Journal of
Otorhinolaryngology, Hearing and Balance Medicine

MDPI

Article

Appropriate Listening Environment and Speaking Style for Individuals with Listening Difficulties Compared with Those with Normal Hearing and Hearing Loss

Chie Obuchi [1,*], Yuka Sasame [2] and Yayoi Yamamoto [3]

[1] Institute of Human Sciences, University of Tsukuba, Tsukuba 305-8572, Japan
[2] Research and Support Center on Higher Education for People with Disabilities, Tsukuba University of Technology; Tsukuba 305-8520, Japan; sasame@a.tsukuba-tech.ac.jp
[3] Department of Speech and Hearing Sciences, International University of Health and Welfare, Narita 286-8686, Japan; yyamamoto@ihwg.jp
* Correspondence: obuchi.chie.fu@u.tsukuba.ac.jp; Tel.: +81-029-853-4789

Abstract

Background/Objectives: Individuals with listening difficulties (LiD) report problems understanding speech despite normal hearing sensitivity. This study investigated how speech characteristics (clarity, speaking rate, and loudness) influence subjective speech understanding in adults with LiD under quiet and noisy conditions, compared with individuals with normal hearing (NH) and those who are hard of hearing (HH). **Methods:** A questionnaire-based survey assessed perceived speech intelligibility across 12 listening conditions created by combining two environments (quiet and noisy) and six speaking styles. Participants included 77 adults with LiD (50 LiD without developmental disorders [DD] and 27 LiD and DD), 30 adults with NH, and 26 individuals with HH. Ratings were analyzed using analysis of variance and correlation analyses. **Results:** Both the LiD and HH groups demonstrated significantly reduced speech understanding in noisy environments when the speaking style was suboptimal, compared with the NH group. In contrast, the LiD group uniquely reported difficulties even under quiet conditions with clear, slow, and loud speech. Loud speech in quiet conditions was not consistently beneficial, particularly in the LiD and DD group, possibly reflecting auditory hypersensitivity. **Conclusions:** Listening difficulties in the LiD group are influenced by environmental and speaker-related factors and cannot be addressed solely by conventional strategies used for hearing loss. Although individualized communication approaches may be required, further investigation, including experimental studies, is necessary to validate this interpretation.

Keywords: auditory processing disorder; listening difficulty; speech characteristics; listening conditions; speaking style

Check for updates

Academic Editor: Yu Sun

Received: 4 March 2026
Revised: 15 May 2026
Accepted: 19 May 2026
Published: 21 May 2026

Copyright: © 2026 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license.

1. Introduction

Some individuals experience difficulty with listening to speech in noisy environments. If their pure-tone audiometry indicates normal hearing sensitivity, these individuals are not considered to have hearing loss but rather an auditory processing disorder (APD) and/or listening difficulties (LiD). The prevalence of APD among children and adults is approximately 0.5–1.0% of the general population [1]. Despite its relatively high prevalence, the underlying pathophysiology of APD remains unclear. Furthermore, no gold standard investigation or standardized criteria exist for the diagnosis of APD [2–4]. In studies

comparing different diagnostic criteria [5], the rates of potential APD diagnosis ranged from 7.3% for the strictest criteria to 96.0% for the most lenient criteria. Although a study has attempted to address these diagnostic issues [6], no international unified approach has been established for clinical practice and research on APD. Recently, experimental studies have increasingly suggested the involvement of poor cognitive ability in LiD, highlighting the need to clarify definitions and establish unified assessment methods [7–10].

Because of its substantial disabling effect, an urgent need exists for appropriate support for individuals with APD or LiD. Various support strategies have been explored, including the use of hearing-assistive technologies and hearing aids to facilitate listening, environmental modifications such as reducing the background noise and encouraging clear speech from speakers, and auditory training that directly targets listening and speech perception skills. A recent systematic review and meta-analysis of adults with APD [11] demonstrated that personal remote microphone systems showed the most consistent benefit for enhancing speech intelligibility outcomes. Low-gain hearing aids have shown mixed results, yielding significant improvements in certain speech perceptual tests in noisy environments with auditory training, although methodological heterogeneity limits definitive conclusions. In pediatric populations, structured computer-based auditory training produces significant enhancements in speech-in-noise perception, correlating with functional listening behavior with the gains maintained at the three-month follow-up, supporting its clinical efficacy for improving central auditory skills in children with APD [12].

According to the American Speech-Language Hearing Association [13], environmental modifications can improve access to auditorily presented information. These include enhancing the auditory signal and modifying the listening environment to improve the clarity or audibility of the signal itself. Such modifications are intended not only to reduce the background noise but also to enhance the speech signal through speaker modifications, thereby improving the clarity of the auditory input. The surrounding acoustic environment and the speaker's speaking style are considered important components of the listening environment. Modifications to the acoustic environment are largely adaptations of interventions that have traditionally been provided to individuals with hearing loss. However, based on recent findings regarding the underlying mechanisms of LiD [7–10], the listening difficulties experienced by these individuals cannot be regarded as equivalent to those associated with typical hearing loss. Therefore, it remains necessary to reconsider whether conventional speaking styles are truly effective for this population.

To address this gap, we aimed to examine how different speech characteristics, including clarity, speaking rate, and loudness, affect speech perception and understanding in individuals with LiD under both quiet and noisy listening conditions, compared with individuals with normal hearing and those who are hard of hearing. This approach allows us to identify whether superficially similar symptoms arise from different underlying mechanisms, and to clarify differences in appropriate management strategies between peripheral hearing loss and listening difficulties involving central and/or cognitive factors.

While the terminology and definitions of APD and LiD remain a matter of international debate, in this study, we used the term "LiD" to encompass individuals presenting with a broad range of listening difficulties.

2. Materials and Methods

2.1. Participants

In this study, 77 adults with normal hearing who had complaints of LiD in everyday life were enrolled in the LiD group. Individuals with LiD were recruited from a peer support organization for people with LiD in Japan. There is only one association for people with listening difficulties in Japan, and it is a large-scale community that includes individ-

uals from various regions who have received diagnoses and follow-up care at different hospitals, as well as those who feel that their symptoms correspond to LiD/APD. Therefore, conducting a survey targeting this peer support organization makes it possible to collect data from individuals with LiD/APD across Japan. The data were collected between August and October 2024. LiD group had normal hearing in standard audiometry assessment and normal syllable intelligibility in a silent environment. None of the participants reported long-term exposure to loud noise or music, thereby excluding the risk of cochlear synaptopathy. Obuchi and Kaga [14] previously assessed subjective LiD complaints using a questionnaire for adults with LiD, which was based on the findings of a previous study that compared the results of three questionnaires [15]. They used the shortened Speech, Spatial, and Qualities of Hearing Scale [16] and combined four psychological domain items to assess the psychological and social reactions of the participants to LiD. Each item was scored from 0 to 10; the responses ranged from "not at all" with a score of 0 to "perfect" with a score of 10. The total scores ranged from 0 to 160, and the cutoff value for LiD was $\leq$109. The mean total score of individuals with LiD was 59.3 (standard deviation [SD]: 20.9; range 14–105); thus, their total scores were below the cutoff value.

Developmental disorder traits have been shown to be related to LiD symptoms [17]. Therefore, we divided these participants into two groups: those with a diagnosis of a developmental disorder or with developmental tendencies, such as attention deficit/hyperactivity disorder, autism spectrum disorder (ASD) (n = 27; LiD and DD, mean age 21.5 $\pm$ 3.7 years), and those without such a diagnosis or tendencies (n = 50; LiD, mean age 23.5 $\pm$ 3.1 years).

In the normal hearing group (NH group), 30 individuals (mean age 21.7 $\pm$ 0.5 years), without an otology history or LiD complaints in everyday life were enrolled. These participants were university and graduate students, and their data were collected between July and September 2024. Regarding subjective LiD experiences, individuals with normal hearing had scores above the cutoff value.

As a comparison group (HH group), 26 individuals with mild-to-moderate hearing loss (mean hearing level: 40.1 $\pm$ 11.5 dB) and four individuals with severe hearing loss (mean hearing level: 103.5 $\pm$ 4.3 dB) who used cochlear implants (CI) were included (mean age 33.1 $\pm$ 11.4 years). These individuals primarily relied on spoken language for communication. CI has been shown to substantially improve speech perception, and recent studies indicate that many CI users achieve performance approaching ceiling levels on speech perception tests [18]. Therefore, in the present study, hearing aid users and CI users were not analyzed as separate groups. In contrast, individuals with hearing loss who use additional communication modes, such as written language or sign language, in combination with speech were excluded from the study. Participants were widely recruited, and data were collected between January and February 2026.

This study was approved by the Ethics Committee of the University of Tsukuba in Ibaraki Prefecture, Japan (reference number: #2024-85A; ethical approval date: 22 July 2024), and was conducted in accordance with the guidelines of the Declaration of Helsinki. Participation was voluntary and participants were informed about the purpose of the study. Only participants who provided informed consent were asked to complete the questionnaire. All data were collected anonymously and treated confidentially.

2.2. Tasks and Procedures

We conducted a survey to assess whether participants can listen to speech or not across two listening environments (quiet and noisy) and six different speaking style conditions. This survey was based on subjective self-reported information obtained through a questionnaire, rather than objective evaluations using auditory tests.

For the noisy environmental condition, the participants were instructed to imagine a level of background noise approximately equal to speech, acknowledging that the perceived noise level may vary across individuals. The background noise was intended to represent environmental sounds, including surrounding noises and other people's conversations.

The speaking conditions were manipulated along three dimensions, with each dimension comprising two contrasting ways of speaking: clarity (clear vs. unclear speech [reduced mouth movements]), speaking rate (fast vs. slow speech), and loudness (loud vs. soft speech). Because the perception of these speech characteristics may differ among individuals, participants were asked to respond based on their own perception of what constitutes loud, soft, fast, and slow speech, among others.

The two environmental and six speaking conditions were combined to create a total of 12 survey items. For each item, the participants were asked questions, such as: "In a quiet environment, how well do you think you would be able to listen to and understand a speech that is articulated clearly by the speaker?" Participants' responses were recorded on a 10-point scale, with 1 indicating "not at all understandable" and 10 indicating "completely understandable." These scores were used as the evaluation scores. The question items were presented to the participants using Google Forms. The order of the questions was in the same sequence for all participants due to the nature of the forms.

2.3. Statistics

The evaluation scores were calculated for each participant under each condition. For each condition, a one-way analysis of variance (ANOVA) was conducted to compare the four participant groups for each environment and speaking style condition, followed by Scheffé's post hoc tests. Effect sizes were calculated using η^2.

Subsequently, three-way ANOVA was conducted to examine the effects of participant, environment, and speaking style on the dependent variable (evaluation scores). ANOVA measures how three independent factors (categorical variables) interact to affect a single continuous response variable, testing for the main effects, two-way interactions, and significant three-way interaction (where the effect of two factors changes across levels of the third). Notably, although some variables deviated from normality, previous studies have demonstrated that ANOVA is relatively robust to such violations, particularly when sample sizes are moderate to large. Therefore, in this study, parametric analyses were conducted.

In addition, the relationships between the results and questionnaire scores for LiD in participants in the LiD group were assessed using Pearson's correlation coefficients. All statistical analyses were conducted using the Bell curve in Excel v.2.00 (Social Survey Research Information Co., Ltd. Tokyo, Japan). Differences were considered statistically significant at $p < 0.05$.

3. Results

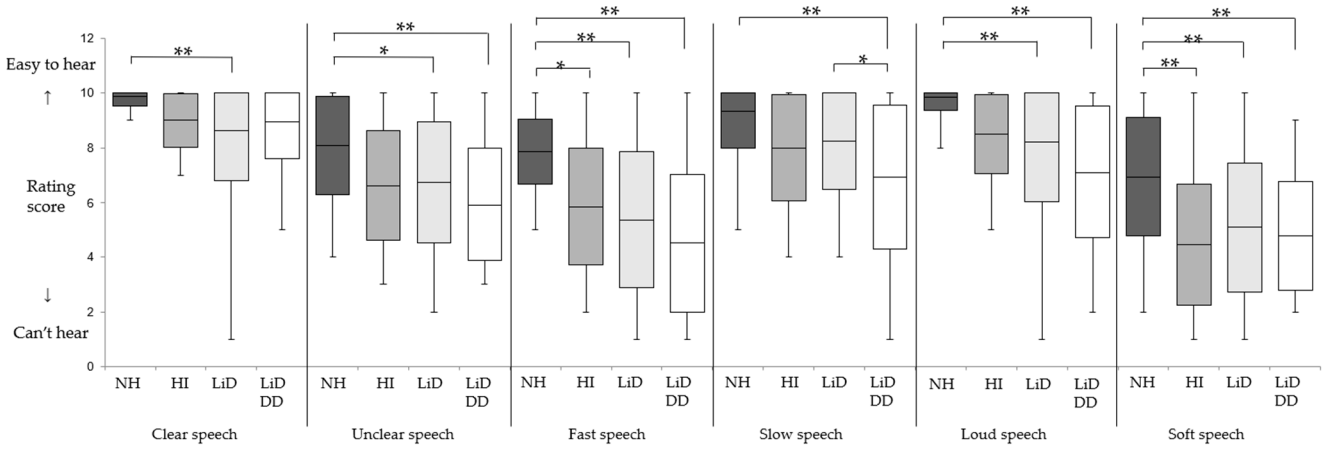
The mean and SD for each questionnaire item score for participant groups, as well as the between-group differences, are presented in Table 1 and Figure 1A,B, along with the perception of different speaking styles under quiet and noisy conditions.

In both quiet and noisy conditions, the HH, LiD, and LiD and DD groups consistently showed significantly poorer perception ratings than the NH group across all speaking styles, as indicated by the one-way ANOVA (all $p \leq 0.002$). The effect sizes indicated that a significant difference was observed under the noisy conditions compared with the quiet conditions.

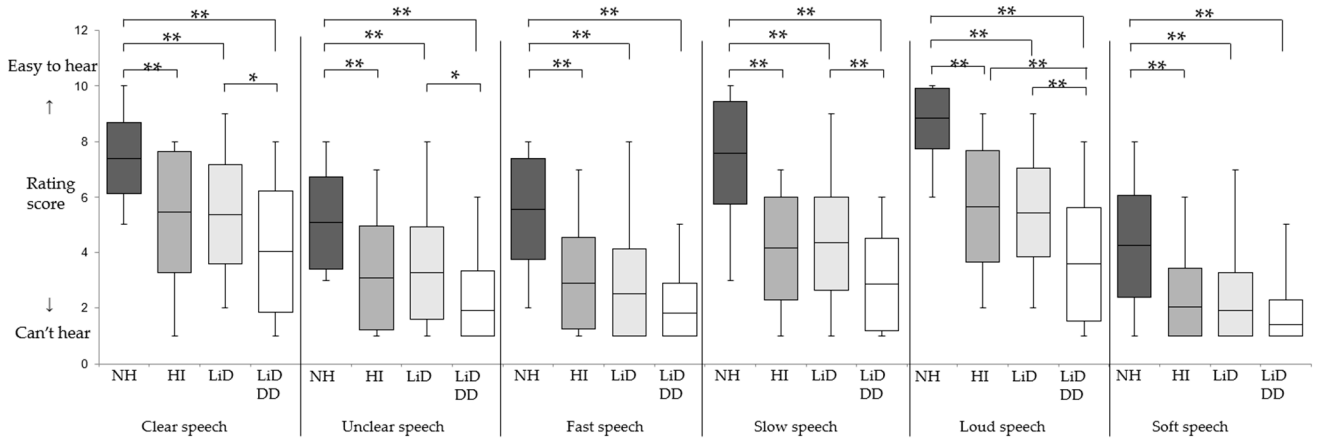
Table 1. Means, SDs, and between-group differences.

Environment	Speaking Style		Individuals with Normal Hearing		Individuals with Hearing Loss		Individuals with LiD		Individuals with LiD & DD		Between-Group Differences			
			Mean	SD	Mean	SD	Mean	SD	Mean	SD	F Value	*p*-Value		η^2
Quiet condition	Clarify	Clear speech	9.87	0.35	9.00	0.98	8.64	1.83	8.96	1349	5.18	$p \leq 0.002$	**	0.11
	Speaking rate	Unclear speech	8.10	1.79	6.62	2.02	6.74	2.22	5.93	2.06	5.66	$p = 0.001$	**	0.12
		Fast speech	7.87	1.20	5.85	2.15	5.38	2.50	4.52	2.52	12.40	$p < 0.001$	**	0.22
		Slow speech	9.33	1.35	8.00	1.94	8.26	1.76	6.93	2.64	7.48	$p < 0.001$	**	0.15
	Loudness	Loud speech	9.83	0.46	8.50	1.45	8.22	2.16	7.11	2.41	10.64	$p < 0.001$	**	0.20
		Soft speech	6.93	2.16	4.46	2.23	5.08	2.35	4.78	2.01	7.30	$p < 0.001$	**	0.15
Noisy condition	Clarify	Clear speech	7.40	1.28	5.46	2.20	5.38	1.79	4.03	2.19	15.85	$p < 0.001$	**	0.27
	Speaking rate	Unclear speech	5.07	1.68	3.08	1.85	3.26	1.66	1.93	1.41	17.61	$p < 0.001$	**	0.29
		Fast speech	5.57	1.83	2.88	1.63	2.52	1.61	1.81	1.08	32.86	$p < 0.001$	**	0.43
		Slow speech	7.60	1.85	4.15	1.87	4.34	1.69	2.85	1.66	38.82	$p < 0.001$	**	0.47
	Loudness	Loud speech	8.83	1.09	5.65	2.02	5.44	1.62	3.59	2.04	47.73	$p < 0.001$	**	0.53
		Soft speech	4.23	1.83	2.04	1.40	1.90	1.36	1.41	0.89	23.90	$p < 0.001$	**	0.36

** $p < 0.01$. SD—standard deviation; LiD—listening difficulty.



(**A**)



(**B**)

Figure 1. (**A**) Rating scores for each speaking style under quiet conditions. (**B**) Rating scores for each speaking style under noisy conditions. The *y*-axis represents each participant's rating score, and the *x*-axis indicates the experimental conditions. * $p < 0.05$, ** $p < 0.01$.

When comparisons were made across each environmental and speaking style condition (Figure 1A), performance for fast speech and soft speech—speech styles that are generally difficult to perceive even under quiet conditions—was significantly poorer in the HH, LiD, and LiD and DD groups than in the NH group. In contrast, under conditions that are generally easier to perceive, such as clear, slow, and loud speech, significantly poorer performance compared with the NH group was observed only in the LiD and LiD and DD groups.

Under the noisy conditions (Figure 1B), scores were significantly lower in the HH, LiD, and LiD and DD groups than in the NH group. Furthermore, for clear, unclear, slow, and loud speech, performance was significantly poorer in the LiD and DD group than in the LiD group.

Regarding the results of the three-way ANOVA, the overall ANOVA model was significant ($F(47, 1548) = 5.88$, $p < 0.001$). Significant main effects were observed for participant ($F = 178.44$, $p < 0.001$), environment ($F = 1084.28$, $p < 0.001$), and speaking style ($F = 156.69$, $p < 0.001$). Each factor independently and substantially contributed to the variation in the dependent variable. Furthermore, significant two-way interactions were found between participant and environment ($F = 11.26$, $p < 0.001$), participant and speaking style ($F = 2.24$, $p = 0.004$), and environment and way of speaking ($F = 11.96$, $p = 0.003$). The three-way interaction between participant, environment, and speaking style was not significant ($F = 1.21$, $p = 0.25$). The combined effect of these three factors did not further modulate the dependent variable.

The relationships between the scores for each condition and the questionnaire scores were examined in individuals with LiD and those with LiD and DD. In the LiD group, significant correlations were observed for unclear speech under the quiet conditions ($r = 0.38$, $p = 0.008$) and for all speaking styles under the noisy conditions (clear speech: $r = 0.38$, $p = 0.006$; unclear speech: $r = 0.39$, $p = 0.003$; fast speech: $r = 0.41$, $p = 0.003$; slow speech: $r = 0.37$, $p = 0.009$; loud speech: $r = 0.38$, $p = 0.006$; soft speech: $r = 0.36$, $p = 0.011$). In the LiD and DD group, a significant correlation was observed only for clear speech under the noisy conditions ($r = 0.38$, $p = 0.05$).

4. Discussion

In this study, we examined how different speech characteristics affect speech perception in individuals with LiD under both quiet and noisy listening conditions, compared with individuals with normal hearing and those who are hard of hearing. Furthermore, we aimed to determine the strategies that may be appropriate to support individuals with LiD. Our results indicated that individuals with LiD or LiD and DD showed significantly greater listening difficulties across all environmental and speaking style conditions; however, their difficulty patterns differed in part from that of individuals with HH. Although both individuals with LiD and those with HH experienced listening difficulties under the noisy conditions, some individuals with LiD also demonstrated listening difficulties under quiet conditions, even for speech styles that are considered to allow easy perception of what is being said, such as clear, slow, and loud speech. This tendency was consistently observed regardless of the presence or absence of DD. In contrast, individuals with HH did not show significant differences from those with NH under quiet conditions when speech was presented in clear, slow, or loud styles.

It is generally recognized that, in individuals with hearing loss, speech understanding improves when speech is spoken clearly and at a slower rate in quiet listening conditions. Clear speech is reportedly more intelligible than conversational speech for listeners with and without hearing loss or hard of hearing in every listening environment [19–21]. Additionally, while such individuals showed poorer speech perception than that of individuals

with normal hearing in noisy environments [22], clear speech reportedly improved their intelligibility [23].

Children with LiD are also vulnerable to adverse listening conditions, such as background noise and variable speaking styles [24,25]. The American Academy of Audiology [26] has further emphasized that compensatory strategies, including slower and clearer speech, as well as environmental modifications, are effective for supporting everyday communication in this population. Clear speech is defined as speech with enhanced acoustic and phonetic contrast, including a slower speaking rate, greater articulatory precision, and expanded vowel space. These modifications reduce perceptual and cognitive load for listeners and are particularly beneficial in adverse listening conditions, including background noise and for individuals who are hard of hearing, hearing aid users, and non-native listeners [23].

The significant interaction between the listening environment and speaking style suggested that when both the environment and speaker's style were unfavorable, individuals with LiD experienced markedly reduced speech intelligibility. Individuals with LiD reported that unclear, fast, or soft speech under noisy conditions was challenging to understand, and many of them assigned the lowest rating "1" to such speech, suggesting that they may have essentially given up on trying to understand the speech. These results indicate that for individuals with LiD, both the listening environment and speaker's speaking style are critical factors, which largely determine the extent to which speech can be understood. Therefore, when communicating with individuals with LiD, careful consideration of both the listening environment and speaking style is essential.

As described above, there is no doubt that clear speech represents an important speaking style for individuals with LiD to facilitate speech understanding. However, some individuals reported difficulty understanding even clear, slow, and loud speech under quiet conditions, suggesting that clear speech alone may not be sufficient to resolve their listening difficulties. Recent evidence indicates that poorer cognitive abilities may contribute to the underlying mechanisms of LiD [7–10]. Thus, even in quiet listening environments, attentional disengagement may occur, potentially resulting in reduced speech comprehension. In such cases, both clear speech and strategies to maintain attentional engagement during conversation even in quiet environments may be important.

Furthermore, loud speech in quiet conditions is considered to allow easy perception of what is being said, and most individuals with NH showed correspondingly high rating scores for this combination. In contrast, reduced rating scores under this condition were observed in individuals with LiD, particularly in those with LiD and DD. These findings are likely attributable to hypersensitivity. Recent studies have shown that individuals with LiD exhibit more traits of ASD than individuals without LiD, even when they have not been formally diagnosed with ASD, and that these traits are associated with auditory hypersensitivity [27]. Auditory hypersensitivity has been reported to reflect difficulties in habituation to sound [28]. In the present study, reduced speech understanding was observed even in individuals with LiD without DD under quiet conditions with clear, slow, and loud speech. These findings suggest that auditory hypersensitivity may contribute to listening difficulties in individuals with LiD, regardless of the presence or absence of a DD diagnosis. For individuals with LiD who exhibit hypersensitivity, it may be necessary to avoid loud speech. The characteristics observed in these LiD cases, as well as their differences from the HH group, will likely need to be further examined by incorporating additional behavioral assessments and by more rigorously validating the supporting evidence.

Speech understanding was markedly reduced in the noisy conditions compared with the quiet conditions in HH, LiD, LiD and DD groups. Individuals with HH experience difficulties in understanding speech in noisy environments not only because of impaired access to speech acoustic cues but also because they are less able to adapt to the background

noise [29,30]. Zahorik and Brandewie [31] showed that although listeners with HH exhibited some perceptual adaptation to room acoustics, the magnitude of this adaptation was substantially reduced compared to that in listeners with normal hearing, particularly in highly reverberant environments. Similarly, individuals with LiD may experience difficulties in adapting to noise.

In individuals with LiD or LiD and DD, significant correlations were partially observed between the scores for each condition and the questionnaire scores. Although both measures are based on subjective evaluations, these findings suggest that the severity of LiD symptoms is closely related to the degree of listening difficulty across different environments and speaking styles. Future studies should conduct objective auditory tests to examine this relationship, which may help in clarifying whether the environmental conditions and speaking styles should be tailored to an individual's symptom severity.

In our study, a few individuals with NH reported difficulty in understanding any speech under quiet or noisy conditions, although they did not complain of encountering listening difficulties in everyday life. Individuals with poor listening ability may not experience problems if they are unconcerned about it or are in supportive everyday environments. Similar findings have been reported in a previous study [17]. Individual differences among those without LiD may make it difficult to distinguish them from individuals with LiD.

This study has some limitations. First, since this study relied exclusively on a questionnaire-based survey and did not include objective behavioral tasks, the results may have been affected by substantial subjectivity. Accordingly, the internal validity and reproducibility of the results should be interpreted with caution. Moreover, the listening environments and speaking styles imagined by participants were not standardized and likely varied considerably across individuals. This lack of control may have introduced additional variability, as differences in individual interpretations could have significantly influenced the responses. Therefore, future studies should adopt more rigorous experimental designs that directly assess these factors under controlled conditions. In particular, it will be essential to clearly define and systematically manipulate listening environments and speaking styles in order to identify those most suitable for individuals with LiD.

Second, we were unable to examine the relationship between participants' auditory test results and their reported listening difficulties, as the types of auditory assessments administered varied across individuals. This lack of standardization represents a critical limitation, preventing a systematic evaluation of how objective auditory performance relates to subjective listening difficulties. Addressing this issue in future research will be essential, as such analyses could provide more concrete and individualized guidance for accommodations based on each participant's assessment results.

Third, the order of the questionnaire items may also have influenced the results. In this study, all participants responded to the items in a fixed sequence, which may have introduced potential order effects. Although the tasks were not expected to strongly bias subsequent responses, the possibility of cumulative or contextual influences cannot be ruled out. Therefore, future studies should carefully consider and control for question order, for example, by randomizing item presentation or counterbalancing the sequence.

Fourth, a more detailed and systematic analysis of differences in speaking styles is critically needed. Individual speaking styles vary widely, and even speech produced by speakers who believe they are using clear speech may remain difficult for individuals with LiD to understand. This highlights a substantial gap between speaker intention and listener experience. Therefore, it is essential to investigate whether and how speakers can effectively adjust their speaking styles to align with the specific needs of listeners. Such work would enable the development of more precise and practical recommendations, ultimately providing more effective support for individuals with LiD in everyday communication.

5. Conclusions

Our findings demonstrate that individuals with LiD, with or without DD, experience significantly greater listening difficulties than individuals with NH across a wide range of listening environments and speaking styles. Although reduced speech understanding under noisy conditions was also observed in individuals with HH, those with LiD showed a distinct pattern, as some experienced listening difficulties even under quiet conditions with speech styles generally considered to facilitate communication, such as clear, slow, and loud speech. These results highlight the importance of considering both environmental and speaker-related factors when communicating with individuals with LiD. Moreover, because conventional strategies used to communicate with individuals with hearing loss (e.g., speaking more clearly or loudly) may not always be sufficient, additional approaches—such as promoting attentional engagement and avoiding excessively loud speech in individuals with hypersensitivity—may be necessary. These points have strong clinical relevance and therefore warrant careful consideration in both research and practice. Future interventions should integrate experimental evaluation of listening conditions with individualized assessment of auditory and cognitive characteristics to provide practical, tailored recommendations for everyday communication support.

Author Contributions: C.O. was responsible for the study design, data collection, data analysis, and interpretation of the results, and drafted and revised the manuscript. Y.S. and Y.Y. contributed to performing the survey and commented on the manuscript. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the JSPS Grants-in-Aids for Scientific Research (KAKENHI), grant numbers 23K25687 and 24H00174.

Institutional Review Board Statement: This study was approved by the Ethics Committee of the University of Tsukuba in Ibaraki Prefecture, Japan (reference number: #2024-85A; ethical approval date: 22 July 2024), and was conducted in accordance with the guidelines of the Declaration of Helsinki.

Informed Consent Statement: Participants were informed about the purpose of the study and that participation was voluntary. Only participants who provided informed consent completed the questionnaire. All data were collected anonymously and treated confidentially. All participants provided informed consent and were briefed in detail before the start of the study.

Data Availability Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Acknowledgments: We gratefully thank the peer support organization for individuals with LiD in Japan and all participants in this study.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

ANOVA	analysis of variance
APD	auditory processing disorder
ASD	autism spectrum disorder
DD	developmental disorder
HH	hard of hearing
LiD	listening difficulty
NH	normal hearing
SD	standard deviation

References

1. Hind, S.E.; Haines-Bazrafshan, R.; Benton, C.L.; Brassington, W.; Towle, B.; Moore, D.R. Prevalence of clinical referrals having hearing thresholds within normal limits. *Int. J. Audiol.* **2011**, *50*, 708–716. [CrossRef]
2. Micallef, L.A. Auditory Processing Disorder (APD): Progress in diagnostics so far. A mini-review on imaging techniques. *J. Int. Adv. Otol.* **2015**, *11*, 257–261. [CrossRef]
3. Moore, D.R. Editorial: Auditory Processing Disorder. *Ear Hear.* **2018**, *39*, 617–620. [CrossRef] [PubMed]
4. Neijenhuis, K.; Campbell, N.G.; Cromb, M.; Luinge, M.R.; Moore, D.R.; Rosen, S.; de Wit, E. An Evidence-Based Perspective on "Misconceptions" Regarding Pediatric Auditory Processing Disorder. *Front. Neurol.* **2019**, *10*, 287. [CrossRef]
5. Wilson, W.J.; Arnott, W. Using different criteria to diagnose (central) auditory processing disorder: How big a difference does it make? *J. Speech. Lang. Hear. Res.* **2013**, *56*, 63–70. [CrossRef]
6. Iliadou, V.; Kiese-Himmel, C. Common Misconceptions Regarding Pediatric Auditory Processing Disorder. *Front. Neurol.* **2018**, *8*, 732. [CrossRef]
7. Roebuck, H.; Barry, J. Parental Perception of Listening Difficulties: An Interaction between Weaknesses in Language Processing and Ability to Sustain Attention. *Sci. Rep.* **2018**, *8*, 6985. [CrossRef] [PubMed]
8. Petley, L.; Hunter, L.L.; Motlagh Zadeh, L.; Stewart, H.J.; Sloat, N.T.; Perdew, A.; Lin, L.; Moore, D.R. Listening difficulties in children with normal audiograms: Relation to hearing and cognition. *Ear Hear.* **2021**, *42*, 1640–1655. [CrossRef] [PubMed]
9. Kawase, T.; Teraoka, R.; Obuchi, C.; Sakamoto, S. Temporal and directional cue effects on the cocktail party problem for patients with listening difficulties without clinical hearing loss. *Ear Hear.* **2022**, *43*, 1740–1751. [CrossRef]
10. Obuchi, C.; Kawase, T.; Kaga, K.; Noguchi, Y. Auditory attention ability under dichotic dual-task situation in adults with listening difficulties. *Audiol. Neurootol.* **2023**, *28*, 175–182. [CrossRef]
11. Crum, R.; Chowsilpa, S.; Kaski, D.; Giunti, P.; Bamiou, D.E.; Koohi, N. Hearing rehabilitation of adults with auditory processing disorder: A systematic review and meta-analysis of current evidence-based interventions. *Front. Hum. Neurosci.* **2024**, *18*, 1406916, Erratum in *Front. Hum. Neurosci.* **2024**, *18*, 1468962. https://doi.org/10.3389/fnhum.2024.1468962. [CrossRef]
12. Loo, J.H.; Rosen, S.; Bamiou, D.E. Auditory training effects on the listening skills of children with auditory processing disorder. *Ear Hear.* **2016**, *37*, 38–47. [CrossRef]
13. American Speech-Language-Hearing Association. Central Auditory Processing Disorder. Available online: https://www.asha.org/practice-portal/clinical-topics/central-auditory-processing-disorder/ (accessed on 4 January 2026).
14. Obuchi, C.; Kaga, K. Development of a questionnaire to assess listening difficulties in adults with auditory processing disorder. *Hear. Balance Commun.* **2020**, *18*, 29–35. [CrossRef]
15. Bamiou, D.E.; Iliadou, V.M.; Zanchetta, S. What can we learn about auditory processing from adult hearing questionnaires? *J. Am. Acad. Audiol.* **2015**, *26*, 824–837. [CrossRef]
16. Noble, W.; Jensen, N.S.; Naylor, G.; Bhullar, N.; Akeroyd, M.A. A short form of the speech, spatial and qualities of hearing scale suitable for clinical use: The SSQ12. *Int. J. Audiol.* **2013**, *52*, 409–412. [CrossRef]
17. Obuchi, C.; Kawase, T.; Sasame, Y.; Yamamoto, Y.; Sasaki, K.; Iwasaki, J.; Okamoto, H.; Kaga, K. Traits of developmental disorders in adults with listening difficulties without diagnosis of autism spectrum disorder and/or attention-deficit/hyperactivity disorder. *J. Clin. Med.* **2024**, *13*, 6281. [CrossRef] [PubMed]
18. Spitzer, E.R.; Landsberger, D.M.; Lichtl, A.J.; Waltzman, S.B. Ceiling effects for speech perception tests in pediatric cochlear implant users. *Cochlear Implant. Int.* **2024**, *25*, 69–80. [CrossRef] [PubMed]
19. Picheny, M.A.; Durlach, N.I.; Braida, L.D. Speaking clearly for the hard of hearing I: Intelligibility differences between clear and conversational speech. *J. Speech Hear. Res.* **1985**, *28*, 96–103. [CrossRef] [PubMed]
20. Payton, K.L.; Uchanski, R.M.; Braida, L.D. Intelligibility of conversational and clear speech in noise and reverberation for listeners with normal and impaired hearing. *J. Acoust. Soc. Am.* **1994**, *95*, 1581–1592. [CrossRef]
21. Ferguson, S.H.; Morgan, S.D. Talker differences in clear and conversational speech: Perceived sentence clarity for young adults with normal hearing and older adults with hearing loss. *J. Speech Lang. Hear. Res.* **2018**, *61*, 159–173. [CrossRef]
22. Smiljanić, R.; Bradlow, A.R. Speaking and hearing clearly: Talker and listener factors in speaking style changes. *Lang. Linguist. Compass.* **2009**, *3*, 236–264. [CrossRef] [PubMed]
23. Shin, S.Y.; Oh, H.; Jin, I.K. Korean Clear speech improves speech intelligibility for individuals with normal hearing and individuals with hearing loss. *J. Am. Acad. Audiol.* **2020**, *31*, 719–724. [CrossRef] [PubMed]
24. Moore, D.R.; Ferguson, M.A.; Edmondson-Jones, A.M.; Ratib, S.; Riley, A. Nature of auditory processing disorder in children. *Pediatrics* **2010**, *126*, e382–e390. [CrossRef] [PubMed]
25. Sharma, M.; Purdy, S.C.; Kelly, A.S. Comorbidity of auditory processing, language, and reading disorders. *J. Speech Lang. Hear. Res.* **2009**, *52*, 706–722. [CrossRef]

26. American Academy of Audiology. Clinical Practice Guidelines Guidelines for the Diagnosis, Treatment and Management of Children and Adults with Central Auditory Processing Disorder. Available online: https://www.audiology.org/wp-content/uploads/2021/06/CAPD-Guidelines-8-2010.pdf_539952af956c79.73897613.pdf?utm_source=chatgpt.com (accessed on 4 January 2026).
27. Sasaki, K.; Iwasaki, J.; Yamamoto, Y.; Sasame, Y.; Kurumai, M.; Obuchi, C. Atypical sensory characteristics of children with listening difficulties: A comparison with children with autism spectrum disorders. *Hear. Balance Commun.* **2023**, *23*, 10–18. [CrossRef]
28. Dwyer, P.; Williams, Z.J.; Vukusic, S.; Saron, C.D.; Rivera, S.M. Habituation of auditory responses in young autistic and neurotypical children. *Autism Res.* **2023**, *16*, 1903–1923. [CrossRef]
29. Marrufo-Pérez, M.I.; Lopez-Poveda, E.A. Adaptation to noise in normal and impaired hearing. *J. Acoust. Soc. Am.* **2022**, *151*, 1741. [CrossRef]
30. Marrufo-Pérez, M.I.; Fumero, M.J.; Eustaquio-Martín, A.; Lopez-Poveda, E.A. Impaired noise adaptation contributes to speech intelligibility problems in people with hearing loss. *Sci. Rep.* **2024**, *14*, 28807. [CrossRef]
31. Zahorik, P.; Brandewie, E. Perceptual adaptation to room acoustics and effects on speech intelligibility in hearing-impaired populations. *Proc. Forum Acust.* **2011**, *27*, 2167–2172. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.