
Empathy ability and emotion perception of people with visual disabilities

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Abstract: As people with visual disabilities have poor visual acuity, they significantly rely on vocal expressions of emotions in recognising and understanding emotions in other people, e.g., empathy. However, there is little understanding of individual differences in emotion perception and empathy abilities among people with visual disabilities. To address the knowledge gap, a convenience sample of 30 people with visual disabilities reported their perceived emotions when given various emotional stimuli of speech and completed the interpersonal reactivity index to report their empathy abilities in terms of perspective taking, empathic concern, personal distress, and fantasy. The participants showed statistically significant individual differences in emotion perception and empathy abilities for various emotions. The research findings could serve as foundational knowledge, contributing to developing adequate interventions to help those with visual disabilities to better manage emotional stress, promote emotional wellness, and construct healthy relationships with others.

Keywords: interpersonal reactivity index; IRI; emotional wellness; emotional ergonomics.

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1 Introduction

It is natural for humans to perceive emotions such as anger, disgust, and fear in themselves and other people, which is a significant part of social life. From a theoretical point of view, the dimensions of valence and arousal are often used to describe and classify various emotional states (Russell and Mehrabian, 1977). Valence (also known as pleasure) is a term to describe the degree to which emotion is positive (pleasant) or negative (unpleasant). Arousal is a term to describe the intensity of emotion, ranging

from low (calm) to high (excited). For example, happiness is an emotion with a combination of high arousal and positive valence, which is distinctive from neutral emotion (Yu et al., 2016). The emotion of fear belongs to the category of negative valence (Sutton et al., 2019), which is also distinctive from neutral emotion. However, the limited ability to perceive emotions in oneself and others would lead to, for example, losing empathy and making poor social judgments in the working place and at home (Lindquist et al., 2014). Empathy refers to an individual's ability to understand and experience other people's emotions, for instance, by mentally putting oneself into others (Thirioux et al., 2016). Empathy is different from sympathy and compassion. Sympathy means that an individual simply understands what another person is feeling; empathy means that an individual understands and feels what another person is feeling; and compassion means that an individual is willing to take actions in order to relieve the suffering of another person (e.g., provisions of social supports) (Thirioux et al., 2016). However, empathy does not refer to the context where an individual would change his/her own personality, but rather get into the mind to deeply understand and feel how another person perceives reality (Badea and Pană, 2010).

Empathy is considered critical in developing good interpersonal relationships and communication skills (Yildiz and Duy, 2013). It is well documented that a lack of empathy is associated with aggression (McPhedran, 2009; Miller and Eisenberg, 1988), offending (Jolliffe and Farrington, 2004), narcissism (Ritter et al., 2011), bullying behaviours (Jolliffe and Farrington, 2011), and depression (Derntl et al., 2012). On the other hand, people with a high level of empathy tend to show pro-social behaviours (Rameson et al., 2012), altruism (Van Lange, 2008), relationship satisfaction (Cramer and Jowett, 2010), and subjective well-being (Wei et al., 2011). Empathy is a central characteristic of emotionally intelligent behaviour (Mayer and Salovey, 1997; Salovey and Mayer, 1990).

Yet, people with visual disabilities are less likely to obtain rich visual information of emotion expressions (e.g., facial expressions and body languages) made by others (Martins et al., 2019), such that it would be difficult for them to develop good interpersonal communication skills in everyday life (Thirioux et al., 2016). For example, the lack of visual cues would prohibit children with visual disabilities from developing social skills and making friends (Jindal-Snape, 2005; Sacks, 2006). Warren (1994) argued that children with visual disabilities were often observed to feel socially uncomfortable and more egocentric as compared to their sighted peers because it was not easy for them to observe, learn, and imitate peers due to their visual limitations. As compared to people without disabilities, their peers with visual disabilities were more likely to be viewed as ones with lower self-esteem induced by a disproportionate number of negative reflections they may have experienced, (Tuttle and Tuttle, 2004). Alternative information about emotion expressions (e.g., verbal and vocal emotion expressions) were often integrated into interventions that aimed to improve social relations and interactions of people with visual disabilities (Wagner, 2004).

Whereas numerous prior studies have examined emotion recognition and empathy in sighted individuals toward people with disabilities (Guarese et al., 2023b; Jones and Miller, 2018; Miller, 2013; Wickline et al., 2016), there is a paucity of research on emotion recognition and empathy in people with visual disabilities (Dyck et al., 2004; Martins et al., 2019; Roch-Levecq, 2006). Martins et al. (2019) invited sighted people and people with congenital blindness and compared their ability to recognise emotions through auditory emotional stimuli. In their study, auditory stimuli expressing various

emotions were presented to those participants. Sighted participants were found to have outperformed the emotion comprehension task, especially associated with a conflicting emotional prosody task under congruent conditions, as compared to their peers with congenital blindness. A psychology study by Kessler et al. (1989) observed that the distress level of unemployed people (e.g., emotions with negative valence – depression and anxiety) are likely to be dramatically decreased after being re-employed, as compared to those who still remained unemployed. As people with visual disabilities tend to encounter difficulties in being employed today (Olson, 2012), there is a concern that many of them would develop negative emotions and suffer from associated mental health issues. Soulis et al. (2013) found gender-related individual differences among children with visual disabilities (24 males and 22 females, aged from 8 to 15). The level of empathy of females was higher than that of males. They suggested that women with visual disabilities are more likely than men with visual disabilities to develop warmth, affection, and deep understanding in interpersonal relationships. Everyone is getting old and affected by aging, such that age-related individual differences in emotion recognition are also concerned for people with visual disabilities. Isaacowitz et al. (2007) found age differences in emotion recognition via lexical stimuli and facial expressions, as younger and older adults tended to recognise the same emotions differently. Ryan et al. (2009) also observed that older adults showed poorer performance than younger adults in recognising emotions via vocal expressions in isolation and in a combination of vocal and facial expressions. However, Hunter et al. (2010) reported that there were no significant age-related differences in detecting congruence in cross-modal emotional cues (voice and facial expressions), as older adults benefited from congruent multisensory information in recognising various emotions as compared to unimodal information (e.g., either voice or facial expressions).

Without a deep understanding of such individual differences related to vision status and socioeconomic factors (e.g., gender, health, age, and job), it would be difficult for researchers and professionals to develop effective interventions (e.g., technology aids or social behavioural support systems) to help those with visual disabilities manage emotional stress, promote emotional well-being, and develop healthy relationships with others. This study aims to advance knowledge of the degree to which people with visual disabilities can recognise, understand, and differentiate various emotions through vocal expressions.

2 Methods

2.1 Participants

This study recruited participants in collaboration with community organisations (e.g., a local community centre and a library for the blind) that provided services to people with visual disabilities. As the community organisations had access to potential participants, they helped to identify potential participants who met the inclusion criteria (i.e., English-speaking, 18 years old or older, and visual acuity worse than 20/70 (World Health Organization, 2008)). They also helped to exclude potential participants with cognitive challenges (e.g., dementia) and communication problems (e.g., hearing and speaking issues). A convenience sample of 30 people with visual disabilities participated in this study. Table 1 shows the participants' characteristics.

Table 1 The participants' characteristics

<i>Participants</i>	<i>n = 30</i>
Visual acuity	
Between 20/200 and 20/400	9
Between 20/400 and 20/1,200	4
Less than 20/1,200, but has light perception	15
No light perception at all	2
Duration of visual disabilities (years)	17.63 ± 23.11
Onset of visual disabilities (years) ^a	
Early onset (n = 10)	0.4 ± 1.26
Late onset (n = 20)	45.81 ± 17.13
Age (years)	59.7 ± 17.84
Gender	
Male	11
Female	19
Race/ethnicity	
African American	11
European American	17
Hispanic American	1
Others	1
Marital status	
Married	14
Not married	7
Widow(er)	4
Divorced	5
Education	
High school or equivalent	7
Certificate or training program	1
Associate	6
Bachelors	5
Masters	10
Doctorate	1
Occupation	
Working full time	5
Working part time	2
Unemployed and not looking for work	4
Unemployed and looking for work	1
Retired or disabled	16
Currently in school	2

Notes: A participants with early-onset visual disabilities had lost their sight before they reached 11 years of age (Voss et al., 2004).

Table 1 The participants' characteristics (continued)

<i>Participants</i>	<i>n = 30</i>
Household income	
≤ \$25,999	6
\$26,000–\$51,999	6
\$52,000–\$74,999	6
≥ \$75,000	5
Declined to answer	7
Head of household	
Living alone	9
With family, relatives, friends, or combination of them	21
Diagnosed with health conditions	16
Participation in physical exercise	22

Notes: A participants with early-onset visual disabilities had lost their sight before they reached 11 years of age (Voss et al., 2004).

2.2 Materials

Stimuli of emotional speech were extracted from the database, Ryerson audio-visual database of emotional speech and song (RAVDESS) (Livingstone and Russo, 2018) that provided an open-access repository of high-quality recordings of emotional speech in North American English. The stimuli included eight emotions – sadness, happiness, anger, calmness, fear, surprise, neutrality, and disgust, which were presented using a neutral statement, 'Kids are talking by the door.'

The interpersonal reactivity index (IRI) (Davis, 1983) helped to measure individual differences in empathy abilities. The IRI is a 28-item self-report measure, which should be completed using a 5-point Likert scale, with options ranging from 'does not describe me well' to 'describes me very well.' Cronbach's alpha coefficients range from 0.70 to 0.78 (Davis, 1980). The IRI helped to measure multi-dimensions of empathy abilities: perspective taking (PT), empathic concern (EC), personal distress (PD), and fantasy. PT refers to the degree to which an individual adopts the perspectives of other people and understands things from their point of view. EC refers to the degree to which an individual experiences the feeling of compassion and concern for unfortunate others. PD refers to the degree to which an individual experiences distress and discomfort in response to extreme distress in others. Fantasy (FS) refers to the degree to which an individual transposes oneself into fictional situations.

2.3 Procedures

This study was conducted by phone, which lasted approximately 60 minutes for each participant. For example, participants listened to a sad speech that was played by the researcher's mp3 audio player and was then asked to report which emotion they perceived among sadness, happiness, anger, calmness, fear, surprise, neutrality, and disgust. By following the same procedure, the remaining stimuli of emotional speech were examined. We randomised the order of stimulus presentations to reduce order effects. Participants completed the IRI questionnaire. This study was approved by the institutional review board (IRB).

2.4 Data analysis

The data were analysed using the descriptive statistics, the Cronbach's α for internal consistency, the Chi-Square test and the Mann-Whitney U test. Statistical analyses were performed using the IBM SPSS Statistics for Macintosh, version 24 (IBM Corp., 2016).

3 Results

Various individual differences were found in emotion perception and empathy ability. Significant research findings are presented below, followed by detailed discussions in the discussion section.

3.1 Individual differences in perceived emotions

This study investigated the degree to which people with visual disabilities recognise and identify various emotions in other people via vocal expressions. The following Table 2 shows the summary of data analysis results.

As shown in Table 2, among all participants ($n = 30$), the frequency of participants whose perceived emotion turned out to be the same as the given stimulus of emotional speech was low in that median is merely 6.5 (21.5%), i.e., poor agreement. As the emotional speech database was developed based on the perception of sighted people, the poor agreement suggests that there would be individual differences in emotion perception between people with and without visual disabilities.

The participants perceived a range of different emotions in response to each stimulus. Thus, the Chi-Square statistic was conducted to examine whether there were any significant associations among the perceived emotions. When the emotional stimuli of angry, neutral, fear, and disgust speech were presented, there were significantly perceived emotions. For example, when given the stimulus of neutral speech, participants significantly perceived neutrality (66%), followed by calmness (23%) and happiness (10%). When given the stimuli of disgust speech, they significantly perceived surprise (37%), followed by neutrality (23%), disgust (13%), and happiness (10%). On the other hand, when the other emotional stimuli of happy, sad, calm, and surprise speech were presented, no significance was found. Interestingly, most participants reported that they felt the emotion of neutrality when given the five emotional stimuli of neutral, fear, sad, happy, and calm speech. When given the emotional stimuli of surprise speech, participants perceived calmness ($n = 9$) and happiness ($n = 9$) although the two emotions of calmness and happiness would typically sound differently – at least to the sighted people. The full reports are available in Table 2.

This study also examined if there were any associations between perceived emotions and socio-demographic variables. As shown in Table 2, a set of socio-demographic variables, such as gender, health, age, and job showed significant associations with perceived emotions when participants were given the emotional stimuli of angry, disgust, happy, and calm speech. The significant associations indicate evidence of individual differences within the group of participants who share the same disability category, visual disability.

Table 2 Summary of statistical analysis results

Stimuli of emotional speech	Emotions perceived by participants when given each stimulus								Association with socio demographic variables
	Neutrality; n (%)	Anger; n (%)	Fear; n (%)	Disgust; n (%)	Happiness; n (%)	Sadness; n (%)	Calmness; n (%)	Surprise; n (%)	
Neutral speech	19 (66%)	0 (0%)	0 (0%)	0 (0%)	3 (10%)	0 (0%)	7 (23%)	0 (0%)	$\chi^2 (2) = 14.35$, $p = 0.001$
Angry speech	1 (3%)	13 (43%)	3 (10%)	6 (20%)	0 (0%)	0 (0%)	0 (0%)	6 (20%)	$\chi^2 (4) = 12.21$, $p = 0.016$ Gender, $p \leq 0.05$, $\chi^2 (4) = 9.48$, $V = 0.57$ Health, $p \leq 0.01$, $\chi^2 (4) = 14.88$, $V = 0.72$
Fearful speech	9 (30%)	0 (0%)	7 (23%)	1 (3%)	1 (3%)	5 (17%)	5 (17%)	1 (3%)	$\chi^2 (6) = 15.17$, $p = 0.019$
Sad speech	10 (33%)	0 (0%)	6 (20%)	0 (0%)	1 (3%)	7 (23%)	4 (13%)	4 (13%)	$\chi^2 (5) = 8.40$, $p = 0.136$
Happy speech	8 (27%)	3 (10%)	1 (3%)	2 (7%)	6 (20%)	0 (0%)	5 (17%)	5 (17%)	$\chi^2 (6) = 6.97$, $p = 0.324$ Age, $p = 0.04$, $\chi^2 (6) = 12.83$, $V = 0.66$
Calm speech	9 (30%)	0 (0%)	2 (7%)	1 (3%)	5 (17%)	3 (10%)	5 (17%)	4 (13%)	$\chi^2 (6) = 9.86$, $p = 0.131$
Disgust speech	7 (23%)	1 (3%)	0 (0%)	4 (13%)	3 (10%)	1 (3%)	1 (3%)	11 (37%)	$\chi^2 (6) = 21.50$, $p = 0.001$ Job, $p = 0.03$, $\chi^2 (6) = 14.07$, $V = 0.71$
Surprise speech	7 (23%)	0 (0%)	0 (0%)	0 (0%)	9 (30%)	0 (0%)	9 (30%)	4 (14%)	$\chi^2 (3) = 2.31$, $p = 0.511$

3.2 Individual differences in empathy capabilities

The IRI questionnaire was administered to better understand individual differences in emotion perception among participants with visual disabilities. As emotion perception is related to an individual ability of recognising and identifying emotions in other people (i.e., empathy), the IRI is an ideal instrument in that it helps to investigate in detail four different aspects of empathy abilities – PT, EC, PD, and fantasy. The participants' responses to the IRI questionnaire showed adequate internal consistency (Cronbach's $\alpha = 0.77$), each construct of which also showed adequate internal consistency, e.g., $\alpha = 0.76$ for PT, $\alpha = 0.76$ for EC, $\alpha = 0.82$ for PD, and $\alpha = 0.75$ for fantasy. The participants' IRI scores, on average, were 2.84 ± 1.12 for PT, 3.30 ± 0.95 for EC, 1.45 ± 1.35 for PD, and 2.18 ± 1.45 for fantasy.

The Mann-Whitney U test was conducted to examine if there was any significant difference in empathy abilities among participants. This study found a significant difference in the PD ability between participants with and without chronic diseases, $U = 66$, $z = -1.92$, $p = 0.05$, $r = -0.40$. The PD ability (1.78 ± 0.96) of those without chronic diseases was higher than that (1.16 ± 0.74) of their peers with chronic diseases. The result suggests that those suffering from chronic diseases tended to perceive less distress and discomfort in response to extreme distress in other people as compared to their peers without chronic diseases.

We also examined individual differences in empathy abilities between the following two groups: participants whose perceived emotion turned out to be 'identical' to the given stimulus of emotional speech and their peer participants whose perceived emotion turned out to be 'different' from that. When the emotional stimulus of surprise speech was given, the PD ability in participants who perceived the identical emotion (i.e., surprise) was higher (2.29 ± 0.85) than that (1.31 ± 1.38) in those who did not so, $U = 13.5$, $z = -2.35$, $p \leq 0.05$, $r = -0.43$. When the emotional stimulus of fear speech was given, the fantasy ability in participants who perceived the identical emotion (i.e., fear) was higher (2.84 ± 1.34) than that (1.98 ± 1.42) in those who did not so, $U = 29$, $z = -2.53$, $p \leq 0.05$, $r = -0.46$.

There was also a significant difference in the perceived distress ability between participants who recognised the emotional stimulus of anger speech as a middle arousal emotion (e.g., neutrality) and a higher arousal emotion (e.g., fear, surprise, anger, and disgust), $U = 9$, $z = -2.15$, $p \leq 0.05$, $r = -0.40$. The perceived distress ability level of participants who perceived the anger speech as a middle arousal emotion (0.48 ± 0.46) was lower than that (2.00 ± 0.83) of their peers who perceived it as a higher arousal emotion.

4 Discussion

4.1 Individual differences in perceived emotions

Individual differences were found in emotion perception among participants with visual disabilities. Participants with visual disabilities tended to perceive the same stimulus of emotional speech differently, e.g., the stimulus of neutral speech was the only one where more than 50% of participants reported that they perceived a neutral emotion. Given the fact that this study used the database of emotional speech that were labelled by sighted

people in a different study by Livingstone et al. (2018), it could be argued that this poor agreement also implies the individual difference in emotion perception between people with and without visual disabilities. A similar research finding was also found in the study by Martins et al. (2019) in which sighted people outperformed an emotion comprehension task via Florida affect battery (FAB) as compared to their peers with blindness. However, their study was limited to participants who were congenitally blind only, while this study included participants who had lost their vision under various conditions in terms of onset time of vision loss, duration of vision loss, and degree of vision loss. This study contributes to offering evidence of individual differences in emotion perception among people with different vision conditions.

The theoretical dimensions of emotions, valence and arousal (Russell and Mehrabian, 1977) tended to be unable to clearly explain the way participants in this study perceived emotions. For example, participants mostly perceived neutrality when given the stimuli of fear, sad, happy, calm, and neutral speech. Calmness represents an emotion with low arousal while happiness is considered as an emotion with high arousal, and both emotions are typically perceived distinctively among sighted people in general. The results lead to a theoretical argument that the way sighted people perceive the stimulus of emotional speech may not be identical with the way their peers with visual disabilities do so. Further research is needed to have a deeper understanding of such individual differences in emotion perception between people with and without visual disabilities.

We found individual differences associated with gender, health, age, and job. For example, when given the stimulus of anger speech, male participants perceived neutrality while none of the female participants perceived neutrality; instead, female participants felt fear and disgust. On the other hand, none of the male participants perceived fear or disgust. Thus, it can be argued that female participants tended to analyse and distinguish the anger speech differently, as compared to their male peers. Female participants with visual disabilities may have clarified the anger speech further by referring to other vocal characteristics, such as pitch, intensity, jitter, and so on (Hartmann et al., 2013), which is beyond such simple dimensions of valence and arousal.

Health-related individual differences were also observed. When given the anger speech, the majority of participants 'without' chronic diseases perceived anger, while participants 'with' chronic diseases perceived a variety of emotions. It can, thus, be argued that health status might be a critical factor influencing how differently participants with visual disabilities perceived the stimulus of anger speech. It is well documented in the literature that patients with chronic diseases tend to pay close attention to taking care of their emotional stressors in order to improve health outcomes (Wierenga et al., 2017). Gross (2013) claimed that a stimulus of emotion is processed through various phases, such as selecting or modifying situations, changing his/her attention to thoughts about the situations, and changing his/her responses to these situations. Based on the previous research reports in the literature, this study argues that participants 'with' chronic diseases may have analysed the stimulus of anger speech via such complicated emotional processes and classified the anger speech as a non-angry emotion (i.e., neutrality) to remain emotionally healthy, while those 'without' chronic diseases classified the anger speech as an anger emotion.

Age-related individual differences were also detected. Happiness is typically viewed as a high arousal emotion with positive valence, such that the stimulus of happy speech should be considered different from the neutral speech. When given the happy speech, the majority of 'younger' participants with visual disabilities perceived happiness;

however, the majority of 'older' participants perceived neutrality, and more interestingly, none of the older participants perceived happiness. Many gerontology studies also reported age-related individual differences with regard to emotion perception (Hunter et al., 2010; Isaacowitz et al., 2007; Ryan et al., 2009). Yet, in contrast with those previous studies, this study targeted at people with visual disabilities, such that visual cues such as facial expressions would be useless and inaccessible to those with visual disabilities. Instead, older participants in this study may have additionally referred to other accessible emotional cues (e.g., vocal characteristics), resulting in perceiving the neutral emotion instead of the happy emotion. Hence, further research is needed to advance the understanding of relationships between multisensory stimuli and emotion perceptions among people with visual disabilities.

This study also found job-related individual differences. When given the stimulus of disgust speech, the 'unemployed' participants perceived a variety of emotions, including anger, neutrality, disgust, happiness, sadness, calmness, and surprise. On the other hand, none of the 'employed' participants perceived the disgust emotion in that the majority of them perceived the surprise emotion instead. The surprise emotion is typically categorised as an emotion with neutral valence (i.e., neither pleasant nor unpleasant). Thus, it could be argued that the 'employed' participants tended to recognise a stimulus of an emotional speech with negative valence (e.g., disgust) as an emotion with neutral valence. Kessler et al. (1989) also observed that psychological distress is closely associated with unemployment. As the high prevalence of unemployment is likely to be observed in people with visual disabilities (Olson, 2012), many of them would probably develop negative emotions and suffer from associated mental health issues. Adequate psychological, economic, or social interventions are recommended to address this challenge in the community of people with visual disabilities.

4.2 Individual differences in empathy capabilities

This study also examined participants' empathy abilities (i.e., PT, EC, PD, and fantasy) to obtain a deeper understanding of associations with individual differences in emotion perception among those with visual disabilities. It was, for example, found that a group of participants recognised a given emotional speech as the same type of emotion (i.e., congruent case), while another group of participants recognised it as different emotions (i.e., incongruent case). The empathy abilities of the two groups were compared. Participants who recognised the stimulus of *surprise* speech as a *surprise* emotion showed a significantly higher level of *PD* of empathy abilities, as compared to their peers who recognised it as non-surprise emotions. It could, thus, be argued that participants showing the congruent case might have the enhanced ability to perceive the stressful condition in others through vocal expressions. As they have a higher level of empathy ability associated with *PD*, they are more likely to develop a deep understanding of the needs and concerns of other persons, which is probably leading to offering empathy and supports (e.g., companionship, emotional, informational, or tangible supports) to others in need.

Participants' empathy abilities were also compared by socio-demographic backgrounds. It was found that the *PD* of empathy abilities in those 'with' chronic diseases was lower than that of their peers 'without' chronic diseases. According to the theory of cognitive adaptation (Taylor, 1983), humans can cope with threats in their lives by creating space for hope, personal growth, and flexibility, ultimately leading to

facilitating their well-being and promoting their psychological health. In other words, humans are believed to be resilient as they adapt to the environments even if it is a life-threatening event, such as a diagnosis of a potentially fatal illness. Given the theoretical logic, participants 'with' chronic conditions in this study may have adapted well to their health issues and somehow learned how to view their lives as less stressful, as compared to their peers 'without' chronic conditions.

This study used the stimuli (i.e., emotional speech samples) that were developed based on the perceptions of sighted people in the study by Livingstone et al. (2018). The results of this study could also be considered as evidence of individual differences in emotion perception between sighted people and people with visual disabilities. There are only a handful of published articles on empathy abilities among adults with visual disabilities; yet, we found a study of Griffin-Shirely et al. (2005) examining empathy abilities among children with visual disabilities. Griffin-Shirely et al. found no significant difference in empathy abilities between sighted children and their peers with visual disabilities. However, it would not be feasible to directly compare their study with this study because their research participants did not include adults. As we noticed a lack of research on individual differences in empathy abilities 'within' adults with visual disabilities as well as 'between' adults with and without visual disabilities, this study's findings contribute to addressing the knowledge gap.

This study referred to the emotional dimension, higher and lower arousal (Russell and Mehrabian, 1977) in order to obtain a deeper understanding about the degree to which participants with visual disabilities recognise the same stimulus of emotional speech differently and its association with empathy abilities. Individual differences were found in perceiving emotions that had different arousal levels, which may be accounted for by different levels of perceived distress of empathy abilities. For instance, when a stimulus of anger speech was given, participants who had a higher level of perceived distress of empathy abilities recognised the anger speech as a higher arousal emotion (e.g., surprise, disgust, happiness, fear, and anger), which is a congruent case. The results lead to the argument that an individual's ability of empathy is likely to influence the degree to which he/she recognises a stimulus of emotional speech as one with higher (or lower) arousal emotion. This research finding can be supported by the study of Eisenberg et al. (1994) who also found close associations between emotion regulation, emotion arousal, and PD ability although they conducted research with sighted participants. For example, a low level of emotion regulation ability was related to a high level of emotional arousal and PD. In contrast, a high level of emotion regulation ability was related to a moderate level of emotional arousal and EC (Eisenberg et al., 1994). Eisenberg et al. (1994) thus, claimed that a high level of emotion regulation ability may contribute to decreasing the probability of experiencing others' emotions as aversive. According to their logic, participants in this study may have been equipped with a low level of emotional regulation ability as they resulted in perceiving a high level of emotional arousal and PD. Yet, as there has been a lack of research reporting the empirical relationships between the arousal emotion dimension and the PD of empathy abilities among people with visual disabilities, the research findings of this study could contribute to advancing the knowledge of individual differences in empathy abilities associated with high/low arousal emotions among people with visual disabilities.

No correlation was found between empathy constructs (PT, EC, PD, and fantasy) and the number of the perceived emotion identical to the given emotional stimuli. As the stimuli (emotional speech samples) were developed based on sighted people's emotional

perception, this result hypothetically suggests that the empathy ability of people with visual disabilities may not contribute much to understanding the emotions of sighted people via vocal expressions. Future research will, thus, examine the hypothesis that people 'with' visual disabilities can better understand the emotional speech of their peers with visual disabilities, as compared to the emotional speech of people 'without' visual disabilities.

The findings of this study have the potential to enhance emotional empathy skills of people with visual disabilities by considering individual differences, which have understudied in prior research (Caron et al., 2023; Guarese et al., 2023a; Manitsa and Doikou, 2022; Milner, 2002; Parks and Kim, 2023). For example, Manitsa et al. (2022) reviewed 17 academic articles published between 1998 and 2018 that introduced a variety of social supports for students with visual disabilities. The supports were designed to promote empathetic behaviour, cooperation, and practical assistance. Although they found positive effects on social skills, they also found that many students with visual disabilities still suffered from a lack of properly designed training. Yildiz et al. (2013) examined the efficacy of an empathy training program in improving the interpersonal communication skills of children with visual disabilities (mean age = 13.5 years). The program instructed those with visual disabilities on how to improve empathic skills, understand that people may interpret events differently, and generate adequate emotional responses. They found no statistically significant differences between the experimental group and the control group. As their training program did not account for individual differences, the research findings of this study can contribute to customising the training program to better accommodate the diverse attributes of people with visual disabilities.

4.3 Limitations and future research

As individual differences were found to be associated with gender, health status, and age among participants with visual disabilities, we will include a group of sighted people who are matched to the socio-demographic backgrounds of participants with visual disabilities and examine the individual differences between the two groups in our future research. This study was conducted during the COVID-19 pandemic, such that participants in this study may have emotionally been affected by public health interventions such as social distancing. As the pandemic is declared over, we will conduct another round of research to investigate the emotion perception and empathy abilities of individuals with visual disabilities. This will allow us to compare the findings to those of the present study and explore the extent to which the pandemic affects human emotion perception and empathy abilities.

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