throat clinics  
154 in local hospitals, the mailing lists of hearing-related charities, and on social media websites.

155 No restrictions were placed on a participants' age, gender or employment status. Participants  
156 had not already taken part in any related research studies. Participants were screened using an  
157 online questionnaire to confirm their eligibility for the study. Those who passed the screening  
158 phase were asked to provide a copy of a recent audiogram (taken within the past two years)  
159 or invited to take part in a short in-person audiometry assessment to confirm their eligibility.

160 The assessment consisted of otoscopy followed by threshold measurements for each ear using  
161 air-conduction audiometry, both conducted in accordance with the British Society of  
162 Audiology recommended procedures (BSA 2010, 2012).

163

#### 164 **Participants**

165 Eight adults with single-sided deafness living in the UK participated in the study (Table 1).

166 All participants were native speakers of English. Participants' aetiologies were mixed and  
167 included vestibular schwannoma, meningitis, and idiopathic hearing loss. The mean age was  
168 57 years (range=37-71) and the average duration of hearing loss was 13 years (range=13  
169 months-28 years). The mean threshold in the better ear was 13 dB HL (range=4-30 dB HL)  
170 and 82 dB HL in the other ear (range=61-119 dB HL). A majority of participants (7 out of 8)  
171 reported experiencing tinnitus with varying levels of severity.

172

173 **Procedure**

174 Three group interviews were conducted using the Critical Incident Technique (CIT). The CIT  
175 was employed to create a semi-structured discussion (Flanagan, 1954) whereby participants  
176 themselves generate all topics for discussion without prior discussion with others or the  
177 researchers facilitating the interview. The rationale for the use of this approach was to ensure,  
178 as far as practically possible, that the choice of topics for discussion was not unduly  
179 influenced by the prior expectations of the facilitators or only a small vocal minority, but  
180 rather reflected the issues that were seen as important and relevant to individual participants  
181 (Glaser & Strauss, 1967). Table 2 describes the specific sequence of activities that were  
182 undertaken in all three interviews.

183

184 Participants were allocated to the interviews according to the order in which they were  
185 recruited. Two participants took part in each of the first two interviews, the aim of which was  
186 to gather in-depth information on the experiences of adults with single-sided deafness. A  
187 third interview was conducted with four participants to: (a) provide further insight into where  
188 those experiences converged or diverged between individuals, who differed in their age,  
189 gender and aetiologies; and (b) assess whether data saturation had been reached (Fusch &  
190 Ness, 2015). The study protocol specified that interim analyses would be conducted after the  
191 second and subsequent interviews, and that additional interviews would only be conducted if  
192 new topics were still likely to be identified.

193

194 All participants provided written informed consent prior to participation and audio recordings  
195 of all discussions were made for written transcription. Two facilitators were present at each  
196 interview. A primary facilitator (moderator) was responsible for maintaining the discussion  
197 between participants and ensuring all participants contributed to each discussion. A co-



198 facilitator sought clarification where the audio recording may not have been clear and  
199 documented interactions, contextual cues and nonverbal behaviors amongst participants. The  
200 discussion was allowed to continue as long as the participants were willing or until all the  
201 topics had been exhausted, whichever came first. The research was approved by Central  
202 Bristol NHS Research Ethics Committee (REC number: 14/SW/1065) and sponsored by  
203 Nottingham University Hospitals NHS Trust.

204

### 205 **Data Analysis**

206 Audio recordings of the interviews and the focus group were transcribed verbatim. A  
207 thematic analysis was conducted using NVivo 10 (QSR International, Melbourne, Australia).  
208 Themes were identified inductively after assigning codes to the transcripts (Braun & Clarke,  
209 2006). Each researcher first read the entire dataset and assigned each individual piece of  
210 information one or more thematic codes. The codes were chosen to factually describe the  
211 nature of the information being discussed in as much detail as possible and were initially  
212 generated by each researcher independently based on their interpretation of the transcripts.  
213 After an initial review of the transcripts, the choice of codes used by each researcher was  
214 discussed and any disagreements resolved by consensus. The transcripts were then recoded  
215 by both researchers using the revised code set. Codes that referred to similar or associated  
216 information were grouped into principal themes and sub-themes by the two researchers.  
217 Disagreements were resolved by consensus.

218

### 219 **Results**

220 A total of 102 topics were submitted by participants across the three interviews that identified  
221 77 situations in which participants experienced difficulty because of their hearing loss and 25

222 situations in which participants either did not experience difficulty or experienced positive  
223 consequences (see Table, Supplemental Digital Material 1). An interim analysis of the topics  
224 of discussion between interview one and two identified a high degree of consistency with  
225 similar topics emerging in both interviews (Table 3). Although the larger sample size of the  
226 third interview may have limited the depth of the discussion relative to the two earlier  
227 interviews, the topics raised by this larger group were consistent with the first two interviews.  
228 A further interim analysis after the third interview showed that no new topics emerged  
229 consistently, suggesting that data saturation had been reached (Fusch & Ness, 2015).  
230 Following the study protocol, no further interviews were conducted.

231  
232 The following sections describe four distinct but related overarching themes in the data  
233 related to single-sided deafness: (1) **the functional consequences**; (2) **the psychological**  
234 **consequences**; (3) **the social consequences**; and (4) **the positive consequences**. The analysis  
235 also identified **coping strategies** that individuals with single-sided deafness develop and  
236 employ to maintain social function. The main subthemes are indicated through the use of  
237 italic font in the following sections.

238

### 239 **Functional Consequences**

240 Difficulties with *recognising and understanding speech* were reported by all participants.  
241 Quiet situations presented the least difficulties as long as only one person is talking at any  
242 time and the talker is in view. In both quiet and noisy situations, participants recognised that  
243 it was important for the sound of interest to be on the side of their better ear to maximise  
244 speech understanding. Noisy situations presented greater difficulties for the participants,  
245 particularly where background noise includes speech or is dynamic in nature. P3 said, "*If*  
246 *everyone's talking at once, it's very difficult to extract one person's conversation. It's just a*

247 *noise*". An associated increase in *listening effort* lead to high levels of fatigue, particularly in  
248 situations where participants were unable to move to a more favourable listening position.  
249 Participants also described how turning their head to ensure that the sound source is on their  
250 non-impaired side could be tiring and uncomfortable. Participants reported that their speech  
251 perception abilities are also hindered by the acoustics of a setting. Wide-open spaces  
252 furnished with hard surfaces that reflect sound and produce echoes (examples included train  
253 stations and airports) were particularly problematic.

254

255 Without the benefits of binaural hearing, participants reported difficulty with *sound*  
256 *localisation* and the ability to selectively attend to one sound, which to some were deemed  
257 the most inconvenient implications of their hearing loss. The inability to localise sounds was  
258 reported to cause difficulties when identifying the direction of unexpected sounds, with  
259 participants reporting that they often presumed (incorrectly) that all sound sources are located  
260 on the side of their non-impaired ear. P1 talked about her first experience of trying to cross a  
261 road after losing her hearing due to meningitis: "*I didn't know where the traffic was, it just*  
262 *seemed to be all around and that was quite scary*". A lack of access to binaural cues also  
263 meant that participants were unable to benefit from 'surround sound' in the cinema, or had  
264 difficulties when listening to music or audiobooks that exploit stereo effects, rendering some  
265 sounds inaudible when listening over headphones. Participants also described a *heightened*  
266 *awareness of sounds* which was most apparent when they first lost their hearing. P6 said  
267 "*When I first walked out into the street and buses were going past it was scary...you're so*  
268 *super aware of every single noise*".

269

270 **Psychological consequences**

271 Participants reported that their hearing loss had many effects on both their mental and  
272 emotional wellbeing. The *initial reaction* to their hearing loss differed depending upon  
273 whether the loss of hearing was sudden or whether it had a determined cause. Participants  
274 who had experienced a sudden loss reported feelings of ‘shock’ and ‘fear’. P6 described the  
275 experience as “devastating” and “life-changing”, especially upon realising his hearing loss  
276 was permanent. The psychological impact for those whom the cause of their hearing loss had  
277 been determined appeared to be less severe. P5, who lost his hearing after surgery to remove  
278 a vestibular schwannoma, said: “*It kind of feels like although the single-sided hearing has*  
279 *changed my life, so much else happened...I knew I was going to lose my hearing so I’d*  
280 *almost prepared myself for it amongst other things*”. Some participants found it hard to  
281 accept their hearing loss and linked it to feelings of depression and anxiety. P7 said “*I*  
282 *remember at one stage, a few weeks after it all happened, just sitting in absolute despair*  
283 *saying I just cannot live for the rest of my life like this*”. Those who had experienced a sudden  
284 hearing loss experienced heightened anxiety and *worry about losing the hearing in their*  
285 *other ear*, whilst all participants were concerned about age-related decline in their remaining  
286 ‘good’ ear.

287

288 Participants felt that there was a ‘*social stigma*’ or negative perception about their hearing  
289 loss from others who often had a lack of understanding and empathy for their communication  
290 difficulties. They reported often being wrongly perceived as being rude or antisocial if they  
291 failed to respond to someone calling their name or saying ‘excuse me’. P1 described the  
292 reactions of a stranger when she did not hear them approaching on a bicycle: “*I was walking*  
293 *on a path at a nature reserve recently and a cyclist came up on my deaf side and rang his*  
294 *bell. I didn’t hear him. Then he overtook and said “are you deaf or something?”*. Many  
295 participants explained how it took time to accept their hearing loss and admit it to others. P4

296 said, “It did take me a long time to say [I’m deaf] to people. I felt embarrassed. I didn’t want  
297 to admit it or something. But now I just say ‘look I’m deaf in that ear’”.

298

299 Participants also reported feelings of *self-stigma* (negative perception of oneself due to  
300 hearing loss) and *low self-efficacy* (belief in ones’ ability to participate). Participants reported  
301 often feeling ‘stupid’ or ‘embarrassed’ due to their communication difficulties, particularly  
302 when they had misheard what someone had said or had wrongly identified who was talking in  
303 a group of people. Some felt like a hindrance as they had to rely on other people to be  
304 involved in a conversation, or felt ‘guilty’ if they had missed what someone had said to them.  
305 Although participants recognised that their hearing loss had reduced their ability to cope with  
306 many everyday situations, they did not appear to consider themselves to be in poor health  
307 because of their hearing loss. ‘Health’ for these individuals was more commonly associated  
308 with pain and chronic illness.

309

### 310 **Social consequences**

311 Participants reported problems with *social interactions*. Interactions with strangers were  
312 considered more difficult than interactions with familiar people (i.e. family and friends).  
313 Strangers showed a lack of awareness and understanding about effective strategies for  
314 communicating with someone who has a hearing loss, often shouting rather than  
315 repositioning themselves on the side of their ‘good’ ear. Familiar voices were reported as less  
316 difficult to comprehend than unfamiliar voices and those with poor enunciation. Family and  
317 friends were seen as more understanding and empathetic and were relied upon to provide  
318 support in challenging listening situations. However, even the closest relatives and friends  
319 could be resistant to adjusting their behaviours and could show frustration when asked to  
320 repeat themselves or talk more slowly. Participants reported a reduction in the amount of time

321 they spent communicating with their spouse due to their hearing loss. They also reported a  
322 lack of conversational intimacy as they did not always feel able to engage in conversations at  
323 quiet levels without risk of embarrassment. Participants reported feeling marginalised at  
324 social events, especially those involving younger family members who are often unaware of  
325 the difficulties that hearing loss creates.

326

327 Some participants reported that their hearing loss had effects on *social interactions in the*  
328 *workplace*. Colleagues would often not be mindful of their hearing difficulties and would talk  
329 quietly or position themselves on the side of their impaired ear. Participants also worried that  
330 they would be perceived as less capable of conducting their job. This concern was  
331 particularly acute among those who worked in a noisy office environment where successful  
332 communication with others was a key element of their role. P4 felt that the difficulties she  
333 had experienced due to her hearing loss eventually contributed to her leaving her profession  
334 as a journalist.

335

336 Participants recognised that their willingness to interact with others and participate in social  
337 situations had changed since their hearing loss leading them to *withdraw from situations* or  
338 *withdraw within situations*. Some participants no longer enjoyed being in places with lots of  
339 background noise as it left them feeling frustrated and isolated. As a result, these individuals  
340 preferred to avoid or withdraw from participating in such situations which could lead to  
341 reduced self-esteem. P3 said "*If I can get out of going to an event I do, because I wouldn't be*  
342 *able to enjoy the conversation... I wouldn't be able to hear properly*". Participants also  
343 reported withdrawing from meetings at work where they anticipated that it would be difficult  
344 to participate. Other participants described how they felt that it was important to engage back  
345 into their everyday life, especially by having a physical presence at social events they

346 enjoyed attending. However, in more challenging situations, such as those with background  
347 noise or where they were unable to choose a favourable positioning in a room, they would  
348 often withdraw within themselves as they were not able to wholly engage and participate. In  
349 turn, this could lead individuals to feel detached from the social group.

350

### 351 **Positive effects**

352 The limited positive effects identified by participants primarily encompassed a positive effect  
353 on the *quality of their sleep* as lying with their good ear on the pillow blocked out unwanted  
354 background noise. Conversely, some participants worried about failing to hear important  
355 sounds such as a smoke alarm, telephone ringing or a child crying whilst they were sleeping.  
356 All participants reported that they had been able to find constructive ways in which to adapt  
357 to their hearing loss and recognised the importance of positive support from family and  
358 friends. These individuals acted as *communication partners* by relaying important  
359 information which may otherwise be missed in conversation. Several participants also  
360 reported that the hearing in their ‘good’ ear appeared enhanced since the onset of their  
361 hearing loss.

362

### 363 **Coping strategies**

364 Coping strategies were developed by participants to aid engagement and participation in  
365 everyday situations. These strategies were primarily a result of self-learning and adaptation  
366 due to a *lack of formal information* and advice from clinicians. Their use of coping strategies  
367 appeared to be dependent upon factors including personality traits, social and professional  
368 circumstances, and personal attitudes towards hearing loss. *Positioning in a social setting* was  
369 regarded as highly important for participants to maximise the signal-to-noise ratio at their

370 better ear and to access visual cues (e.g. lip-reading) to aid their ability to understand speech.  
371 Participants also highlighted the importance of *support from family and friends* both in  
372 communicating in challenging listening situations and to help in potentially-dangerous  
373 situations such as crossing a road when they are unable to localise the sound of traffic or  
374 identify the distance of vehicles.

375

376 Participants reported that they do not generally wear *hearing-assistive devices*. In general,  
377 they did not find conventional hearing aids to be beneficial for their hearing. Consequently,  
378 they felt frustrated that their hearing loss was an invisible condition and some had even  
379 considered wearing a hearing aid solely to remind others of their hearing loss. Those who had  
380 trialled a contralateral routing of signals (CROS) hearing aid (Harford and Barry 1965)  
381 deemed its benefits to be limited and did not persist with its use or use it regularly. Some  
382 participants relied on *other technologies* to enhance their hearing and listening abilities such  
383 as using subtitles, a speakerphone, a sound-bar for the television, or headphones that can be  
384 manipulated so that all sounds play in one-ear only.

385

## 386 **Discussion**

387 The primary aim of the current study was to explore the lasting psychological and social  
388 consequences that SSD places on the individual using a technique that attempts to isolate the  
389 researchers from the process of selecting topics for discussion (Glaser & Strauss, 1967). It is  
390 inevitable that there will be individual differences in how people cope with a health condition  
391 such as SSD and the degree to which the condition imposes burden upon them. However,  
392 consistency was observed both in the topics that were identified across the interviews (Table  
393 3) and the content of the subsequent discussions, as indicated by the well-defined themes and



394 sub-themes that emerged in the inductive thematic analysis. As only a small number of  
395 patients with acquired SSD were consulted in this study, caution should be exercised in  
396 generalising the results to the broader population of patients with SSD that encompasses a  
397 greater variation in aetiology and duration of deafness than sampled in the present study and  
398 also includes those deafened congenitally. However, it is notable that the findings form  
399 strong parallels with those of previous studies whose samples differed from that of the current  
400 study on some of these factors (e.g. Giolas & Wark, 1967; Sano, 2013; Subramaniam et al,  
401 2005; Wie et al, 2010). This apparent consistency prompts the conclusion that there are  
402 common longer-term psychological and social consequences of SSD that arise among  
403 individuals despite differences in their age, aetiology, and duration of monaural auditory  
404 deprivation. The current thematic analysis identified recurring consequences that included  
405 worry about losing the hearing in the better ear, strong negative emotions including  
406 embarrassment and frustration, low self-efficacy, and negative coping strategies such as  
407 withdrawing from and within challenging everyday listening situations.

408

409 While one might expect that the effects of SSD would be exclusively negative, participants in  
410 the present study were able to identify some positive consequences of their hearing loss.

411 Previous studies investigating the positive aspects of acquired hearing loss have identified  
412 major themes including reduced disturbance by unwanted sounds (Stephens & Kerr, 2003),  
413 recognition of one's ability to develop successful communication strategies (Manchaiah et al,  
414 2015), and benefits of receiving communicative support from others to offload some of the  
415 burden that hearing loss imposes (Lockey et al, 2010). These themes capture the positive  
416 consequences identified by participants in the present study that included improvements in

417 the ability to fall and stay asleep, the ability to develop coping strategies in the absence of  
418 advice from clinicians, and the receipt of help from others.

419

420 The extent of the negative psychological and social consequences of SSD may perhaps be  
421 surprising given the fact that these individuals have access to one largely unimpaired ear.  
422 However, this apparent incongruence is compatible with the notion that it is not  
423 straightforward to predict an individual's 'hearing handicap'<sup>1</sup> based upon the level (as  
424 measured by the audiogram) or lateralisation of hearing loss alone (Hallberg et al, 2008). A  
425 hearing loss that is confined to one ear only cannot therefore be assumed to have only  
426 minimal effects on health and well-being (Wie et al, 2010), which may be influenced strongly  
427 by factors beyond the audiogram such as whether the onset of a hearing loss is gradual or  
428 sudden (Sano, 2013). In fact, some aspects of the psychological and social consequences of  
429 SSD were similar to those reported by individuals with mild and moderate levels of hearing  
430 loss (Heffernan et al, 2016) and those with severe-to-profound losses (Mäki-Torkko et al,  
431 2015). For example, individuals with hearing loss of varying degrees and laterality  
432 consistently report withdrawing from and within busy social situations, feeling negative  
433 emotions as a result of their hearing loss, and experiencing participation restrictions that have  
434 a tangible impact on their everyday life. The burden of having to rely on other people to  
435 communicate effectively was reported by the current participants but it has also been noted in  
436 individuals with milder forms of hearing loss (Lockey et al, 2010). However, the present  
437 study also suggests that the burden imposed by SSD is highly situation specific whereby an  
438 individual's capacity to integrate and participate in a given situation may be altered by even a

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<sup>1</sup> In this context, hearing handicap refers to the extent to which their hearing loss affects their behavior and well-being (Ventry & Weinstein, 1982).

439 small change in the listening environment. For example, participants reported having little or  
440 no difficulty conversing with one person in a quiet room but also reported that they would  
441 experience considerable difficulty with the addition of even low levels of background noise  
442 or if even one other person spoke at the same time.

443

444 Although the CROS aid is the standard audiological intervention for those with SSD in the  
445 UK where this study was conducted (Baguley et al, 2006; Kitterick et al, 2014), only one  
446 participant in this study reported using one consistently but only in a specific listening  
447 situation (watching television) and reported little or no benefit from doing so. The uptake and  
448 use of CROS aids has been suggested to relate to the motivation of the patient to take up  
449 technological support (Harford and Barry, 1965) and also to the cosmetic appearance and  
450 discomfort from wearing an aid that may occlude, or be perceived to occlude, the normal-  
451 hearing ear (Ryu et al, 2015). Uptake and usage may also be affected by a mismatch between  
452 patient needs and device capabilities. However, approximately half of the participants had  
453 never been offered a CROS aid and some of those individuals were completely unaware of  
454 the intervention, suggesting that provision of CROS devices may also vary geographically in  
455 the UK. This apparent lack of provision and uptake of hearing-assistive devices (e.g. CROS,  
456 BCHD and CI) is particularly problematic in light of existing evidence for the beneficial  
457 effects that they can have on quality of life by alleviating listening difficulties (Desmet et al,  
458 2012; Hol et al, 2010; Kompis et al, 2017; Mertens et al, 2015; Ryu et al, 2015; Saliba et  
459 al, 2011; Schröder et al, 2010; Wesarg et al, 2013; Távora-Vieira et al, 2015) and increasing  
460 overall health and well-being (Arndt et al, 2011).

461

462 The fact that the burden imposed by SSD is not immediately obvious from the audiogram  
463 alone and is not likely to be apparent in the quiet confines of the clinic may explain, at least  
464 in part, why no participant in the present sample reported being referred for counselling or  
465 offered non-technological forms of support or why so few appeared to have been offered  
466 devices such as CROS aids. In particular, participants suggested that they would have  
467 benefitted from receiving information about the long-term implications of their condition, the  
468 potential benefits and limitations of available interventions and devices (e.g. CROS, BCHD  
469 and CI), and advice on techniques and strategies for self-management. Participants also  
470 reported that their coping strategies were a result of self-learning developed from years of  
471 experience of living with their hearing loss rather than based on advice from a clinical  
472 professional. It would therefore seem appropriate for the clinical management of individuals  
473 with SSD to incorporate information-giving (Fig. 1, shaded decision nodes) to target the  
474 counterproductive strategies that were identified by participants in the present study; i.e. the  
475 sub-themes of withdrawing *within* situations (where the individual was motivated to attend  
476 despite their listening difficulties) and withdrawing *from* situations (where participation was  
477 considered counterproductive to their well-being). The provision of this information could  
478 provide an opportunity to discuss the chronic symptoms and implications of the condition  
479 ('lack of formal information' sub-theme), reduce any negative emotions associated with  
480 engaging in social situations ('social interactions' sub-theme), and aim to develop motivation  
481 for engagement and uptake of hearing-assistive devices such as CROS aids or BCHDs  
482 ('hearing-assistive devices' sub-theme; Ferguson et al, 2016) (Fig. 1, 'Motivated to  
483 participate?'). It could support individuals to develop realistic expectations about their ability  
484 to integrate and participate with others ('social stigma' and 'self-stigma' sub-themes),  
485 encourage positive beliefs around their ability to participate ('low self-efficacy' sub-theme;  
486 Bandura, 1977), and ensure that individuals understand what benefits their hearing-assistive

487 devices can provide and in what situations ('hearing-assistive devices' sub-theme; Fig. 1,  
488 'Appropriate expectations?'). Finally, clinicians could deliver advice on developing positive  
489 coping strategies such as how to position oneself within a social situation to maximise  
490 audibility ('positioning in a social setting' sub-theme; Fig. 1, 'Aware of coping strategies?').  
491 However, this advice would have to be modified to account for the use of rerouting devices  
492 such as CROS aids and BCHDs; their use may conflict with listening strategies that would  
493 otherwise be beneficial such as positioning unwanted noises toward the deaf ear.

494

495 The present qualitative analysis leads to the conclusion that SSD imposes a substantial degree  
496 of burden across multiple domains of health that can lead to negative effects on psychological  
497 well-being and restrictions on social participation. Almost 50 years ago, Giolas & Wark  
498 (1967) proposed that the clinical management of individuals with SSD should address these  
499 negative effects and there is now a large body of evidence for how hearing-assistive devices  
500 can alleviate listening difficulties and support participation in everyday life (Finke et al,  
501 2017b; Kitterick et al, 2016; Peters et al, 2015). However, patients still identify a lack of  
502 clinical support, which the present qualitative analysis suggests could be addressed through  
503 information giving. The integration of this additional support into their clinical management  
504 plan could help these individuals to develop, manage, and adopt effective coping strategies  
505 and maximize take-up and use of hearing-assistive devices.

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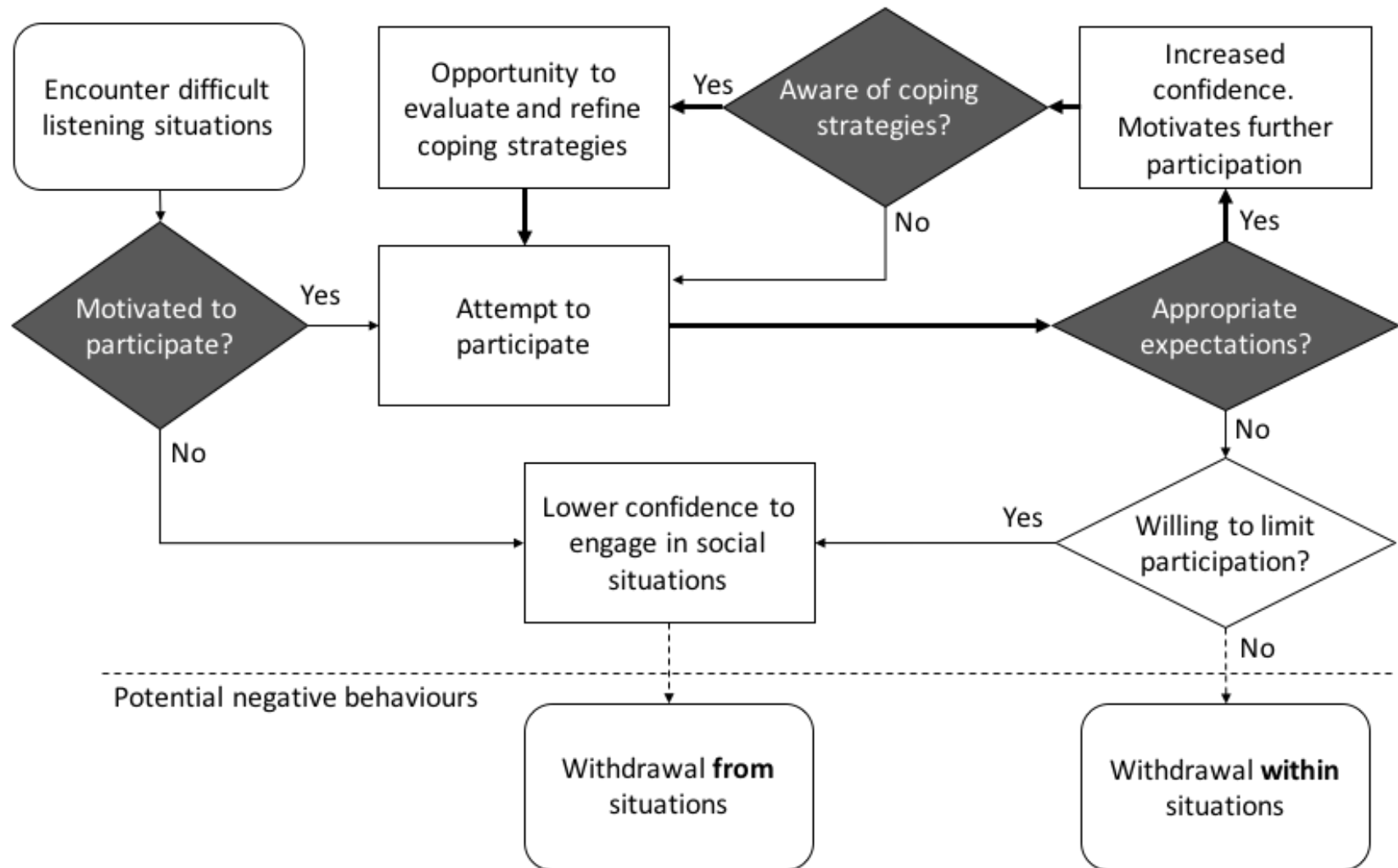
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689 **Figure captions**

690 **Figure 1:** Flow chart demonstrating the main coping strategies that participants reported  
691 using in social situations and the sequence of events that prompt the use of a given  
692 strategy; i.e. positive engagement, withdrawal from situations (social isolation /  
693 avoidance), or withdrawal within situations (introversion). Events are indicated using  
694 rectangles and decisions are indicated using diamonds. The potential influences of  
695 counselling on behavior are indicated by the shaded decision nodes.

Figure 1



**Table 1: Demographic information for the individuals with single-sided deafness that participated in the interviews.**

<i>Participant ID</i>	<i>Gender</i>	<i>Age</i>	<i>Employment status</i>	<i>Onset</i>	<i>Aetiology</i>	<i>Duration</i>	<i>Tinnitus</i>	<i>Reported device use</i>
<b>P1</b>	female	67	retired	sudden	idiopathic	23+ years	yes	Hearing aid
<b>P2</b>	male	71	retired	sudden	surgery for vestibular schwannoma	8 years, 5 months	yes	CROS
<b>P3</b>	female	53	self-employed part time	progressive	meningitis	26 years, 9 months	yes	None
<b>P4</b>	female	68	retired	sudden	idiopathic	5 years	no	None
<b>P5</b>	male	66	retired	progressive	age-related decline	28 years	yes	None
<b>P6</b>	female	56	employed full-time	sudden	idiopathic	2 years	yes	None
<b>P7</b>	male	40	employed full-time	sudden	surgery for vestibular schwannoma	6 years, 4 months	yes	None
<b>P8</b>	male	37	employed full-time	sudden	idiopathic	1 year, 1 month	yes	None



<i>Activity</i>	<i>Description</i>
<b>Introduction</b>	The facilitator gave an overview of the research question, the motivation for asking the question, and presented the structure of the activity. Participants were able to ask questions before proceeding on to the first activity.
<b>Topic generation</b>	Participants were provided with red and green ‘topic’ cards and asked to fill in the cards without conferring with others. The red (or green) cards captured situations in which their hearing loss created (or did not create) difficulties for them or had negative (or positive) consequences. To ensure that the topic generation exercise captured all relevant issues, no matter how sensitive, each card included a box that participants could tick to indicate that they did not wish the topic to be discussed with the other participants.
<b>Break</b>	The facilitator and co-facilitator grouped cards that contained similar topics for discussion (e.g. localising sounds, communication, social impacts, psychological effects, etc.).
<b>Semi-structured discussion</b>	Participants were handed back their responses cards. The facilitator read out each identified topic in turn and proceeded to ask questions to seek clarification or to gain a better understanding of the situation or consequences linked to each topic. This process was repeated until all topics and responses had been discussed. The facilitator encouraged all participants to contribute to each topic of discussion to ensure all views were captured. The semi-structured discussion ended when the participants felt that all topics written on their cards had been discussed.
<b>Unstructured discussion</b>	An open-ended question was posed by the facilitator to capture any other situations or consequences related to their hearing loss that had not yet been discussed. Any additional topics were discussed as in the semi-structured discussion.
<b>Debriefing</b>	Participants were thanked for their involvement, reminded of the purposes of the study, and informed that the results would be provided to them when available. Before leaving, participants were provided with an information sheet containing the contact details of national charities and support organisations related to hearing loss and well-being and were informed to contact their family doctor with any concerns about their hearing, health or well-being.

**Table 2: Sequence and description of activities in each of the three interviews.**

**Table 3: Examples of similar topics identified by patients in the ‘topic generation exercise’ across the three group interviews.**

<b>Interview 1</b>	<b>Interview 2</b>	<b>Interview 3</b>
P3: “Group discussion in a room with background noise e.g. music,TV or other conversation going on.”	P2: “Group conversations, particularly in social settings where people, understandably, talk over each other.”	P7: “Group conversations i.e. when there is background noise.”
P5: “Need to position myself on the corner of a table in order to hear as much as possible with my good ear.”	P2: “Concerts – need to choose sides.”	P4: “Joining a meeting late and not being able to select a seat which aids my SSD.”
P5: “I have no appreciation of music in stereo. This is very noticeable when I recollect exactly what a particular piece of music or a play with sound effects was like when I could hear with both ears.”	P6: “Music - I miss stereo sound.”	P8: “I miss stereo music with headphones.”
P5: “Knowing which direction traffic is approaching from.”	P6: “Direction - If I’m walking across a road I have to rely on my eyes to know where a car is coming from.”	P7: “Can't tell which direction sound is coming from.”

## **List of Supplemental Digital Content**

Supplemental Digital Content 1: Table listing the individual topics identified by participants themselves using the Critical Incident Technique within each category. Pdf

**The raw unedited text from the topic cards completed by participants during the ‘topic generation exercise’. Similar negative and positive topics have been grouped together within each interview.**

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### **Interview 1: Negative consequences / difficulties**

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Concern over loss of hearing in good ear.

Fear of anything happening to the other 'good' ear.

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Feeling isolated, frustrated and left out of conversations - only hear snippets of what is said and lack of confidence to join in. Feel like people think you are dull or have nothing to say.

---

If someone approaches on my deaf side and I can't see them it makes me jump.

Knowing which direction traffic is approaching from.

Discerning direction of sound. E.g. traffic noise or of who is speaking where.

Having to go around in circles to ascertain the direction of a noise.

Unable to tell where family members are in the house if they are not in the same room as me. My first question is always 'where are you?' 'I'm here' does not help.

Need to position myself on the corner of a table in order to hear as much as possible with my good ear.

As my left ear is profoundly deaf, listening to the radio in a car is harder on the passenger side than on the driver side. Also hearing a person whilst driving is difficult.

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Other people not being sympathetic. People shouting when I tell them I have a hearing loss or don't bother trying to talk to you. Lack of willingness to engage. Other people exasperated because you can't hear.

Networking situations at work, particularly with people who don't know me and don't understand about my hearing disability.

People will repeat something once, but do not want to repeat it again if asked. Eventually they talk to someone else because it is less of an effort for them.

If I'm at a table at a formal or informal dinner I have to notify the person on my left that if they say something I won't hear them. This usually ensures that they do not make any effort to talk to me.

Trying to get workplace to make reasonable adjustments and having to fight. Positioning myself at work in open plan office - need to be in a corner with colleagues to right and in front of me. Convincing people of this and having to fight for the position is frustrating.

My ex-boss who used to say 'pardon?' every time I said I had a hearing loss (his little joke) until someone pointed out it was not funny.

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Airports / train stations can't hear announcements.

Noisy young children - can't hear what other people are saying.

Group discussion in a room with background noise e.g. music, TV or other conversation going on.

One to one discussion in a noisy environment. E.g. noisy pub / restaurant. I can do this but it is tiring. Sometimes ask to move e.g. in corner or against wall.

Syndicate groups in e.g. a work conference if more than one group in the same room.

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Certain social occasions e.g. meal in busy restaurant with lots of chatter - strain to follow conversation and person on deaf side. Effort to concentrate on them – fatigue.

If someone is on my left and actually makes an effort to speak to me I have to turn my ear and cup my right ear. This is very fatiguing on a long airplane flight.

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I have no appreciation of music in stereo. This is very noticeable when I recollect exactly what a particular piece of music or a play with sound effects was like when I could hear with both ears.

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I have continuous tinnitus in my left ear due to cochlear damage caused by an infection following a stapedotomy. Other SSD impaired people may have the same problem.

Check for cause of SSD if it is a problem with the cochlear they will probably suffer with tinnitus.

I have no balance mechanism due to my left ear. This could also apply to others whose loss of hearing is caused by cochlear damage.

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### **Interview 1: Positive consequences / no difficulty**

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One to one discussion in quiet environment.

Group discussion in quiet room where only one person talks at once.

Group conversation in a quiet room is OK.

Group discussion in a quiet room where only one person talks at once.

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Sleeping – Sleep on good ear if there is noise.

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Being in a nosy environment if I'm with someone e.g. a friend who understands.

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Music.

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Tinnitus doesn't bother me any more even though it's there all the time. I tune out from it.

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TV usually OK.

TV is ok as it is not usually in stereo.

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Telephone usually OK.

Telephone is OK with hearing ear.

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Telling people I have a hearing disability.

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### **Interview 2: Negative consequences / difficulties**

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Direction - If I'm walking across a road I have to rely on my eyes to know where a car is coming from.

Direction - When I'm driving - where is the ambulance.

Direction - I can't tell where somebody is. If my husband says 'I'm here' I can't tell where he is. He has to say 'I'm in the kitchen'.

Direction - If I drop something I've no idea where it rolls to.

No directional information.

Frustration. Where is the squeak coming from in the car?

In the car. When I drive, my wife is on my deaf side.

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Music - I miss stereo sound.

Sound 'topography' is 'flat' so bird song etc. is lacking (possibly a directional problem?)

Concerts - need to choose sides.

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Have difficulty in noise (crowded) situations and find I just hear a general hubbub of noise and have to be very close to somebody to hear what they are saying.

At work - meetings are often difficult if too many people talk at once, or especially if there is a phone link to another global office. I have to make sure I sit close to the speaker.

Group conversations, particularly in social settings where people, understandably, talk over each other.

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I work in an open-plan environment and find it difficult to hear some people (especially those who speak quietly). I have to go into a quiet room to phone somebody otherwise I have difficulty distinguishing their voice over the voice of others.

Confusing 'live' sound with that which is on the TV & radio.

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Telephone - I want to hold the phone in my right hand, but I often want to jot down a note and I'm right handed.

Telephone - Can't switch ears. If my arm gets tired it's difficult. In a public situation if somebody wants to get past me and they talk into my left (bad) ear saying 'excuse me' they often think I'm rude and ignoring them.

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I'm more antisocial, as I find conversations more difficult. It seems that 'muzak' is more often found in restaurants, waiting rooms etc.

Withdrawal of my active interest. Previously I might seek the sources of an unexpected sound, now, less often.

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I use a 'wake & shake' alarm clock, because I sleep mostly on my good ear. However, I worry about not hearing other sounds at night - like my burglar alarm going off.

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I find I'm saying 'excuse me' a lot of the time and people have to repeat what they say.

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Cycling – balance.

Tinnitus possibly worse, very one-sided.

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### **Interview 2: Positive consequences / no difficulty**

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I've found I can lip read better than most people.

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I've realised how good the hearing is in my right ear and there are millions of worse things a person can have.

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I can switch off noise more easily sometimes at work when I'm concentrating.

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Sleeping - I can put hearing ear into the pillow.

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Somehow, I hear things I'm not intended to hear. Change in tone on speaking 'sotto voce'.

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### **Interview 3: Negative consequences / difficulties**

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Background noise - find it hard to hear as just one ear trying to deal with all the 360 degree sound.

Completely ignore people on my deaf side if they speak and there is any background noise.

Parties are a nightmare (but sometimes I am quite glad of an excuse to opt out).

Group conversations i.e. when there is background noise.

Very difficult to interact in groups larger than 2-3 people.

Conversations within a group socially.

Had difficulty with meetings at work.

If more than one person talks at once I give up and have to tell whoever is speaking to wait.

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One to one conversations on 'deaf side' in a noisy environment.

Speaking to my son, when I pick him up from school (he's 7), so therefore small, with background noise I can't hear what he is saying.

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Talking on the phone if there is background noise.

Telephone- have to use my other ear now.

Had difficulty taking telephone calls at work.

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Listening whilst on the phone.

Talking on the phone for a long period of time as arm aches and can't swap ears.

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Hearing bicycles / people behind me when out walking.

Hearing people who are talking behind me.

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Again - not knowing where sounds are coming from, crossing the road takes much more concentration, is more dangerous.

No idea where sounds are coming from - someone calls me, I have no idea where to look. The mobile phone goes and I don't know where to go to answer it.

Can't tell which direction sound is coming from.

Can be slightly concerning when cycling as can't always hear where cars are coming from.

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Can't hear when I am a passenger in a car, and I have to twist my head around.

Have to continually turn my head to one side to listen to noises/ conversation in front of me. Can result in a sore neck.

Constantly have to change the side I walk when walking/talking to people even after continuously telling people I need to be on their right they don't listen.

I always position myself on the outside of a group as it is impossible to be in the middle and try and keep up with what's going on.

Finding good places to sit when eating with friends.

Joining a meeting late and not being able to select a seat which aids my SSD.

It can be tiresome having to tell total strangers why you don't hear them or why they have to talk on my good side. In restaurants / on trains/ on planes.

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A lot of the time I can phase out thinking about the problems but sometimes it feels impossible that I must be like this for the rest of my life.

Periodic depression.

A feeling that no-one understands and that they would only take any interest if I was deaf completely.

Difficult hearing shop assistants - I feel stupid.

Sometimes family forget and I get frustrated when I can't hear - it feels very unfair.

Getting people to understand that I can't hear on the left side so please talk to me on my right.

I don't feel part of large gatherings and no longer am able to enjoy large socials.

I always avoid large groups and my socialising is almost non-existent because of this.

I hate to be thought of as rude for ignoring people on my SSD side who aren't aware.

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Terror about any problem with my good ear.

The unknown 'SSD' causes, etc. No answers from medical professionals, sometimes dismissive, left in the dark.

Questions' about further recurrence, further deafness.

Will my hearing deteriorate in the right ear?

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Enjoyment of music - now only in mono, some distortion at certain levels.

I miss stereo music with headphones.

Distorted hearing at certain volumes.

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I find it exhausting listening to someone when there is background noise.

I get much more tired from the extra effort it takes to concentrate and spend more time lying down.

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Tinnitus - since hearing loss night and day – awful.

Am aware that I have some tinnitus in both ears, but with the one with no hearing it is intense and sometimes makes me feel desperate.

I can feel very dizzy if walking in crowds and noisy environments (possibly not as a result of SSD but because of acoustic neuroma surgery).

I have some dizziness left over from labyrinthitis, but I am not sure if this is made worse by the deafness - affecting my balance.

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**Interview 3: Positive consequences / no difficulty**

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Not any real problem watching TV if it is just me in the room and no other noise.

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Ear plugs to cancel out noise last twice as long.

If trying to sleep when there is noise I can lay on one side and not hear the surrounding noise.

I'm not kept awake when the neighbours have parties.

I was only the only one in the house who slept well when my little granddaughter was born.

I can't hear my husband snoring.

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Better with one-to-one conversations.

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