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Studying Interpreters’ Stress in Crisis Communication Evidence from Multimodal Technology of Eye-tracking, Heart Rate and Galvanic Skin Response

--Manuscript Draft--

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Abstract

This article references risk communication theory and cognitive load (CL) theory to analyse the stress experienced by interpreters involved in crisis communication within Covid-19 medical scenarios. It considers the nature of stress both from psychological (mental) and physiological perspectives, exploring the relationship between the level of CL, interpreters' stress, and the quality of interpreting in crisis communication. This research identifies the strategies used by interpreters when operating in pandemic working environments and compares their CL and physiological stress changes within and outside contexts of crisis communication. We hypothesize that interpreters experience greater psychological stress and an increased CL which adversely affect their interpreting in crises compared to normal routine situations. To test this hypothesis, an experiment combined eye-tracking with Heart Rate (HR) and Galvanic Skin Response (GSR) technology. 25 novice interpreters interpreted simulated medical scenarios between English and Chinese for a Covid-19 patient and a diabetes patient respectively. This is one of the first studies to apply the multimodal approach of eye-tracking, HR, and GSR technology to record the physiological stress and mental status of interpreters. We advocate more systematic interdisciplinary research concerning interpreters' stress in crisis communication, and we outline recommendations for future crisis interpreting training and for individual professionals involved in crisis management.

Keywords: medical interpreting, cognitive load, interpreters' stress, risk communication, eye-tracking, multimodal technology.

Studying Interpreters' Stress in Crisis Communication:

Evidence from Multimodal Technology of Eye-tracking, Heart Rate and Galvanic Skin Response

Introduction

A phenomenon labelled the 'psycho-affective turn' in Interpreting Studies has recently attracted considerable scholarly attention, focusing primarily on the factors of motivation, anxiety, and stress which can condition an interpreter's performance (Kurz, 2003; Seeber, 2011; Korpal, 2016; Walczyński, 2021). However, relatively few academic studies have investigated the nature of the interpreter's stress in situations of tension and crisis (Moser-Mercer, 2015; Daly and Chovaz, 2020; Federici and O'Brien, 2020). Interpreting, particularly medical interpreting, is a high-stress task, and the interpreter's linguistic and cognitive ability are very important during this work; however, the theoretical importance and practical consequences of stress-affective factors require a greater degree of academic consideration. The EU-funded research project led by Sharon O'Brien has been instrumental in raising awareness of evolving research into translation and training in crisis communication (Federici and O'Brien, 2020; Cadwell, 2019); but so far only limited experimental research has been conducted into the psychological and mental stress experienced by interpreters in crisis and hazard situations, and into the impact of these factors on their performance.

To bridge this gap, this study references risk communication (RC) theory (Ruhrmann and Guenther, 2017; Federici and O'Brien, 2020) and cognitive load (CL) theory (Gile, 1995/2009; Choi, Merrienboer and Paas, 2014) to identify and compare the stress and the emotional states experienced by interpreters in crisis communication both from mental and physiological perspectives. It focuses on the distinctive challenges posed by the Covid-19 pandemic, specifically the urgent needs of a Covid-19 patient, and also on the task of interpreting in more routine medical scenarios – in this case, involving a diabetes sufferer. Interpreting in hospital settings normally requires interpreters to interpret in both directions, conveying the comments of patients and doctors in turn. Interpreters often need to resolve problems of multilingual communication involving a considerable level of uncertainty among various stakeholders (e.g. doctors, patients, and those who accompany them);

communication is at the heart of risk mitigation, particularly in disaster scenarios and crisis responses (Federici, 2021). RC, especially during crisis and hazard situations, aims to enable informed participants to reduce potentially hazardous behaviour and levels of harm. The process is widely recognized as focusing on ‘two-way and multi-directional communications’ connected with any health hazard. These calamitous and sometimes tragic situations can influence the interpreters’ emotions and psychological stress levels, and subsequently affect their CL and the quality of their interpreting (Gamhewage, 2014).

We hypothesize that the stress – the reaction of the brain to a given stimulus or stressor, such as the threatening, arduous, or uncertain contexts experienced by interpreters in situations characterized by crisis communication – impacts considerably upon their CLs and on the quality of their interpreting. To test this hypothesis, an experiment was conducted by using multimodal technology that combines eye-tracking with heart rate (HR) and galvanic skin response (GSR) technology supported by the ErgoLAB multimedia platform developed by Kingfar[1]. This is one of the first studies to use a multimodal approach of eye-tracking, SR, and HR technology to record the physiological stress status of interpreters under live medical interpreting conditions (see The Study). The aims are trifold:

1) to explore the relationship between the level of CL, interpreters’ stress, and the quality of interpreting in crisis communication;

2) to compare interpreters’ CL and physiological stress changes within and outside contexts of crisis communication;

3) to identify the strategies used by interpreters when faced by the challenges of a pandemic working environment.

The article advocates more systematic interdisciplinary research into interpreters’ stress in crisis communication scenarios. To this end, its introduction is followed by the theoretical underpinnings of the study: RC theory is applied to interpreters’ CL and performance. We then introduce the central experiment of this study, outlining the main research hypotheses and three sub-hypotheses, the participants, the material designs, the multimodal equipment, the stimuli display, and the procedure for evaluating the interpreters’ performance. The data analysis and discussion sections consider the experiment results and test our hypotheses.

These sections identify and compare the psychological stress level of interpreters in crisis situations and in normal medical settings, evaluate the quality of their interpreting performance, and identify the interpreting strategies used. We conclude by proposing recommendations and suggesting approaches for future research.

RC in Translation and Interpreting Studies

RC, an interactive information exchange involving risks and hazards that normally combines cultural-sociological and theoretical approaches, was developed by psychologists and sociologists in the early 1980s (Ruhrmann and Guenther, 2017). Today, RC theory in relation to RC capacities is developed through preparedness, response, and recovery, and has become a recognized tool in risk reduction. In Translation and Interpreting Studies, O'Brien et al. in their EU-funded project, propose a '4Rs' RC strategy: reduction, readiness, response, and resilience in dealing with crisis situations (O'Brien and Federici, 2020), which reflects ISO 18841 (2018) interpreting service requirements and recommendations. In their recent studies, Federici and O'Brien (2020) suggest that there should be a focus on 'risk perception as a linguistic issue for which appropriate language and modes of communication ought to be used to pursue all the commitments to risk reduction' (p. 19). This is directly relevant to interpreters (and translators) who work in hospital settings, as translation and interpretation play a crucial role in ensuring appropriate RC to patients and other parties involved. Relatively few previous studies, such as Cooper and Tung, 1982; Moser-Mercer et al., 1998; Kurz, 2003, 2015; Korpal, 2016, 2017, have investigated the psychological stress status and emotions of interpreters themselves. These studies show that the emotional state and stress experienced by interpreters can influence their CL and performance (in terms of the quality of their interpreting), as well as their communication with patients and with all parties involved (Korpal, 2016; Weng et al., 2022). However, almost no experimental research has investigated whether interpreters experience a high level of psychological stress in crisis and hazard situations compared with normal hospital situations, or identified their interpreting RC strategies in such contexts. This is tested throughout our main hypothesis and sub-hypothesis 1.

The Psychological Stress of Interpreters, their CLs, and their Interpreting Performance

As mentioned above, the concept of psychological stress is a reaction of the brain to a given stimulus or stressor, such as sudden threatening, traumatic, and uncertain short-duration situations (e.g. disasters), which can cause both physiological and psychological reactions. Empirical studies indicate that working in stressful conditions affects the health of interpreters and influences their levels of psychological stress during simultaneous interpreting processes (Kurz, 2003; Seeber, 2011; Korpal, 2017), conference interpreting (Bontempo and Napier, 2011; Seeber and Arbona, 2020), and sign language interpreting (Daly and Chovaz, 2020). In hospital settings, interpreters are sometimes exposed to hazard situations involving another person's trauma; these cause excessive mental stress that may regularly affect the CLs of interpreters and their performance (McGee, et al., 2002). This is evidenced by the recent questionnaire research by Daly and Chovaz (2020) which shows that interpreters experience significant levels of traumatic psychological stress during the interpreting process, and suggests that some interpreters also suffer from post-traumatic stress due to a lack of mental health training to prepare them for assignments in crisis situations. They further argue that traumatic situations adversely affect interpreters' emotions; thus, they cause psychological stress to interpreters, and subsequently affect their CL and performance.

CL theory – a model of human information processing – is recognized as one of the most effective theoretical justifications of mental processing in interpreting and translation (Gile, 2009; Seeber, 2011; Chen, 2017; Shao and Chai, 2021). CL theory, particularly in manipulating stress for crisis management, outlines the multi-dimensional architecture of our functional working memory (Paas et al., 2010; Korpal, 2016, 2017). Information is composed of different elements that interact with each other: the greater the interaction between elements, the more the complexity of the CL increases. This is because our working memory supplies temporary storage and management of the information necessary for complex cognitive processes, and it has a limited capacity (Sweller et al., 1998; Andreea et al., 2010; Chen et al., 2016). Based on this, Gile's Tightrope Hypothesis postulates that our working memory has a limited size and interpreters 'tend to work close to the maximum cognitive effort' (Gile, 2021, p.139). In a crisis, particularly within the context of the Covid-19 pandemic situation, an interpreter's CL may increase due to a split focus whose 'demands exceed available capacity'

(Plevoets and Defrancq, 2018, p.2). Hence, if there is overload as a consequence of increasing an interpreter's psychological stress, it can compromise an interpreter's performance. If material is presented whose complexity is unable to be processed or recognized by a person's working memory, it will result in cognitive overload (Shreve and Angelone, 2010). This will be tested through our sub-hypothesis 2 and 3.

The Study

The advent of translation technologies has contributed significantly to the advancement of research into the process of interpreting, and its results are significant. So far, a wide range of technologies, such as eye-tracking (Su and Li, 2019), EEG (Electroencephalogram) (Weng et al., 2022), fMRI (Functional magnetic resonance imaging) (Hervais-Adelman et al., 2015), HR and GSR (Korpal and Jasielska, 2019), have been used in a variety of interpreting research focusing on interpreters' emotions (Korpal and Jasielska, 2019), stress (Bower, 2015; Korpal, 2017), and directionality of translation and interpreting (Chen, 2020). These studies have proved that the use of a combination of different data elicitation techniques is an effective way of capturing the process-product interface of interpreting and translation (Buchweitz and Alves, 2006). In this study, eye-tracking technology is combined with biosensor technology that simultaneously measures HR and skin conductance level. It is therefore possible to monitor whether there is a correlation between interpreters' psychological stress, crisis situations, and the quality of their interpreting performance. Eye-tracking was used to monitor interpreters' CL and psychological activities. Two objective physiological stress parameters – HR and skin conductance level – were simultaneously monitored during the interpreting process to determine whether crisis communication (with a Covid patient) and normal hospital communication (with a diabetes patient) differ in their physiological stress responses. As mentioned above, we hypothesize that the stress experienced by interpreters in crisis communication situations impacts considerably upon their CL and on the quality of their interpreting performance. To test this research hypothesis, we subdivided it into three sub-hypotheses:

H1: Interpreters experience a high level of psychological stress in crisis and hazard situations compared with normal hospital situations.

H2: Interpreters produce a higher level of CL and psychological stress in crisis situations than in normal hospital situations during the interpreting process.

H3: Interpreters have a better performance (in terms of the quality of their interpreting) in normal hospital situations than in crisis situations.

Participants

25 novice interpreters (13 females and 12 males, with an average age of 21) who are in their third year of study for joint honours degrees in Medical Science and English Language at Peking University (in the top 2 of China's university rankings) participated in the experiment. All participants are native Chinese speakers who have learned English for more than 10 years. These participants have had similar interpreting and translation training as part of their university courses, and they have a similarly high level of language proficiency both in English and Chinese as these are key components of their university study. The interpreters were asked to interpret two simulated medical scenarios in Chinese and English for a Covid patient and a diabetes patient.

Materials and Procedure

In this experiment, we designed two face-to-face medical interpreting tasks, recorded them, and made them available online. Each interpreting setting included a 2-minute virtual environment stimulus and a 3-minute interpreting activity. Virtual environments have proven to be effective in eliciting authentic mental and behavioural responses in psychological research (Gamberini, et al., 2015).

Interpreting task 1 was designed for medical interpreting in crisis situations. A 2-minute virtual reality background featuring ambulance sirens and news footage of the Covid-19 crisis and hospital deaths was used as a contextual stimulus. We focused the scenario on a British professor, John Smith, who works at Peking University and lives in Beijing, China. John is feeling unwell due to a fever and continuous dry cough, and has an existing medical condition: a liver problem. He calls 120 (the Chinese service for health emergencies) for help; Dr Minghua Liu receives the call. After receiving John's call, Dr Liu suggests an immediate online video meeting with John's private doctor, James Best, in Britain. Dr Liu thinks that John needs to go to hospital and calls an ambulance for him. John and his private doctor in Britain do not speak Chinese and Dr Liu does not speak English.

Interpreting task 2 is designed for medical interpreting in normal hospital situations. A 2-minute virtual reality background of images featuring the urban setting of Oxford, its university, and hospital was used for contextual preparation, creating a more neutral ambience. The scenario was as follows: A British professor, John Smith, works at Peking University and thus lives in Beijing. He has a medical condition: diabetes. He is running out of medicine that was prescribed by his British doctor, James Best. Due to his work, he is unable to travel back to the UK. He calls Dr Minghua Liu, who works at the University clinic, for help. After receiving John's call, Dr Liu advises John to arrange an online video appointment with his British doctor. John and his British doctor do not speak Chinese and Dr Liu does not speak English.

In addition to a 2-minute stimulus video for both activities, we also ensured that both activities were of a similar delivery rate and similar linguistic level (e.g. textual difficulty, lexical density, syntactic difficulties, and similar numbers of technical terms), proven variables affecting CL (Plevoets and Degrancq, 2018). Each dialogue consists of 556 words. The Word and Phrase Tool (Davies, 2020), based on the Corpus of Contemporary American English (COCA), was used to test the level of difficulties of the texts. As can be seen from Figure 1, both activities have around 79 percent of words that are in the frequency range of the top 1-500 most commonly used words, around 16 percent of the words are in the range of the 501st to 3000th most frequently used words, and only 5 percent of the texts' words are in the range of words beyond 3000th place in terms of frequency.

Figure 1 Profile of Texts

	Task 1 - Covid-19 Patient	Task 2 - Diabetes Patient
Number of Words	556	556
Frequency Range (1-500)	79.1%	78.9%
Frequency Range (501-3000)	15.9%	16.1%
Frequency Range (3000+)	5.0%	5.0%
Average Length of Sentences	8.54 words	8.55 words

Multimodal Equipment and Stimuli Display

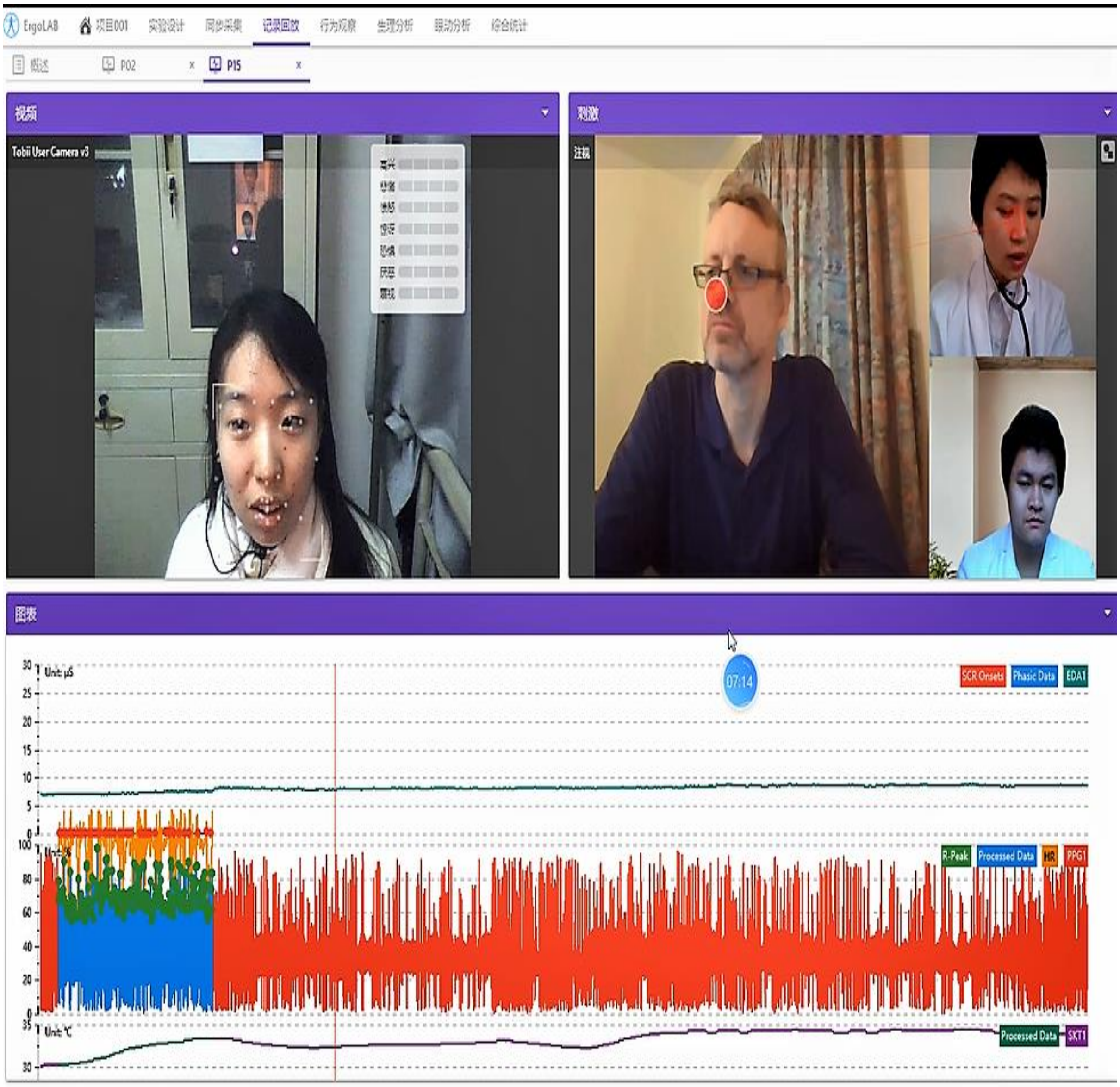
With the participants' consent, multimodal technology – eye-tracking, GSR, and HR – as a triangulation method was used in this study to overcome the weaknesses and intrinsic bias that can vitiate one specific form of technology and a single research methodology.

Tobii Pro X3-120 portal Eye Tracker with E-Prime extension, which features a large, high resolution (1920 x 1080 pixels), was used to observe the interpreters' behaviour and to record the real-time CL and psychological stress produced during the interpreting process, as it can measure fixation and gaze more accurately and precisely.

ErgoLab biosensor, a wearable physiological and psychological recording system that simultaneously collects HR and skin conductivity response amplitude, was used to measure the interpreters' psychological stress index and provide insight into issues that might not be detected without eye tracking. Two sensor electrodes were connected to the participants' fingertips to measure the stress-relaxation balance of the nerve system effectively.

The data was processed by the ErgoLAB platform, also known as the 'Person-Machine-Environment' Synchronisation Platform. Figure 2 shows screenshots of the experiment process and the process of this research. The multimodal technology allows us to record psychological stress during an interpreting situation requiring cognitive processing and responses from interpreters. We believe that this method can increase both the validity and the credibility of this experiment. RStudio (Version 1.3), a statistical computing and graphic programming language, is used for data analysis in this study.

Figure 2 The Experiment Process



Participant Performance Evaluation

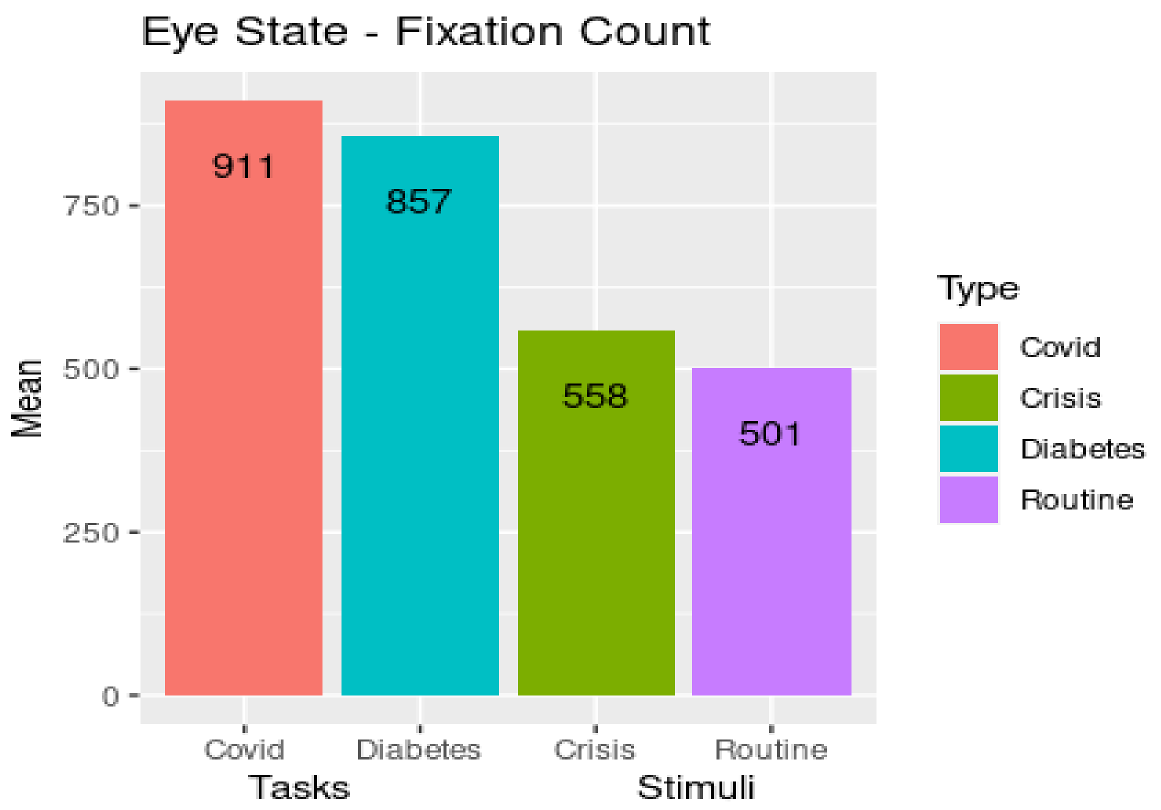
The participants' performance in terms of the quality of their interpreting was peer reviewed by three interpreting lecturers who used the University of Stirling's Community Interpreting exam marking criteria; these are in line with the National Occupational Standards in Interpreting [2]. The criteria are based on three evaluation matrixes: the participants' conveyance of linguistic meaning (accuracy of factual information, concepts, and completeness), delivery (flow, speed, volume, clarity, articulation, pronunciation), and professionalism (interpersonal management, eye contact instances, hesitation). The participants' self-evaluation was used as supplementary data in the discussion. The following section discusses the results and findings after testing our hypotheses.

Data Analysis and Findings

Interpreters' Psychological Stress and CLs in Crisis and Normal Situations

To test our first research hypothesis concerning whether interpreters experience a high level of psychological stress in crisis and hazard situations compared to normal situations, we selected fixation count (fixation duration, total fixation count, and numbers of saccade movements) elucidated from our eye-tracking data, because previous studies have proved that longer eye fixations reflect greater CLs and psychological stress (Seeber, 2011; Underwood and Jebbett, 2004). The eye state of fixation count can be seen in Figure 3. A fixation is when the eye is relatively still. An average of 558 instances and 501 instances of fixation count occurring during crisis stimuli and during normal, urban stimuli respectively were observed. 911 instances during the Covid patient interpreting process and 857 instances for the diabetes patient respectively, were observed. The eye state data indicates that the participants have higher numbers of fixation count within crisis stimuli and task performance compared to the normal stimuli and task performance. A high count may indicate a higher level of stress, whilst a low count may either indicate a low level of stress or being less attentive.

Figure 3 Eye state - fixation count



Our null hypothesis states that there is no difference between crisis situations and normal routine situations. To test our first sub-hypothesis, we conducted a paired t-test between the crisis and routine stimuli regarding total fixation duration count (TFC). The visual difference between stimulus and task can be seen in Figure 4. The crisis stimuli have on average 26.59 more TFC than the normal stimuli. Intuitively, this is logical as an individual would fixate less frequently with fewer things happening than with more things happening. A paired t-test generally tests the significance of a null hypothesis which means that the two test subjects are the same. Upon conducting a t-test, we obtained a p-value of 0.00004392 and a 95% confidence interval of 16.92492 and infinity. The mean of the differences is 26.5948 – see Figure 5. Therefore, we reject the null hypothesis at all significance levels. We also calculated numbers of fixation count and numbers of saccades, and the results yielded are similar to those of the TFC results, confirming that there is a difference between crisis situations and normal situations. We therefore conclude that interpreters in this study experience a higher level of psychological stress in crisis / hazard situations compared to normal situations.

Figure 4 Total Fixation Duration of Stimuli and Tasks

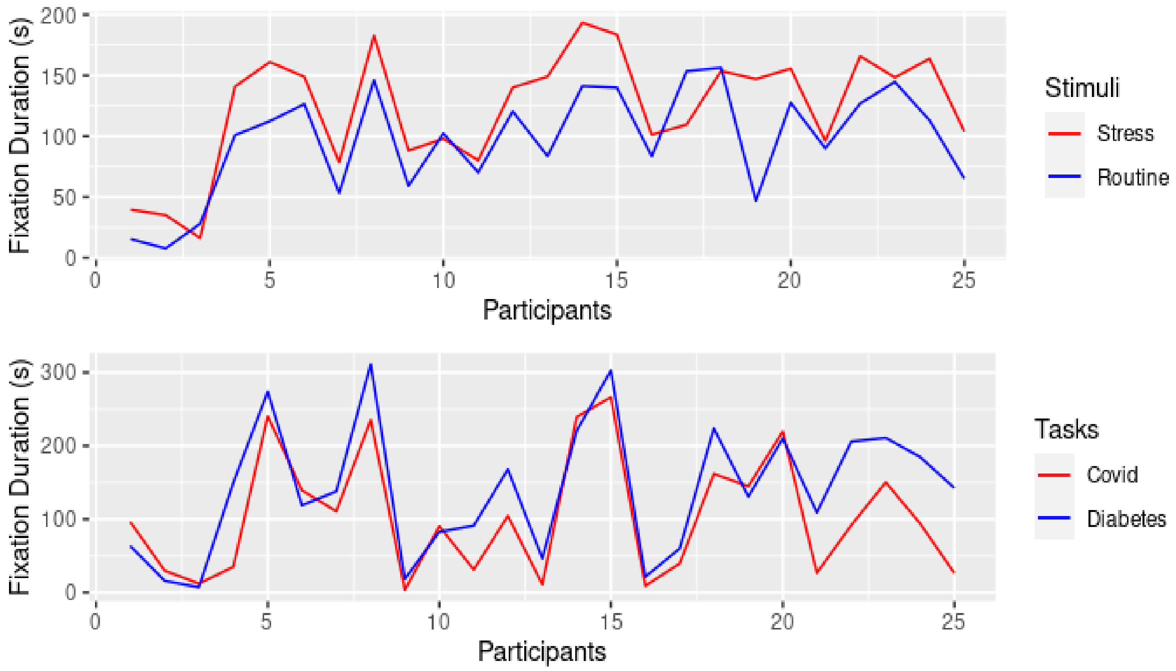


Figure 5 Statistics of the paired t-tests

	Matrix	t-value	df	95% Confidence Interval	Mean of the Differences	p-value
Stimuli: Crisis vs. Routine	Total Fixation Count	4.7054	24	$(16.92492, \infty)$	26.5948	0.00004392
	Number of Fixations	-3.205	24	$(-204.17929, -44.22071)$	-124.2	0.003794
Tasks: Covid vs. Diabetes	Total Fixation Count	-2.5392	24	$(-0.021753604, -0.002246396)$	-0.012	0.01801
	Mean Fixation Count	3.897	24	$(-\infty, -20.13328)$	-5.89	0.0003417
	Heart Rate Total Power	-2.2701	24	$(-18220478.4, -867039.1)$	-9543759	0.03246
	Level of Skin Temperature	-3.8644	24	$(-\infty, -0.5784431)$	-1.038	0.0003709

Interpreters' Psychological Stress and CL During the Interpreting Process

To test our second sub-hypothesis concerning whether the interpreters produced a higher level of psychological stress and CL during the process-product interface in crisis situations than in normal hospital situations, we measured both total fixation duration and mean fixation count and two other psychological stress indicators: skin response and HR. The results of total fixation duration between stress and routine stimuli, and Covid and diabetes tasks can be seen in Figure 4 above. A paired t-test for mean fixation count between Covid and diabetes patient interpreting obtains a p-value of 0.0003417 (smaller than 0.01) and records the mean of the differences to be -35.89 – see Figure 5. We can therefore reject the null hypothesis in favour of our research hypothesis that a true difference exists between the interpreters' psychological stress and CLs in the two interpreting activities.

HR has proven to be a common objective instrument for measuring psychological stress and cardiac state (Tiwari et al., 2021). HR variable, the fluctuation in beat-to-beat interval, represents the sympathetic level (stress) or the parasympathetic activation (non-stress) level. It also reflects the (im)balance between the sympathetic and parasympathetic systems (Korpal, 2016). HR power spectral tool analyses the beat-to-beat variations in the HR of the nerve system activity, including a measurement of the overall power variation of a continuous series of heartbeats into its frequency components: a low-frequency band (LF) at 0.04-0.15 Hz, which indicates a dominant sympathetic component, and a high-frequency band (HF) at 0.15-0.4 Hz for a dominant parasympathetic component. The results of the participants' heartbeat ratio of LF and HF between the Covid and diabetes tasks can be seen in Figure 6. For the Covid interpreting task, the average of LF is 0.044Hz and the average of HF is 0.153, and both LF and HF of the Covid interpreting task are higher than those for the diabetes task (LF 0.043Hz and HF 0.163Hz). The paired t-test of the power spectral results indicate t = -2.2701, p-value = 0.03246, smaller than 0.05, which shows that there is a true difference between interpreting activities in crisis situations and normal situations, and this result echoes the eye-tracking data above.

Figure 6 Heartbeat Ratio of LF and HF

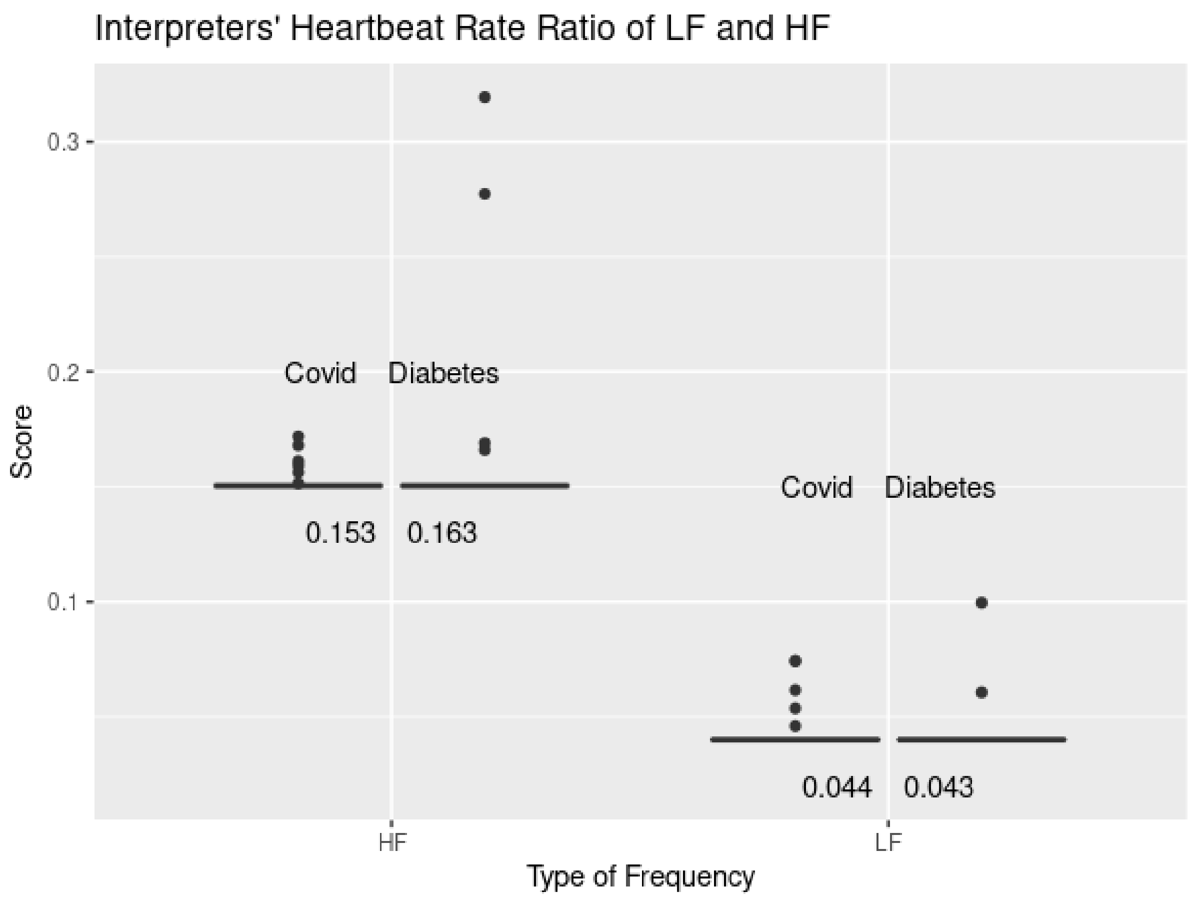
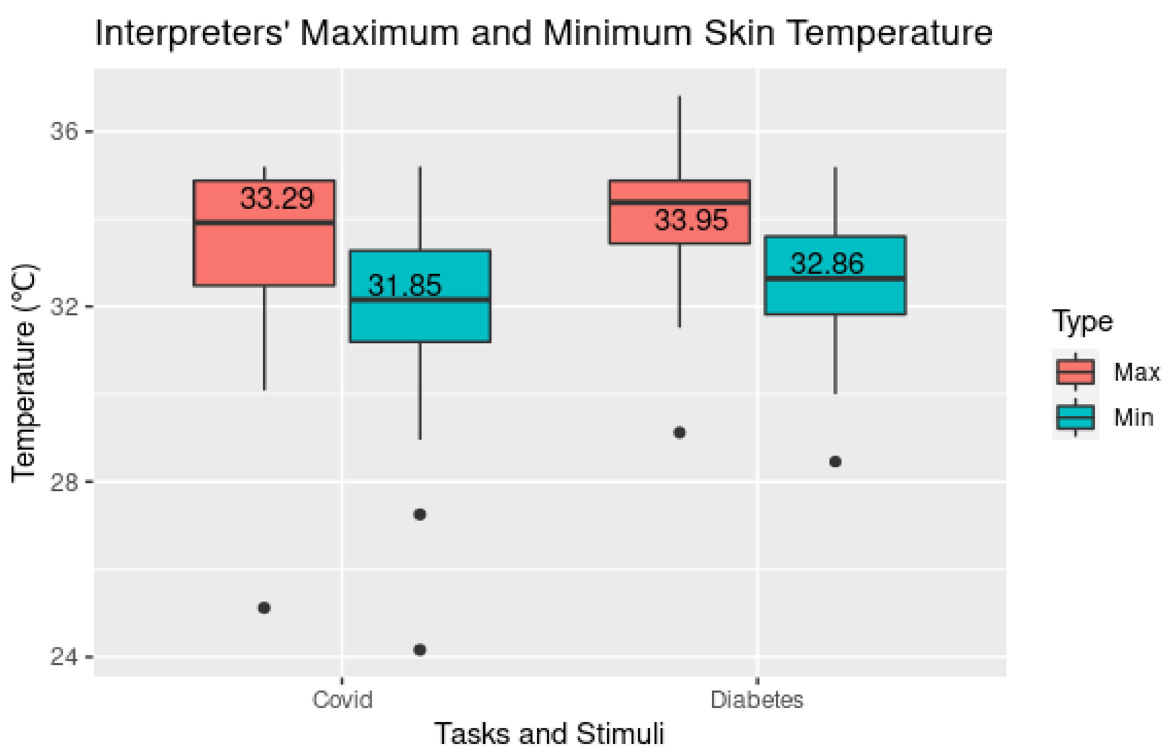


Figure 7 Interpreters' Max and Min Skin Temperature

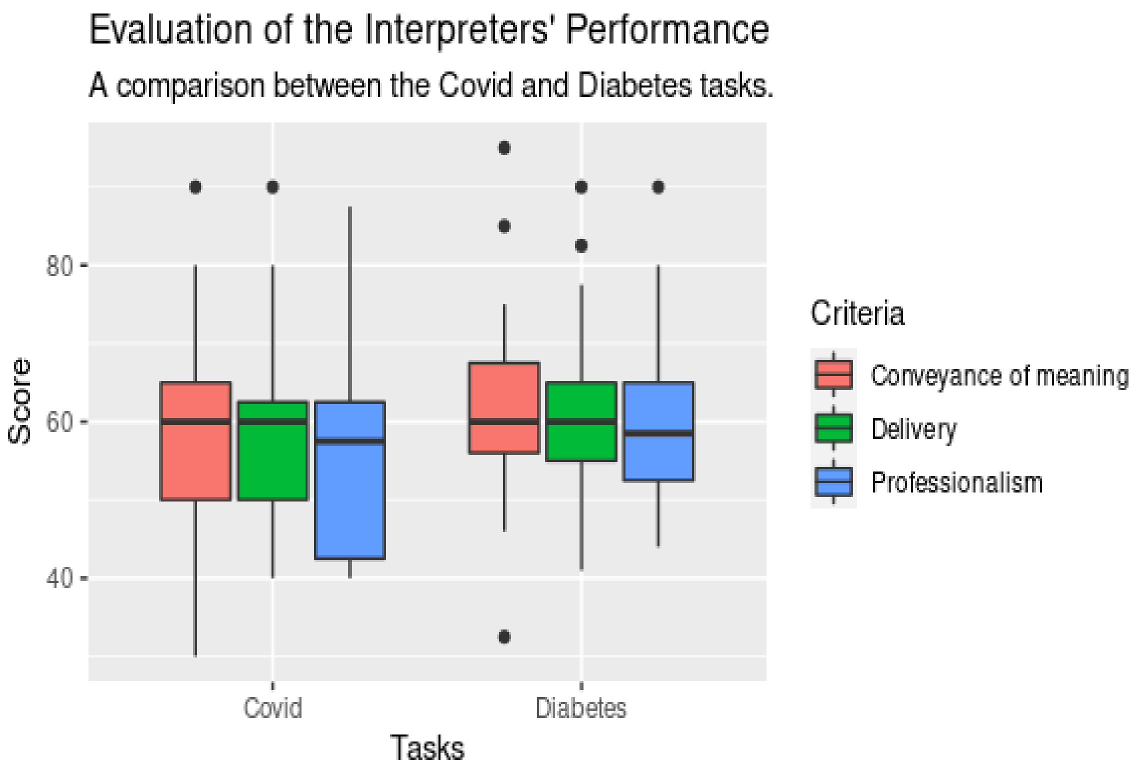


Skin conductance level, a type of electrodermal reactivity also known as galvanic skin response, has been used as an additional indicator. Empirical research shows that a combination method with HR can measure the physiological parameters of interpreters' emotion and stress (Kurz, 2003). The change in skin conductivity and skin temperature indicate an indirect measure of the interpreters' activity in their sympathetic and parasympathetic nervous system. Previous psychological research shows that changes in skin temperature and skin electricity level indicate the intensity of the stress and emotion levels (Herborn, et al., 2015). We have compared the skin temperature of interpreters during the Covid and diabetes tasks. According to Herborn et al. (2015), skin temperature reveals the intensity of acute stress; skin temperature temporarily drops under acute stress. The difference between the two activities is shown in Figure 7. Both the maximum and minimum mean skin temperature during the Covid interpreting (max 33.29 ℃ and min 31.85℃, with an average of 32.73) are lower than those recorded during the diabetes interpreting process (max 33.95 and min 32.86, an average of 33.46). The p-value of this paired t-test is = 0.0003709, which is less than 0.01. We therefore reject the null hypothesis in favour of the alternative hypothesis that there are true differences in skin temperatures. To conclude, all three different measurements show significant differences between crisis and routine interpreting tasks, and indicate that the interpreters experienced a higher level of psychological stress in traumatic crisis situations.

Interpreters' Performance in Crisis and Normal Situations

As outlined above, the interpreters' performance was peer evaluated by three professionals based on 1) conveyance of meaning 2) delivery and 3) professionalism. The results can be seen in Figure 8. The average grades for the three marking criteria were 59, 59 and 57.44 respectively for the Covid patient interpreting; whilst for the diabetes patient interpreting, the average grades were 62.16, 61.18 and 60.32. Figure 8 also shows that most participants achieved between 52 and 62 in conveying the accuracy of meaning for the Covid patient and between 60 and 72 for the diabetes patient, although the data also show the individual differences in terms of performance. Overall, the interpreters in this study performed better in a more normal working environment compared to working in crisis and hazard situations. To further test our third sub-hypothesis concerning whether the interpreters performed better in terms of interpreting quality in normal hospital situations than in crisis situations, we found that the difference between the total mean of crisis performance and normal performance is significantly different. This is evidenced by p-value = 0.0000002839, strongly contradicting the null hypothesis that the two means are the same. That is, the Covid performance is on average -5.24 lower than the diabetes performance, as shown in Figure 5 above. We found that there is a significant difference in terms of the interpreters' performance in crisis settings as opposed to routine settings.

Figure 8 Evaluation of the Interpreters' Performance



Discussion

Interpreters' Challenges and RC Strategies in Crisis and Routine Situations

The above statistical tests indicate that the interpreters in this study showed significant levels of psychological stress and higher levels of CL in crisis situations compared to routine situations. The experiment also shows that crisis situations negatively affect their performance, as the results indicate that the interpreters performed significantly better when interpreting routine situations rather than crisis situations. Effective interpreting in hospital settings requires interpreters to find corresponding linguistic terminologies and meanings between languages, and also to manage their own physiological and psychological state appropriately during patient encounters. We have identified many ongoing challenges during the interpreting process.

Federici (2020, p.14) argues that during crisis communication, translators are actors who put 'their knowledge, experience and expertise at the service of society as a whole' to mediate human conflicts or disasters derived from natural hazards. Active RC requires us first to recognize the nature of risk and crisis situations and then try to find ways to minimize risk. The interpreters' self-evaluation data revealed that some interpreters were highly motivated to help the patient and indicated their efforts to manage the crisis themselves: 'I was really concerned about the patient's health condition' and 'I wanted to help the patient as much as I could'; thus, 'I tried to control my own emotion' and 'I took several deep breaths' when the tasks started. Most interpreters revealed their difficulties in concentrating during crisis RC situations: 'my brain was totally blank'; 'I forgot what the patient said'; 'I was still very stressed and upset'. This evidence reflects the findings of Rosiers et al. (2016) that both individual difference and different cognitive appraisals of a given event contribute to the interpreters' psychological stress. This is particularly relevant at the beginning of the tasks, as many participants acknowledged that they were still affected after watching the crisis stimuli, felt that they could still 'hear' the siren echoing in the room, and could still 'see' seriously ill, hospitalized people. In their self-reflections, a couple of participants admitted that they forgot elements of the patient and doctors' conversation. The study of the experiment data and of the participants' self-evaluation shows that all the participants experienced a certain level of psychological stress in crisis situations but it also reveals individual differences in RC strategies both in crisis and routine situations. This is also evidenced by the first fixation metrics which show the time that passed before the interpreters looked at the patient and the doctors. To be more precise, it shows how long it takes for each interpreter to start interpreting. As can be seen in Figure 9, in crisis situations it takes about an average of 134 microseconds longer for the participants to concentrate on the areas of interest: it takes an average of 500µs of first gaze duration for the Covid task and 366µs for the diabetes task. All 25 participants recorded a longer first fixation in the Covid interpreting task than for the diabetes task, only one interpreter recorded the same length. The self-evaluation data also indicates the interpreters' own management competence in handling crisis situations by keeping their own mental stress in check and decreasing any negative emotions. The benefit of this is providing a reliable conveyance of linguistic meaning to patients in crisis situations and normal routine situations, compared with other interpreters who need more time to recover and concentrate on their interpreting. According to Gile (2009), the process of interpreting is characterized by four components: audition and analysis, memory, production, and coordination. In our study, we have identified two additional components: efforts towards managing risk and efforts towards communicating in crisis interpreting. In the study, we found that the interpreters' risk management effort included the identification and evaluation of risk and of personal response to hazardous situations. Their efforts to communicate in a crisis centred on minimizing any traumatic impact and maximizing communicational interaction with the patients by working through the '4R' stages: reduction, readiness, response, and resilience.

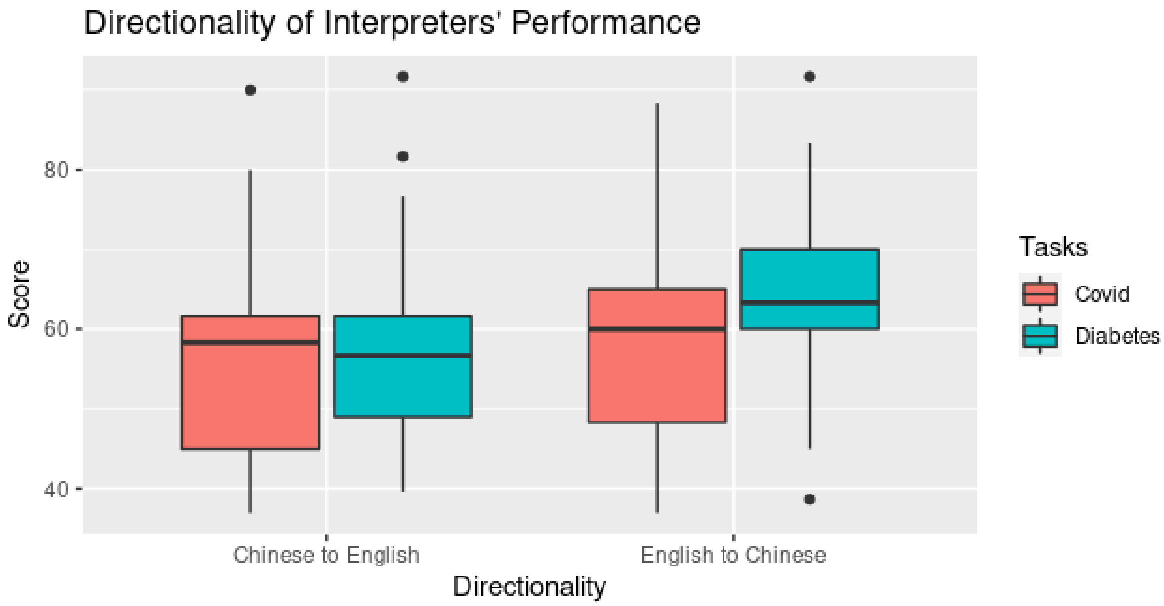
Figure 9 The Covid and Diabetes Interpreting Tasks: the Timing of the Participants' First Gaze

Directionality and Performance

In terms of performance, the participants were significantly better when interpreting for the diabetes patient compared to the Covid patient. The interpreters conveyed the meaning of the utterances relatively more accurately in the routine interpreting scenario. Many participants admitted their difficulties in finding appropriate medical terms and in using correct grammar and sentence order in both directions. 'I spent lots of time thinking how to translate specific words'; 'I found it difficult to form correct sentences in such a short time' as 'I was too stressed' and 'I was distracted'. Another participant observation was: 'I felt guilty for not being able to calm down swiftly to help the patient'. Several participants in this study also admitted that their performance was unsatisfactory in terms of conveying linguistic meanings, in terms of their delivery, and in making eye contact with the patient and doctors in the Covid scenario. They felt they made more errors due to being overstressed; they found it hard to concentrate in crisis situations.

As regards the quality of performance of translation directionality, the results show that the mean marks for the crisis interpreting and routine interpreting scenarios from English into Chinese are 59.70 and 64.02 respectively, while from Chinese into English the marks were 57.20 and 58.41 respectively (Figure 10). The results indicate that directionality also influenced the interpreters' performance; there was a significantly different quality of performance between the Covid and diabetes scenarios when interpreting from English into Chinese. However, there was no significant difference between the two tasks from Chinese into English. In evaluating the accuracy of their linguistic performance, we found that the linguistic accuracy of crisis interpreting for the Covid patient ranged from 31 to 90. The lowest marks seemed to reflect the interpreters' psychological stress level both according to the eye-tracking data and the interpreters' own reflections. This again indicates that interpreting in crisis settings involves the two additional forms of cognitive effort mentioned above, namely, risk management and communication strategies in a crisis. These identified differences in psychological stress in crisis scenarios and routine situations could form the basis for targeted stress and risk management training. These results reflect the research findings of Wang (2017) and Chen (2020), namely that in the language pair of Chinese and English, translation directionality can significantly affect the relationship between processing types, text types, and the distribution pattern of the participants' attention.

Figure 10 Directionality of Interpreters' Performance



Correlation Between Crisis, Psychological Stress, CL, and Performance

We used a Pearson correlation coefficient to estimate the relationship between the interpreters' performance (the outcome variable), and psychological stress in crisis and routine situations, respectively. A correlation coefficient value typically less than 0.5 and greater than -0.5 shows no correlation. As shown in Figure 11, the result indicates a coefficient value of 0.000682, which suggests that the positive correlation between psychological stress and performance in crisis situations is significant. However, the result between the routine interpreting performance and psychological stress is -0.133; this indicates a weak correlation between psychological stress and performance in routine situations.

Mertens-Hoffmann (2001) and Kurz (2003) studied the interpreter's workload according to four factors: psychological, physiological, physical, and performance factors. Their studies indicate that the correlation between measures of stress and performance is weak for highly trained interpreting professionals; however, our study suggests that the association between stress and performance is also weak for novice interpreters in routine situations. We also conducted a multilinear regression test to test the links between crisis/normality, psychological stress, CL, and performance. We found that performance is not directly correlated with any of the measured variables, eye fixation, frequency of HR, and skin temperature. For the routine interpreting scenario, we found no association between the interpreters' performance and psychological stress. This shows that there may be other factors, not taken into account during the experiment, which influenced the performance. For example, the interpreters' exact English language proficiency may be relevant, because we did not examine whether linguistic factors impacted their performance. In addition, the Covid interpreting experiment was conducted first, and then the diabetes experiment after a 30-minute break. This might have influenced the increase in performance, as students were perhaps more familiar with the experiment format.

Figure 11 Correlations of Interpreters' Psychological Stress and Interpreters' Performance in Crisis and Routine Situations

Correlations of Interpreters' Stress and Performance in a Crisis Situation			
Factors		Psychological Stress in Crisis Situations	Crisis (Covid) Interpreting Performance
Psychological Stress in Crisis Situations	Pearson Correlation Sig. (2-Tailed) Number of Participants	1 25	0.000682 < 0.001 25
Crisis (Covid) Interpreting Performance	Pearson Correlation Sig. (2-Tailed) Number of Participants	0.000682 < 0.001 25	1 25
Correlations of Interpreters' Stress and Performance in a Routine Situation			
Factors		Psychological Stress in Routine Situations	Routine (Diabetes) Interpreting Performance
Psychological Stress in Routine Situations	Pearson Correlation Sig. (2-Tailed) Number of Participants	1 25	−0.133 0.0526 25
Routine (Diabetes) Interpreting Performance	Pearson Correlation Sig. (2-Tailed) Number of Participants	−0.133 0.0526 25	1 25

Recommendations and Conclusion

The results of this experiment enable us to identify and compare possible areas in which it would be advisable to launch more comprehensive research into the psychological stress experienced by interpreters and its subsequent impact on their performance in crisis scenarios and routine situations. Based on the results of this study, we recommend three areas for future research as follows.

Recommendation 1: systematic interdisciplinary research into an interpreter's stress and emotional state in crisis communication.

So far, much experimental research has been carried out into the particularities of interpreting in cognitive and psychological terms (Walczyński, 2016, 2019), but there is a more pressing need for research projects focusing on the specific areas of risk and crisis interpreting (and translation), including the interpreters' emotional state, the psychological and physiological stress that they experience, and their well-being. The focus of this present study is to identify and compare interpreters' physiological stress in crisis scenarios and routine medical settings, so we only considered data that recorded interpreters' stress, CL, and performance. However, the scope of this project could be broadened to include more aspects of interdisciplinary research relevant to the stress and emotional state of interpreters by incorporating research from neuroscience, cognitive psychology, sociology, translation, and linguistics. This study was restricted to novice interpreters; it would therefore be useful to compare and analyse the different factors that influence the performances of novice interpreters and professional interpreters in crisis situations. In addition to language pairs, translation directionality also affects the CL of an interpreter (Su and Li, 2019); therefore, it would be valuable to compare interpreting strategies and challenges in both directions. Another logical research progression would be a controlled experiment to compare the performance of interpreters in terms of their cognitive effort to overcome linguistic difficulties, and their gaze patterns, before and after crisis interpreting training. This would shed light on the aspects of crisis interpreting training that are most useful to novice and professional interpreters.

Recommendation 2: Experimental research on crisis interpreting by using multimodal technology

Regarding the applicability of different CL, psychological stress, and mental state assessment technologies, this study has proven that a multimodal technological approach that combines eye-tracking, HR, and GSR is an effective way to make a live, simultaneous record of an interpreter's process-product. We have found that there is a positive association between crisis and psychological stress, CL, and performance levels; however, we tested a relatively small number of novice interpreters and the experiment itself is a simulation in this study. It is suggested that a further study with trained and experienced crisis interpreters and/or with real live interpreting situations focusing specifically on interpreters' psychological stress in terms of directionality, and on interpreters' emotional intelligence in RC, is conducted as the second phase of this process-product research. Further research by using multimodal technology such as EEG, fMRI, and face recognition can identify an interpreter's emotional state and brain dynamics more clearly.

Recommendation 3: Targeted research related to crisis interpreting training

In this study, we have identified two additional types of mental effort used during crisis interpreting, focusing on risk management and communication during medical interpreting. Daly and Chovaz (2020) report that interpreters 'lack adequate supports and/or specialised training to manage the potential negative emotion' associated with working in crisis scenarios (p. 353). It is necessary, in the context of global pandemics and other increasingly frequent crises, that courses focusing more specifically on crisis interpreting are organized by universities or by other professional bodies to help interpreters manage their psychological stress and emotional state, and thus improve their general psychological and physical well-being. The interpreters dealing with the simulated crisis situations in this study showed evidence of increased psychological stress and CL which affected their performance. These empirical results reiterate the calls by Federici and O'Brien (2020) for specific translation and interpreting training and collaborative research for translators and interpreters in crisis contexts; interpreters will consequently be better prepared and will benefit from more effective RC skills. We therefore recommend training for translators and interpreters at the more context-specific level of crisis communication, including role-playing, simulation of crisis scenarios, and the diffusion of instruments and strategies for RC. This will equip novice interpreters, in particular, with effective crisis communication skills to enable competing narratives to emerge from traumatic situations. Interpreters should receive similar training to hospital staff as regards preventive risk management measures, and this should be embedded within targeted interpreting training. We would reiterate the proposal by Alexander and Pescaroli (2019) that more targeted training, focusing on crisis communication strategies and behaviour schema, could help interpreters to control their psychological stress and to react more calmly in real-life emergency situations.

To conclude, this study has provided scientific evidence from processes of eye-tracking, HR, and GSR that interpreters in medical crisis situations experience increased psychological stress and a greater CL. These impact more negatively on their performance than in normal situations. We have also identified a range of different RC strategies. In addition, all the interpreters in this study channelled two additional forms of cognitive effort focusing on risk management and communication during the medical interpreting process. We therefore recommend a future training focus that targets the development of risk management and communication strategies in traumatic situations, an approach that should focus on reduction, readiness, response, and resilience during the interpreting process.

Acknowledgement

We thank Kingfar Research Support Program for its technical support. Our gratitude also goes to all volunteers who participated in this research and those who initially engaged in the abstract discussion. We wish to thank Qi Li, William Hope, and Qiucen Chen for helping to collect the data.

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[1] http://kingfar.net/

[2] National-Occupational-Standards-Interpreting-CILT-2006.pdf (dpsionline.co.uk)

Review Response

Dear,

Many thanks for your email and granting us a short extension to submit our revised article. I am extremely grateful to you for including my research article in your edited special issue 'Translating hazard.'

I would like to express our greatest thanks to the reviewers for their very helpful feedback and comments. Please see below our response to reviewers' feedback and comments.

Comment 1: Literature: The selected literature is relevant, but the authors could refer to some more central sources; sometimes rather specific statements/claims are not supported by sources (see detailed comments in attached PDF); some of the references do not seem fully adequate for the ideas/content they refer to (e.g. see comment on Blumenthal; or Gile 2005; for details see attached file).

- Thanks for the helpful comments. This has been revised fully – please see attached revised article.

Comment 2: Method/Data: The method chosen (multimodal approach, combining different technologies) is adequate in relation to the topic and research questions. Some of the conclusions (e.g. the part on "strategies" or "support systems", see attached file) cannot be fully supported by the data (or are not sufficiently explained) - maybe give these parts more thought?

- Thanks for your comments. I have revised some wording in this part. Please see Pages 14, 18.

Comment 3: Theoretical background: It would be desirable to more clearly state the theoretical base, e.g which Cognitive Load Theory; Risk Communication Theory - by whom? For details s. attached file.

- Thanks for your comments. This has been revised accordingly, please see Pages 4-5.

Comment 4: Discussion, analysis and results: The discussion of the results of the article are of quality and provide incentive for follow-up studies, except for the section on the "strategies" (see above), which could be improved.

- Thanks for your comments. This has been revised, please see Pages 23-24.

Comment 5: Coherence and readability: The article is sufficiently coherent and well readable; it might benefit from more thorough copyediting (consistence in spelling, consistent use of abbreviations, spelling of author names).

- The article has been proofread by a British university lecturer.

Comment 6: I find your study interesting, and on surface level it seems to be carried out well. However, your report lacks too much information, and I don't see how risk communication is a valid theoretical framework. I give more comments below, and a lot of more detailed comments in the text (using comments function in adobe, if you cannot read it please let the editor know).

- Thanks for your comments. I have improved this. Please see attached revised article.

Comment 7: As a general comment, the reader has the author does not support their argument with enough background literature, and also seems to define risk communication differently than the literature. The research study is original and novel, and can contribute to the field, but it is currently immature.

- Thanks for your comments here. I have added more literature to support my arguments.

Comment 8: The contribution has a potential to contribute to increased understanding of cognitive load in medical interpreting, but as said above I find it immature. As far as I can understand the manuscript is original, the overall study design and approach seems appropriate, but information is lacking on participant and research design.

- Thanks, please see my revised submission.

Comment 9: the manuscript needs language revision, the language is mostly correct, but some formulations are so awkward that they are difficult to understand.

- Thanks for the comments. One of our co-authors is a native English academic. To address this issue, we also asked one of my colleagues at the university to proofread the article.

Comment 10: The introduction and background need to be more worked through. The author fails to convince me how risk communication is a viable theoretical framework in this research. Also, sometimes I don't understand whether the author cites other works, or make proper claims. This may perhaps be solved in language revision.

- Thanks, I have engaged with more literature.

Comment 11: The methods section lacks a lot of information on the study design and methods. It is sometimes difficult to understand data collection and therefore also to interpret the results. The study would not be replicable in this shape.

- Thanks for your comments. We have added a couple of sentences. It is difficult choice for us as the article can include 7000 words only.

Comment 12: Also, the author mentions consent, but does not discuss it at all in detail, as this is work with students as participants, it merits more detail and reflection.

- Thanks. We attached the ethical approval form for reference.

Comment 13: The actual results are not put to question in this review, although my statistical knowledge is too limited to actually review the statistics. Having said that, I find that the statistics is presented in a way that makes me doubt the authors statistical skills as well. There are also a few occasions where I really have a hard time to see that the raw data really supports the statistical results reported. Some of this may be due to language revision, but I would encourage a review of the stats.

- We have asked one of our co-authors, who is a statistician, to use R and LaTeX to replace all the figures to make it more consistent and coherent.
- We have also revised the wordings of the statistics.

Comment 14: The results match the method as far as I can tell, but as said above, the description of methods must be clarified. Furthermore, the author mixes the results with the conclusion, and at some occasions conclusions (very far reaching) are given in the results section.

- Thanks for your comments. Please see above.

Comment 15: As I find the theoretical framework of risk communication ill matching to the study, the authors fail to convince me in their conclusions. Furthermore, the authors draw very far-reaching conclusions from their findings. Having said that the study in itself seems well conducted, but the authors give too little information about the design.

- Thanks very much for the comments. Please see above and the revised article.

Comment 16: The tables and figures are very basic in their presentation, they seem to be pasted directly from a statistical software. I would also encourage the authors to split some of the figures e.g. figure 4 as reference to the figures are difficult in the running text.

- All tables and figures have been replaced.

Comment 17: The author gives necessary references, but seems to stick to the bare minimum, the paper would gain from having more references, and also be careful about how you refer to the work. I don't think Gile ever used "audacity" about his effort models.

- Thanks. This has been revised accordingly.

Comment 18: In-texts comments

- Many thanks for the reviewers' detailed comments and feedback. We have addressed all comments and feedback accordingly.

Thanks again for your comments and feedback.
Best wishes,

Studying Interpreters' Stress in Crisis Communication: Evidence from Multimodal Technology of Eye-tracking, Heart Rate and Galvanic Skin Response

Introduction

A phenomenon labelled the 'psycho-affective turn' in Interpreting Studies has recently attracted considerable scholarly attention, focusing primarily on the factors of motivation, anxiety, and stress which can condition an interpreter's performance (Kurz, 2003; Seeber, 2011; Korpal, 2016; Walczyński, 2021). However, relatively few academic studies have investigated the nature of the interpreter's stress in situations of tension and crisis (Moser-Mercer, 2015; Daly and Chovaz, 2020; Federici and O'Brien, 2020). Interpreting, particularly medical interpreting, is a high-stress task, and the interpreter's linguistic and cognitive ability are very important during this work; however, the theoretical importance and practical consequences of stress-affective factors require a greater degree of academic consideration. The EU-funded research project led by Sharon O'Brien has been instrumental in raising awareness of evolving research into translation and training in crisis communication (Federici and O'Brien, 2020; Cadwell, 2019); but so far only limited experimental research has been conducted into the psychological and mental stress experienced by interpreters in crisis and hazard situations, and into the impact of these factors on their performance.

To bridge this gap, this study references risk communication (RC) theory (Ruhrmann and Guenther, 2017; Federici and O'Brien, 2020) and cognitive load (CL) theory (Gile, 1995/2009; Choi, Merrienboer and Paas, 2014) to identify and compare the stress and the emotional states experienced by interpreters in crisis communication both from mental and physiological perspectives. It focuses on the distinctive challenges posed by the Covid-19 pandemic, specifically the urgent needs of a Covid-19 patient, and also on the task of interpreting in more routine medical scenarios – in this case, involving a diabetes sufferer. Interpreting in hospital settings normally requires interpreters to interpret in both directions, conveying the comments of patients and doctors in turn. Interpreters often need to resolve problems of multilingual communication involving a considerable level of uncertainty among various stakeholders (e.g. doctors, patients, and those who accompany them);

communication is at the heart of risk mitigation, particularly in disaster scenarios and crisis responses (Federici, 2021). RC, especially during crisis and hazard situations, aims to enable informed participants to reduce potentially hazardous behaviour and levels of harm. The process is widely recognized as focusing on 'two-way and multi-directional communications' connected with any health hazard. These calamitous and sometimes tragic situations can influence the interpreters' emotions and psychological stress levels, and subsequently affect their CL and the quality of their interpreting (Gamhewage, 2014).

We hypothesize that the stress – the reaction of the brain to a given stimulus or stressor, such as the threatening, arduous, or uncertain contexts experienced by interpreters in situations characterized by crisis communication – impacts considerably upon their CLs and on the quality of their interpreting. To test this hypothesis, an experiment was conducted by using multimodal technology that combines eye-tracking with heart rate (HR) and galvanic skin response (GSR) technology supported by the ErgoLAB multimedia platform developed by Kingfar[1]. This is one of the first studies to use a multimodal approach of eye-tracking, SR, and HR technology to record the physiological stress status of interpreters under live medical interpreting conditions (see The Study). The aims are trifold:

1) to explore the relationship between the level of CL, interpreters' stress, and the quality of interpreting in crisis communication;

2) to compare interpreters' CL and physiological stress changes within and outside contexts of crisis communication;

3) to identify the strategies used by interpreters when faced by the challenges of a pandemic working environment.

The article advocates more systematic interdisciplinary research into interpreters' stress in crisis communication scenarios. To this end, its introduction is followed by the theoretical underpinnings of the study: RC theory is applied to interpreters' CL and performance. We then introduce the central experiment of this study, outlining the main research hypotheses and three sub-hypotheses, the participants, the material designs, the multimodal equipment, the stimuli display, and the procedure for evaluating the interpreters' performance. The data analysis and discussion sections consider the experiment results and test our hypotheses.

These sections identify and compare the psychological stress level of interpreters in crisis situations and in normal medical settings, evaluate the quality of their interpreting performance, and identify the interpreting strategies used. We conclude by proposing recommendations and suggesting approaches for future research.

RC in Translation and Interpreting Studies

RC, an interactive information exchange involving risks and hazards that normally combines cultural-sociological and theoretical approaches, was developed by psychologists and sociologists in the early 1980s (Ruhrmann and Guenther, 2017). Today, RC theory in relation to RC capacities is developed through preparedness, response, and recovery, and has become a recognized tool in risk reduction. In Translation and Interpreting Studies, O'Brien et al. in their EU-funded project, propose a '4Rs' RC strategy: reduction, readiness, response, and resilience in dealing with crisis situations (O'Brien and Federici, 2020), which reflects ISO 18841 (2018) interpreting service requirements and recommendations. In their recent studies, Federici and O'Brien (2020) suggest that there should be a focus on 'risk perception as a linguistic issue for which appropriate language and modes of communication ought to be used to pursue all the commitments to risk reduction' (p. 19). This is directly relevant to interpreters (and translators) who work in hospital settings, as translation and interpretation play a crucial role in ensuring appropriate RC to patients and other parties involved. Relatively few previous studies, such as Cooper and Tung, 1982; Moser-Mercer et al., 1998; Kurz, 2003, 2015; Korpal, 2016, 2017, have investigated the psychological stress status and emotions of interpreters themselves. These studies show that the emotional state and stress experienced by interpreters can influence their CL and performance (in terms of the quality of their interpreting), as well as their communication with patients and with all parties involved (Korpal, 2016; Weng et al., 2022). However, almost no experimental research has investigated whether interpreters experience a high level of psychological stress in crisis and hazard situations compared with normal hospital situations, or identified their interpreting RC strategies in such contexts. This is tested throughout our main hypothesis and sub-hypothesis 1.

The Psychological Stress of Interpreters, their CLs, and their Interpreting Performance

As mentioned above, the concept of psychological stress is a reaction of the brain to a given stimulus or stressor, such as sudden threatening, traumatic, and uncertain short-duration situations (e.g. disasters), which can cause both physiological and psychological reactions. Empirical studies indicate that working in stressful conditions affects the health of interpreters and influences their levels of psychological stress during simultaneous interpreting processes (Kurz, 2003; Seeber, 2011; Korpal, 2017), conference interpreting (Bontempo and Napier, 2011; Seeber and Arbona, 2020), and sign language interpreting (Daly and Chovaz, 2020). In hospital settings, interpreters are sometimes exposed to hazard situations involving another person's trauma; these cause excessive mental stress that may regularly affect the CLs of interpreters and their performance (McGee, et al., 2002). This is evidenced by the recent questionnaire research by Daly and Chovaz (2020) which shows that interpreters experience significant levels of traumatic psychological stress during the interpreting process, and suggests that some interpreters also suffer from post-traumatic stress due to a lack of mental health training to prepare them for assignments in crisis situations. They further argue that traumatic situations adversely affect interpreters' emotions; thus, they cause psychological stress to interpreters, and subsequently affect their CL and performance.

CL theory – a model of human information processing – is recognized as one of the most effective theoretical justifications of mental processing in interpreting and translation (Gile, 2009; Seeber, 2011; Chen, 2017; Shao and Chai, 2021). CL theory, particularly in manipulating stress for crisis management, outlines the multi-dimensional architecture of our functional working memory (Paas et al., 2010; Korpal, 2016, 2017). Information is composed of different elements that interact with each other: the greater the interaction between elements, the more the complexity of the CL increases. This is because our working memory supplies temporary storage and management of the information necessary for complex cognitive processes, and it has a limited capacity (Sweller et al., 1998; Andreea et al., 2010; Chen et al., 2016). Based on this, Gile's Tightrope Hypothesis postulates that our working memory has a limited size and interpreters 'tend to work close to the maximum cognitive effort' (Gile, 2021, p.139). In a crisis, particularly within the context of the Covid-19 pandemic situation, an interpreter's CL may increase due to a split focus whose 'demands exceed available capacity'

(Plevoets and Defrancq, 2018, p.2). Hence, if there is overload as a consequence of increasing an interpreter's psychological stress, it can compromise an interpreter's performance. If material is presented whose complexity is unable to be processed or recognized by a person's working memory, it will result in cognitive overload (Shreve and Angelone, 2010). This will be tested through our sub-hypothesis 2 and 3.

The Study

The advent of translation technologies has contributed significantly to the advancement of research into the process of interpreting, and its results are significant. So far, a wide range of technologies, such as eye-tracking (Su and Li, 2019), EEG (Electroencephalogram) (Weng et al., 2022), fMRI (Functional magnetic resonance imaging) (Hervais-Adelman et al., 2015), HR and GSR (Korpal and Jasielska, 2019), have been used in a variety of interpreting research focusing on interpreters' emotions (Korpal and Jasielska, 2019), stress (Bower, 2015; Korpal, 2017), and directionality of translation and interpreting (Chen, 2020). These studies have proved that the use of a combination of different data elicitation techniques is an effective way of capturing the process-product interface of interpreting and translation (Buchweitz and Alves, 2006). In this study, eye-tracking technology is combined with biosensor technology that simultaneously measures HR and skin conductance level. It is therefore possible to monitor whether there is a correlation between interpreters' psychological stress, crisis situations, and the quality of their interpreting performance. Eye-tracking was used to monitor interpreters' CL and psychological activities. Two objective physiological stress parameters – HR and skin conductance level – were simultaneously monitored during the interpreting process to determine whether crisis communication (with a Covid patient) and normal hospital communication (with a diabetes patient) differ in their physiological stress responses. As mentioned above, we hypothesize that the stress experienced by interpreters in crisis communication situations impacts considerably upon their CL and on the quality of their interpreting performance. To test this research hypothesis, we subdivided it into three sub-hypotheses:

H1: Interpreters experience a high level of psychological stress in crisis and hazard situations compared with normal hospital situations.

H2: Interpreters produce a higher level of CL and psychological stress in crisis situations than in normal hospital situations during the interpreting process.

H3: Interpreters have a better performance (in terms of the quality of their interpreting) in normal hospital situations than in crisis situations.

Participants

25 novice interpreters (13 females and 12 males, with an average age of 21) who are in their third year of study for joint honours degrees in Medical Science and English Language at Peking University (in the top 2 of China's university rankings) participated in the experiment. All participants are native Chinese speakers who have learned English for more than 10 years. These participants have had similar interpreting and translation training as part of their university courses, and they have a similarly high level of language proficiency both in English and Chinese as these are key components of their university study. The interpreters were asked to interpret two simulated medical scenarios in Chinese and English for a Covid patient and a diabetes patient.

Materials and Procedure

In this experiment, we designed two face-to-face medical interpreting tasks, recorded them, and made them available online. Each interpreting setting included a 2-minute virtual environment stimulus and a 3-minute interpreting activity. Virtual environments have proven to be effective in eliciting authentic mental and behavioural responses in psychological research (Gamberini, et al., 2015).

Interpreting task 1 was designed for medical interpreting in crisis situations. A 2-minute virtual reality background featuring ambulance sirens and news footage of the Covid-19 crisis and hospital deaths was used as a contextual stimulus. We focused the scenario on a British professor, John Smith, who works at Peking University and lives in Beijing, China. John is feeling unwell due to a fever and continuous dry cough, and has an existing medical condition: a liver problem. He calls 120 (the Chinese service for health emergencies) for help; Dr Minghua Liu receives the call. After receiving John's call, Dr Liu suggests an immediate online video meeting with John's private doctor, James Best, in Britain. Dr Liu thinks that John needs to go to hospital and calls an ambulance for him. John and his private doctor in Britain do not speak Chinese and Dr Liu does not speak English.

Interpreting task 2 is designed for medical interpreting in normal hospital situations. A 2-minute virtual reality background of images featuring the urban setting of Oxford, its university, and hospital was used for contextual preparation, creating a more neutral ambience. The scenario was as follows: A British professor, John Smith, works at Peking University and thus lives in Beijing. He has a medical condition: diabetes. He is running out of medicine that was prescribed by his British doctor, James Best. Due to his work, he is unable to travel back to the UK. He calls Dr Minghua Liu, who works at the University clinic, for help. After receiving John's call, Dr Liu advises John to arrange an online video appointment with his British doctor. John and his British doctor do not speak Chinese and Dr Liu does not speak English.

In addition to a 2-minute stimulus video for both activities, we also ensured that both activities were of a similar delivery rate and similar linguistic level (e.g. textual difficulty, lexical density, syntactic difficulties, and similar numbers of technical terms), proven variables affecting CL (Plevoets and Degrancq, 2018). Each dialogue consists of 556 words. The Word and Phrase Tool (Davies, 2020), based on the Corpus of Contemporary American English (COCA), was used to test the level of difficulties of the texts. As can be seen from Figure 1, both activities have around 79 percent of words that are in the frequency range of the top 1-500 most commonly used words, around 16 percent of the words are in the range of the 501st to 3000th most frequently used words, and only 5 percent of the texts' words are in the range of words beyond 3000th place in terms of frequency.

Figure 1 Profile of Texts

	Task 1 - Covid-19 Patient	Task 2 - Diabetes Patient
Number of Words	556	556
Frequency Range (1-500)	79.1%	78.9%
Frequency Range (501-3000)	15.9%	16.1%
Frequency Range (3000+)	5.0%	5.0%
Average Length of Sentences	8.54 words	8.55 words

Multimodal Equipment and Stimuli Display

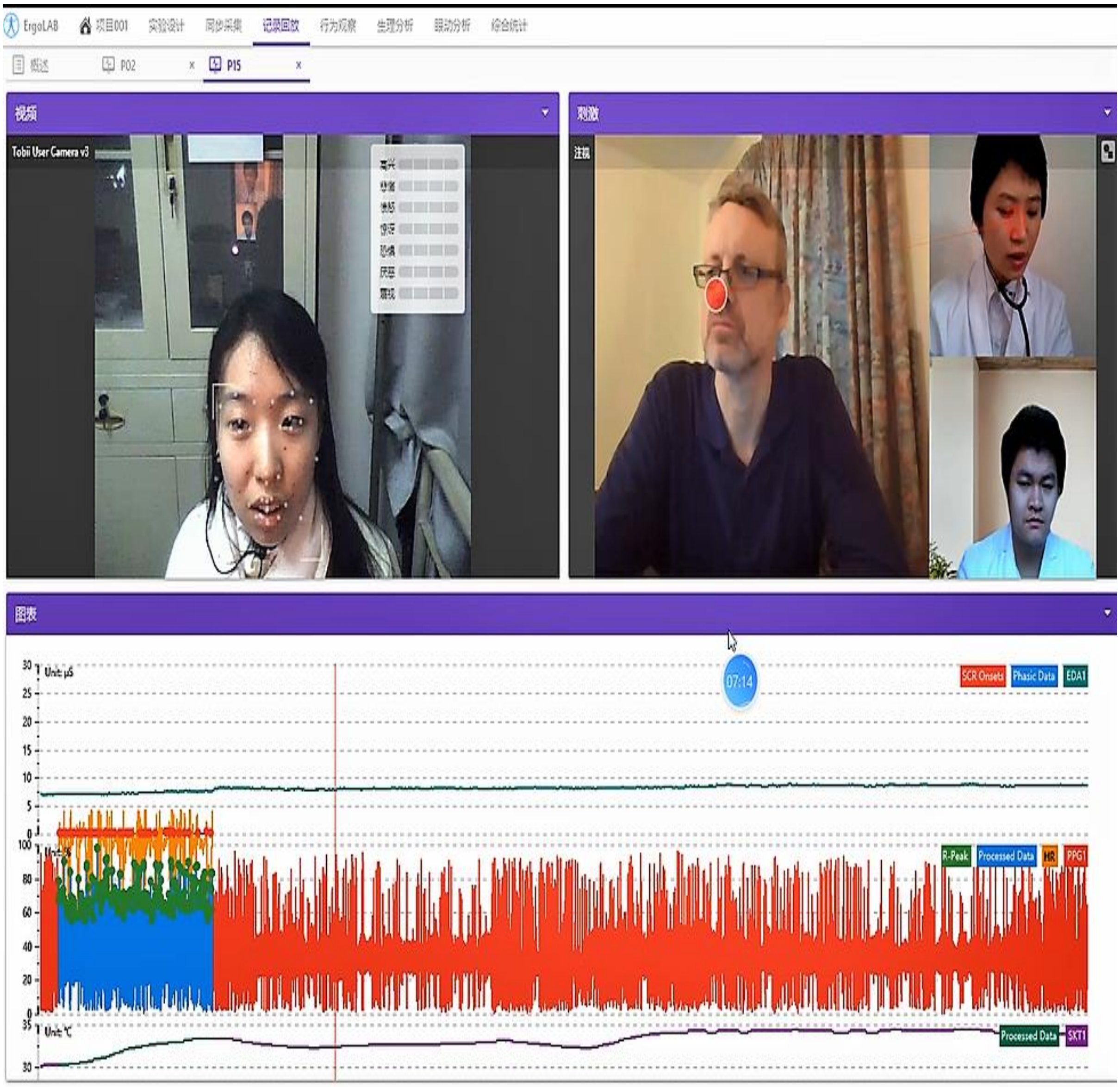
With the participants' consent, multimodal technology – eye-tracking, GSR, and HR – as a triangulation method was used in this study to overcome the weaknesses and intrinsic bias that can vitiate one specific form of technology and a single research methodology.

Tobii Pro X3-120 portal Eye Tracker with E-Prime extension, which features a large, high resolution (1920 x 1080 pixels), was used to observe the interpreters' behaviour and to record the real-time CL and psychological stress produced during the interpreting process, as it can measure fixation and gaze more accurately and precisely.

ErgoLab biosensor, a wearable physiological and psychological recording system that simultaneously collects HR and skin conductivity response amplitude, was used to measure the interpreters' psychological stress index and provide insight into issues that might not be detected without eye tracking. Two sensor electrodes were connected to the participants' fingertips to measure the stress-relaxation balance of the nerve system effectively.

The data was processed by the ErgoLAB platform, also known as the 'Person-Machine-Environment' Synchronisation Platform. Figure 2 shows screenshots of the experiment process and the process of this research. The multimodal technology allows us to record psychological stress during an interpreting situation requiring cognitive processing and responses from interpreters. We believe that this method can increase both the validity and the credibility of this experiment. RStudio (Version 1.3), a statistical computing and graphic programming language, is used for data analysis in this study.

Figure 2 The Experiment Process



Participant Performance Evaluation

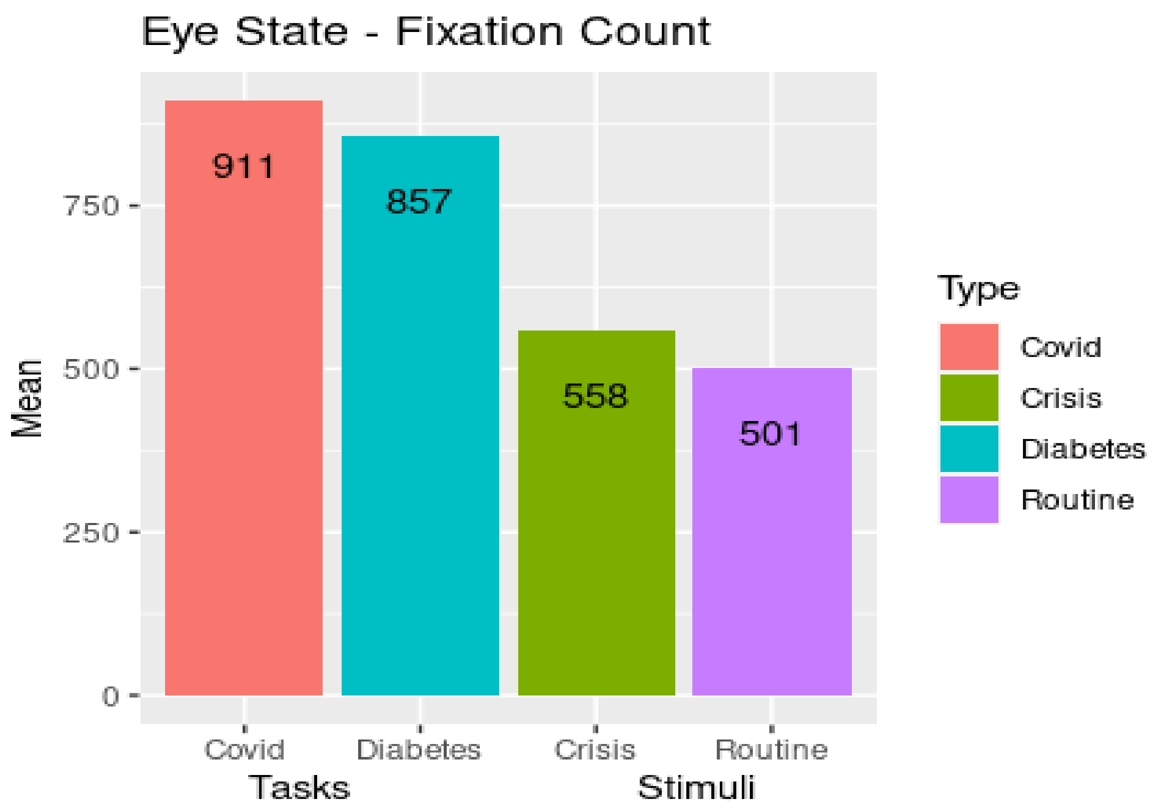
The participants' performance in terms of the quality of their interpreting was peer reviewed by three interpreting lecturers who used the University of Stirling's Community Interpreting exam marking criteria; these are in line with the National Occupational Standards in Interpreting [2]. The criteria are based on three evaluation matrixes: the participants' conveyance of linguistic meaning (accuracy of factual information, concepts, and completeness), delivery (flow, speed, volume, clarity, articulation, pronunciation), and professionalism (interpersonal management, eye contact instances, hesitation). The participants' self-evaluation was used as supplementary data in the discussion. The following section discusses the results and findings after testing our hypotheses.

Data Analysis and Findings

Interpreters' Psychological Stress and CLs in Crisis and Normal Situations

To test our first research hypothesis concerning whether interpreters experience a high level of psychological stress in crisis and hazard situations compared to normal situations, we selected fixation count (fixation duration, total fixation count, and numbers of saccade movements) elucidated from our eye-tracking data, because previous studies have proved that longer eye fixations reflect greater CLs and psychological stress (Seeber, 2011; Underwood and Jebbett, 2004). The eye state of fixation count can be seen in Figure 3. A fixation is when the eye is relatively still. An average of 558 instances and 501 instances of fixation count occurring during crisis stimuli and during normal, urban stimuli respectively were observed. 911 instances during the Covid patient interpreting process and 857 instances for the diabetes patient respectively, were observed. The eye state data indicates that the participants have higher numbers of fixation count within crisis stimuli and task performance compared to the normal stimuli and task performance. A high count may indicate a higher level of stress, whilst a low count may either indicate a low level of stress or being less attentive.

Figure 3 Eye state - fixation count



Our null hypothesis states that there is no difference between crisis situations and normal routine situations. To test our first sub-hypothesis, we conducted a paired t-test between the crisis and routine stimuli regarding total fixation duration count (TFC). The visual difference between stimulus and task can be seen in Figure 4. The crisis stimuli have on average 26.59 more TFC than the normal stimuli. Intuitively, this is logical as an individual would fixate less frequently with fewer things happening than with more things happening. A paired t-test generally tests the significance of a null hypothesis which means that the two test subjects are the same. Upon conducting a t-test, we obtained a p-value of 0.00004392 and a 95% confidence interval of 16.92492 and infinity. The mean of the differences is 26.5948 – see Figure 5. Therefore, we reject the null hypothesis at all significance levels. We also calculated numbers of fixation count and numbers of saccades, and the results yielded are similar to those of the TFC results, confirming that there is a difference between crisis situations and normal situations. We therefore conclude that interpreters in this study experience a higher level of psychological stress in crisis / hazard situations compared to normal situations.

Figure 4 Total Fixation Duration of Stimuli and Tasks

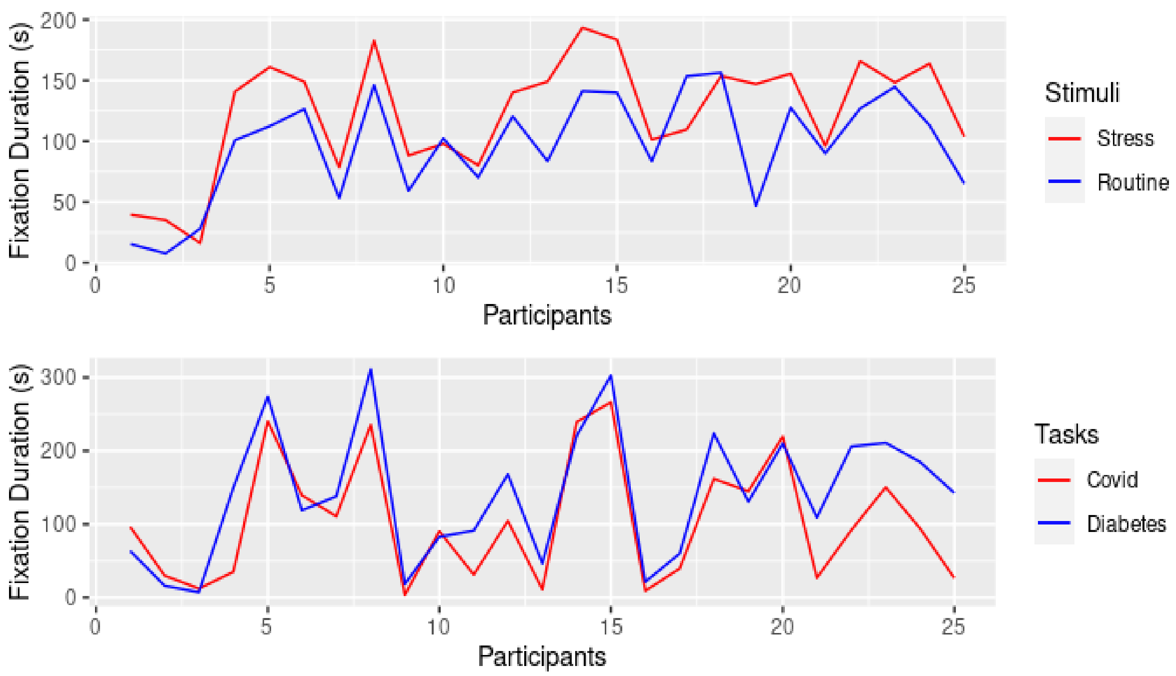


Figure 5 Statistics of the paired t-tests

	Matrix	t-value	df	95% Confidence Interval	Mean of the Differences	p-value
Stimuli: Crisis vs. Routine	Total Fixation Count	4.7054	24	$(16.92492, \infty)$	26.5948	0.00004392
	Number of Fixations	-3.205	24	$(-204.17929, -44.22071)$	-124.2	0.003794
Tasks: Covid vs. Diabetes	Total Fixation Count	-2.5392	24	$(-0.021753604, -0.002246396)$	-0.012	0.01801
	Mean Fixation Count	3.897	24	$(-\infty, -20.13328)$	-5.89	0.0003417
	Heart Rate Total Power	-2.2701	24	$(-18220478.4, -867039.1)$	-9543759	0.03246
	Level of Skin Temperature	-3.8644	24	$(-\infty, -0.5784431)$	-1.038	0.0003709

Interpreters' Psychological Stress and CL During the Interpreting Process

To test our second sub-hypothesis concerning whether the interpreters produced a higher level of psychological stress and CL during the process-product interface in crisis situations than in normal hospital situations, we measured both total fixation duration and mean fixation count and two other psychological stress indicators: skin response and HR. The results of total fixation duration between stress and routine stimuli, and Covid and diabetes tasks can be seen in Figure 4 above. A paired t-test for mean fixation count between Covid and diabetes patient interpreting obtains a p-value of 0.0003417 (smaller than 0.01) and records the mean of the differences to be -35.89 – see Figure 5. We can therefore reject the null hypothesis in favour of our research hypothesis that a true difference exists between the interpreters' psychological stress and CLs in the two interpreting activities.

HR has proven to be a common objective instrument for measuring psychological stress and cardiac state (Tiwari et al., 2021). HR variable, the fluctuation in beat-to-beat interval, represents the sympathetic level (stress) or the parasympathetic activation (non-stress) level. It also reflects the (im)balance between the sympathetic and parasympathetic systems (Korpal, 2016). HR power spectral tool analyses the beat-to-beat variations in the HR of the nerve system activity, including a measurement of the overall power variation of a continuous series of heartbeats into its frequency components: a low-frequency band (LF) at 0.04-0.15 Hz, which indicates a dominant sympathetic component, and a high-frequency band (HF) at 0.15-0.4 Hz for a dominant parasympathetic component. The results of the participants' heartbeat ratio of LF and HF between the Covid and diabetes tasks can be seen in Figure 6. For the Covid interpreting task, the average of LF is 0.044Hz and the average of HF is 0.153, and both LF and HF of the Covid interpreting task are higher than those for the diabetes task (LF 0.043Hz and HF 0.163Hz). The paired t-test of the power spectral results indicate t = -2.2701, p-value = 0.03246, smaller than 0.05, which shows that there is a true difference between interpreting activities in crisis situations and normal situations, and this result echoes the eye-tracking data above.

Figure 6 Heartbeat Ratio of LF and HF

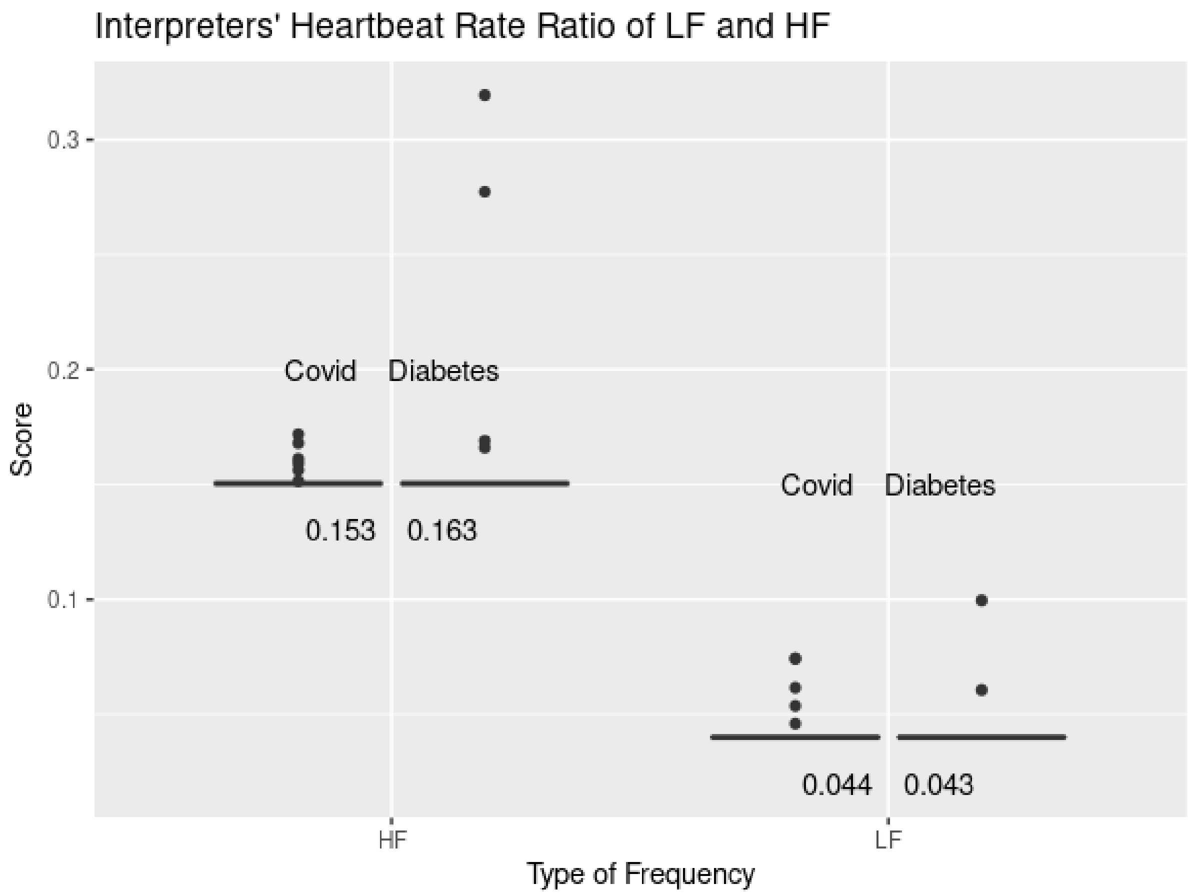
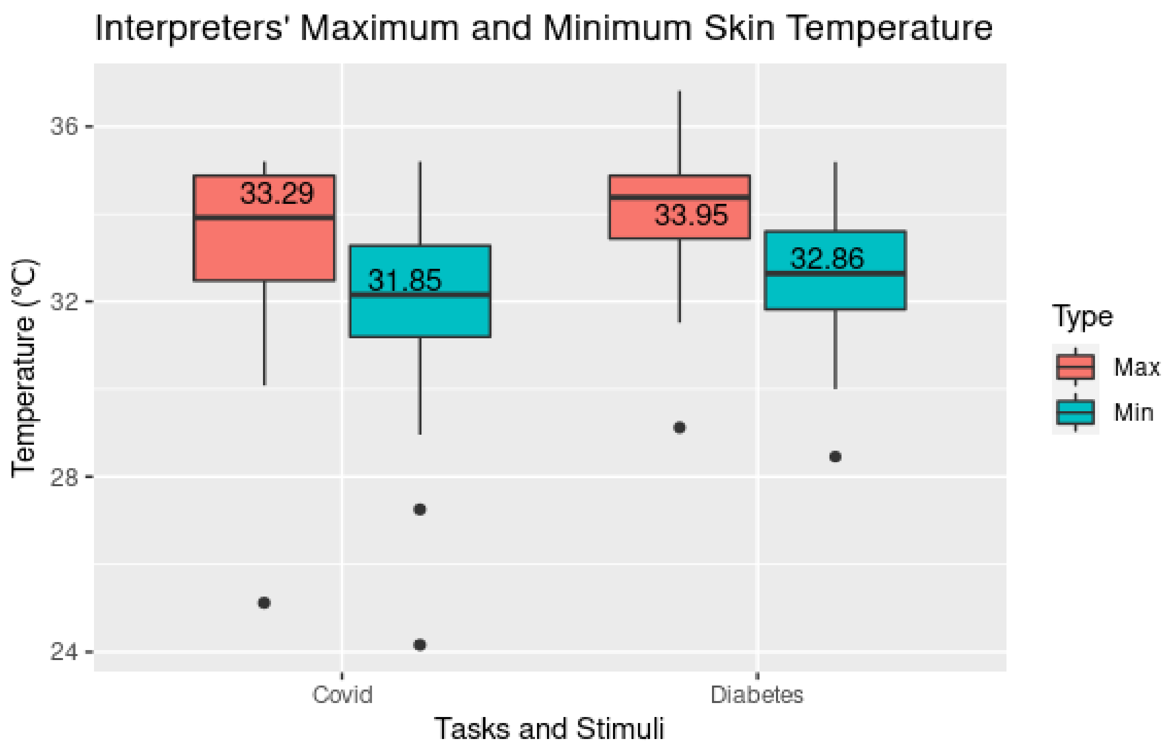


Figure 7 Interpreters' Max and Min Skin Temperature

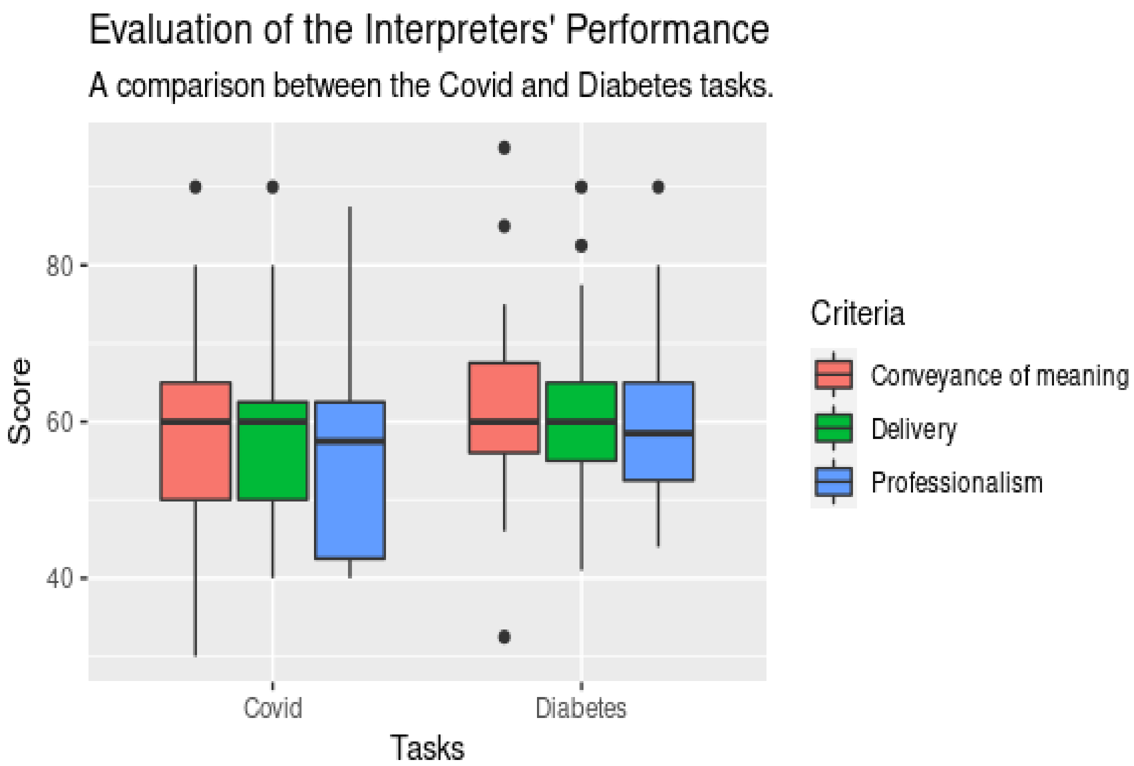


Skin conductance level, a type of electrodermal reactivity also known as galvanic skin response, has been used as an additional indicator. Empirical research shows that a combination method with HR can measure the physiological parameters of interpreters' emotion and stress (Kurz, 2003). The change in skin conductivity and skin temperature indicate an indirect measure of the interpreters' activity in their sympathetic and parasympathetic nervous system. Previous psychological research shows that changes in skin temperature and skin electricity level indicate the intensity of the stress and emotion levels (Herborn, et al., 2015). We have compared the skin temperature of interpreters during the Covid and diabetes tasks. According to Herborn et al. (2015), skin temperature reveals the intensity of acute stress; skin temperature temporarily drops under acute stress. The difference between the two activities is shown in Figure 7. Both the maximum and minimum mean skin temperature during the Covid interpreting (max 33.29 ℃ and min 31.85℃, with an average of 32.73) are lower than those recorded during the diabetes interpreting process (max 33.95 and min 32.86, an average of 33.46). The p-value of this paired t-test is = 0.0003709, which is less than 0.01. We therefore reject the null hypothesis in favour of the alternative hypothesis that there are true differences in skin temperatures. To conclude, all three different measurements show significant differences between crisis and routine interpreting tasks, and indicate that the interpreters experienced a higher level of psychological stress in traumatic crisis situations.

Interpreters' Performance in Crisis and Normal Situations

As outlined above, the interpreters' performance was peer evaluated by three professionals based on 1) conveyance of meaning 2) delivery and 3) professionalism. The results can be seen in Figure 8. The average grades for the three marking criteria were 59, 59 and 57.44 respectively for the Covid patient interpreting; whilst for the diabetes patient interpreting, the average grades were 62.16, 61.18 and 60.32. Figure 8 also shows that most participants achieved between 52 and 62 in conveying the accuracy of meaning for the Covid patient and between 60 and 72 for the diabetes patient, although the data also show the individual differences in terms of performance. Overall, the interpreters in this study performed better in a more normal working environment compared to working in crisis and hazard situations. To further test our third sub-hypothesis concerning whether the interpreters performed better in terms of interpreting quality in normal hospital situations than in crisis situations, we found that the difference between the total mean of crisis performance and normal performance is significantly different. This is evidenced by p-value = 0.0000002839, strongly contradicting the null hypothesis that the two means are the same. That is, the Covid performance is on average -5.24 lower than the diabetes performance, as shown in Figure 5 above. We found that there is a significant difference in terms of the interpreters' performance in crisis settings as opposed to routine settings.

Figure 8 Evaluation of the Interpreters' Performance



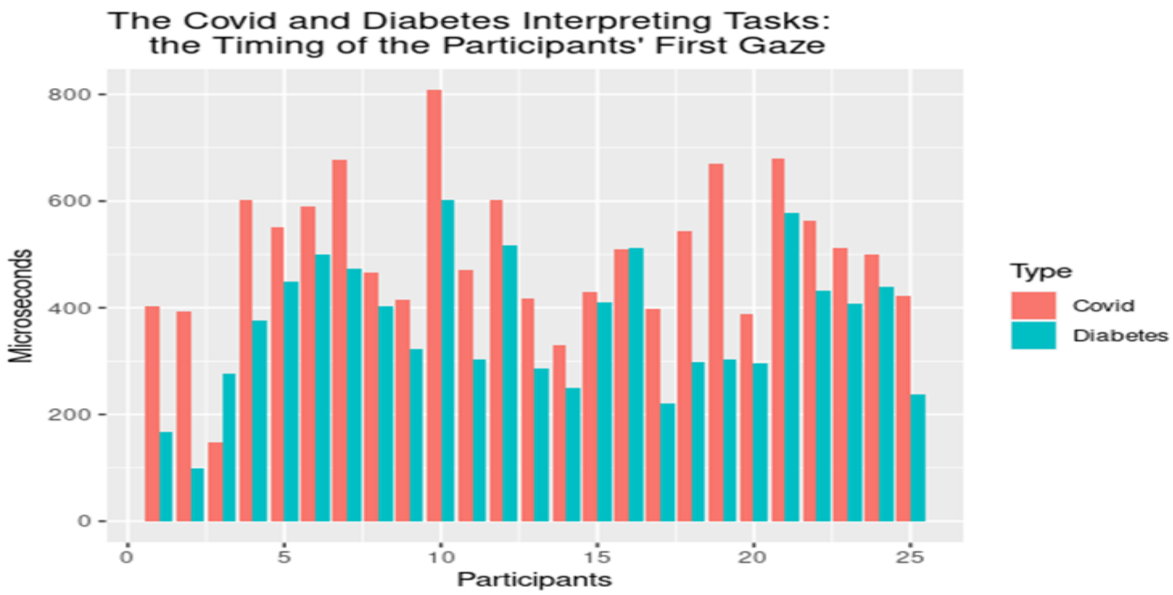
Discussion

Interpreters' Challenges and RC Strategies in Crisis and Routine Situations

The above statistical tests indicate that the interpreters in this study showed significant levels of psychological stress and higher levels of CL in crisis situations compared to routine situations. The experiment also shows that crisis situations negatively affect their performance, as the results indicate that the interpreters performed significantly better when interpreting routine situations rather than crisis situations. Effective interpreting in hospital settings requires interpreters to find corresponding linguistic terminologies and meanings between languages, and also to manage their own physiological and psychological state appropriately during patient encounters. We have identified many ongoing challenges during the interpreting process.

Federici (2020, p.14) argues that during crisis communication, translators are actors who put 'their knowledge, experience and expertise at the service of society as a whole' to mediate human conflicts or disasters derived from natural hazards. Active RC requires us first to recognize the nature of risk and crisis situations and then try to find ways to minimize risk. The interpreters' self-evaluation data revealed that some interpreters were highly motivated to help the patient and indicated their efforts to manage the crisis themselves: 'I was really concerned about the patient's health condition' and 'I wanted to help the patient as much as I could'; thus, 'I tried to control my own emotion' and 'I took several deep breaths' when the tasks started. Most interpreters revealed their difficulties in concentrating during crisis RC situations: 'my brain was totally blank'; 'I forgot what the patient said'; 'I was still very stressed and upset'. This evidence reflects the findings of Rosiers et al. (2016) that both individual difference and different cognitive appraisals of a given event contribute to the interpreters' psychological stress. This is particularly relevant at the beginning of the tasks, as many participants acknowledged that they were still affected after watching the crisis stimuli, felt that they could still 'hear' the siren echoing in the room, and could still 'see' seriously ill, hospitalized people. In their self-reflections, a couple of participants admitted that they forgot elements of the patient and doctors' conversation. The study of the experiment data and of the participants' self-evaluation shows that all the participants experienced a certain level of psychological stress in crisis situations but it also reveals individual differences in RC strategies both in crisis and routine situations. This is also evidenced by the first fixation metrics which show the time that passed before the interpreters looked at the patient and the doctors. To be more precise, it shows how long it takes for each interpreter to start interpreting. As can be seen in Figure 9, in crisis situations it takes about an average of 134 microseconds longer for the participants to concentrate on the areas of interest: it takes an average of 500µs of first gaze duration for the Covid task and 366µs for the diabetes task. All 25 participants recorded a longer first fixation in the Covid interpreting task than for the diabetes task, only one interpreter recorded the same length. The self-evaluation data also indicates the interpreters' own management competence in handling crisis situations by keeping their own mental stress in check and decreasing any negative emotions. The benefit of this is providing a reliable conveyance of linguistic meaning to patients in crisis situations and normal routine situations, compared with other interpreters who need more time to recover and concentrate on their interpreting. According to Gile (2009), the process of interpreting is characterized by four components: audition and analysis, memory, production, and coordination. In our study, we have identified two additional components: efforts towards managing risk and efforts towards communicating in crisis interpreting. In the study, we found that the interpreters' risk management effort included the identification and evaluation of risk and of personal response to hazardous situations. Their efforts to communicate in a crisis centred on minimizing any traumatic impact and maximizing communicational interaction with the patients by working through the '4R' stages: reduction, readiness, response, and resilience.

Figure 9 The Covid and Diabetes Interpreting Tasks: the Timing of the Participants' First Gaze

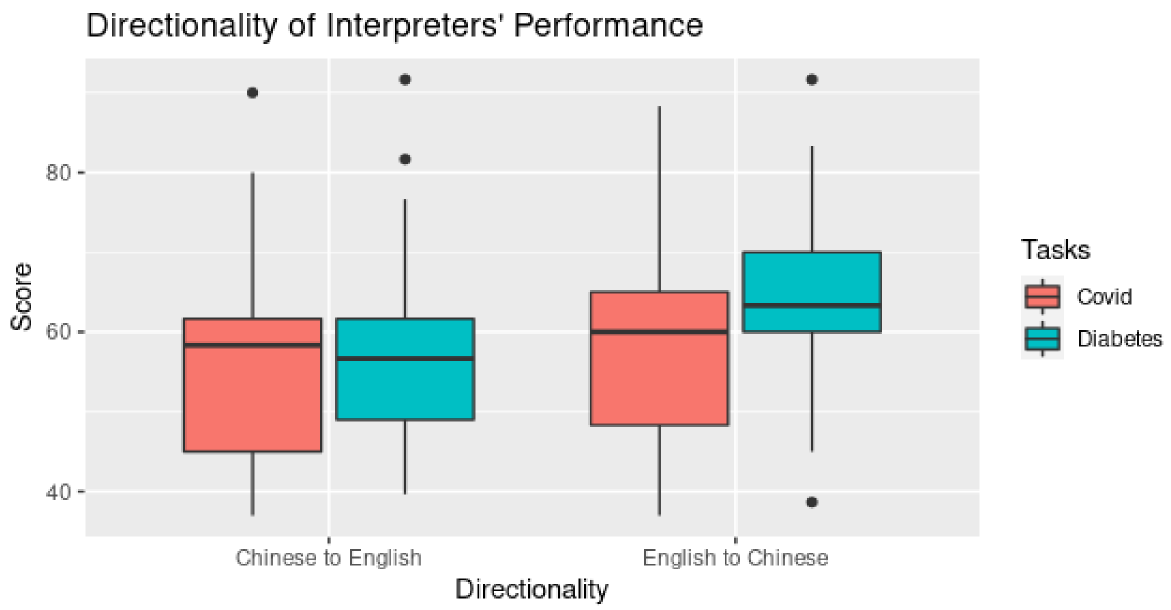


Directionality and Performance

In terms of performance, the participants were significantly better when interpreting for the diabetes patient compared to the Covid patient. The interpreters conveyed the meaning of the utterances relatively more accurately in the routine interpreting scenario. Many participants admitted their difficulties in finding appropriate medical terms and in using correct grammar and sentence order in both directions. 'I spent lots of time thinking how to translate specific words'; 'I found it difficult to form correct sentences in such a short time' as 'I was too stressed' and 'I was distracted'. Another participant observation was: 'I felt guilty for not being able to calm down swiftly to help the patient'. Several participants in this study also admitted that their performance was unsatisfactory in terms of conveying linguistic meanings, in terms of their delivery, and in making eye contact with the patient and doctors in the Covid scenario. They felt they made more errors due to being overstressed; they found it hard to concentrate in crisis situations.

As regards the quality of performance of translation directionality, the results show that the mean marks for the crisis interpreting and routine interpreting scenarios from English into Chinese are 59.70 and 64.02 respectively, while from Chinese into English the marks were 57.20 and 58.41 respectively (Figure 10). The results indicate that directionality also influenced the interpreters' performance; there was a significantly different quality of performance between the Covid and diabetes scenarios when interpreting from English into Chinese. However, there was no significant difference between the two tasks from Chinese into English. In evaluating the accuracy of their linguistic performance, we found that the linguistic accuracy of crisis interpreting for the Covid patient ranged from 31 to 90. The lowest marks seemed to reflect the interpreters' psychological stress level both according to the eye-tracking data and the interpreters' own reflections. This again indicates that interpreting in crisis settings involves the two additional forms of cognitive effort mentioned above, namely, risk management and communication strategies in a crisis. These identified differences in psychological stress in crisis scenarios and routine situations could form the basis for targeted stress and risk management training. These results reflect the research findings of Wang (2017) and Chen (2020), namely that in the language pair of Chinese and English, translation directionality can significantly affect the relationship between processing types, text types, and the distribution pattern of the participants' attention.

Figure 10 Directionality of Interpreters' Performance



Correlation Between Crisis, Psychological Stress, CL, and Performance

We used a Pearson correlation coefficient to estimate the relationship between the interpreters' performance (the outcome variable), and psychological stress in crisis and routine situations, respectively. A correlation coefficient value typically less than 0.5 and greater than -0.5 shows no correlation. As shown in Figure 11, the result indicates a coefficient value of 0.000682, which suggests that the positive correlation between psychological stress and performance in crisis situations is significant. However, the result between the routine interpreting performance and psychological stress is -0.133; this indicates a weak correlation between psychological stress and performance in routine situations.

Mertens-Hoffmann (2001) and Kurz (2003) studied the interpreter's workload according to four factors: psychological, physiological, physical, and performance factors. Their studies indicate that the correlation between measures of stress and performance is weak for highly trained interpreting professionals; however, our study suggests that the association between stress and performance is also weak for novice interpreters in routine situations. We also conducted a multilinear regression test to test the links between crisis/normality, psychological stress, CL, and performance. We found that performance is not directly correlated with any of the measured variables, eye fixation, frequency of HR, and skin temperature. For the routine interpreting scenario, we found no association between the interpreters' performance and psychological stress. This shows that there may be other factors, not taken into account during the experiment, which influenced the performance. For example, the interpreters' exact English language proficiency may be relevant, because we did not examine whether linguistic factors impacted their performance. In addition, the Covid interpreting experiment was conducted first, and then the diabetes experiment after a 30-minute break. This might have influenced the increase in performance, as students were perhaps more familiar with the experiment format.

Figure 11 Correlations of Interpreters' Psychological Stress and Interpreters' Performance in Crisis and Routine Situations

Correlations of Interpreters' Stress and Performance in a Crisis Situation			
Factors		Psychological Stress in Crisis Situations	Crisis (Covid) Interpreting Performance
Psychological Stress in Crisis Situations	Pearson Correlation Sig. (2-Tailed) Number of Participants	1 25	0.000682 < 0.001 25
Crisis (Covid) Interpreting Performance	Pearson Correlation Sig. (2-Tailed) Number of Participants	0.000682 < 0.001 25	1 25
Correlations of Interpreters' Stress and Performance in a Routine Situation			
Factors		Psychological Stress in Routine Situations	Routine (Diabetes) Interpreting Performance
Psychological Stress in Routine Situations	Pearson Correlation Sig. (2-Tailed) Number of Participants	1 25	−0.133 0.0526 25
Routine (Diabetes) Interpreting Performance	Pearson Correlation Sig. (2-Tailed) Number of Participants	−0.133 0.0526 25	1 25

Recommendations and Conclusion

The results of this experiment enable us to identify and compare possible areas in which it would be advisable to launch more comprehensive research into the psychological stress experienced by interpreters and its subsequent impact on their performance in crisis scenarios and routine situations. Based on the results of this study, we recommend three areas for future research as follows.

Recommendation 1: systematic interdisciplinary research into an interpreter's stress and emotional state in crisis communication.

So far, much experimental research has been carried out into the particularities of interpreting in cognitive and psychological terms (Walczyński, 2016, 2019), but there is a more pressing need for research projects focusing on the specific areas of risk and crisis interpreting (and translation), including the interpreters' emotional state, the psychological and physiological stress that they experience, and their well-being. The focus of this present study is to identify and compare interpreters' physiological stress in crisis scenarios and routine medical settings, so we only considered data that recorded interpreters' stress, CL, and performance. However, the scope of this project could be broadened to include more aspects of interdisciplinary research relevant to the stress and emotional state of interpreters by incorporating research from neuroscience, cognitive psychology, sociology, translation, and linguistics. This study was restricted to novice interpreters; it would therefore be useful to compare and analyse the different factors that influence the performances of novice interpreters and professional interpreters in crisis situations. In addition to language pairs, translation directionality also affects the CL of an interpreter (Su and Li, 2019); therefore, it would be valuable to compare interpreting strategies and challenges in both directions. Another logical research progression would be a controlled experiment to compare the performance of interpreters in terms of their cognitive effort to overcome linguistic difficulties, and their gaze patterns, before and after crisis interpreting training. This would shed light on the aspects of crisis interpreting training that are most useful to novice and professional interpreters.

Recommendation 2: Experimental research on crisis interpreting by using multimodal technology

Regarding the applicability of different CL, psychological stress, and mental state assessment technologies, this study has proven that a multimodal technological approach that combines eye-tracking, HR, and GSR is an effective way to make a live, simultaneous record of an interpreter's process-product. We have found that there is a positive association between crisis and psychological stress, CL, and performance levels; however, we tested a relatively small number of novice interpreters and the experiment itself is a simulation in this study. It is suggested that a further study with trained and experienced crisis interpreters and/or with real live interpreting situations focusing specifically on interpreters' psychological stress in terms of directionality, and on interpreters' emotional intelligence in RC, is conducted as the second phase of this process-product research. Further research by using multimodal technology such as EEG, fMRI, and face recognition can identify an interpreter's emotional state and brain dynamics more clearly.

Recommendation 3: Targeted research related to crisis interpreting training

In this study, we have identified two additional types of mental effort used during crisis interpreting, focusing on risk management and communication during medical interpreting. Daly and Chovaz (2020) report that interpreters 'lack adequate supports and/or specialised training to manage the potential negative emotion' associated with working in crisis scenarios (p. 353). It is necessary, in the context of global pandemics and other increasingly frequent crises, that courses focusing more specifically on crisis interpreting are organized by universities or by other professional bodies to help interpreters manage their psychological stress and emotional state, and thus improve their general psychological and physical well-being. The interpreters dealing with the simulated crisis situations in this study showed evidence of increased psychological stress and CL which affected their performance. These empirical results reiterate the calls by Federici and O'Brien (2020) for specific translation and interpreting training and collaborative research for translators and interpreters in crisis contexts; interpreters will consequently be better prepared and will benefit from more effective RC skills. We therefore recommend training for translators and interpreters at the more context-specific level of crisis communication, including role-playing, simulation of crisis scenarios, and the diffusion of instruments and strategies for RC. This will equip novice interpreters, in particular, with effective crisis communication skills to enable competing narratives to emerge from traumatic situations. Interpreters should receive similar training to hospital staff as regards preventive risk management measures, and this should be embedded within targeted interpreting training. We would reiterate the proposal by Alexander and Pescaroli (2019) that more targeted training, focusing on crisis communication strategies and behaviour schema, could help interpreters to control their psychological stress and to react more calmly in real-life emergency situations.

To conclude, this study has provided scientific evidence from processes of eye-tracking, HR, and GSR that interpreters in medical crisis situations experience increased psychological stress and a greater CL. These impact more negatively on their performance than in normal situations. We have also identified a range of different RC strategies. In addition, all the interpreters in this study channelled two additional forms of cognitive effort focusing on risk management and communication during the medical interpreting process. We therefore recommend a future training focus that targets the development of risk management and communication strategies in traumatic situations, an approach that should focus on reduction, readiness, response, and resilience during the interpreting process.

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	Task 1 - Covid-19 Patient	Task 2 - Diabetes Patient
Number of Words	556	556
Frequency Range (1-500)	79.1%	78.9%
Frequency Range (501-3000)	15.9%	16.1%
Frequency Range (3000+)	5.0%	5.0%
Average Length of Sentences	8.54 words	8.55 words

Figure 2 Click here to access/download;Figure;Fig 2.png

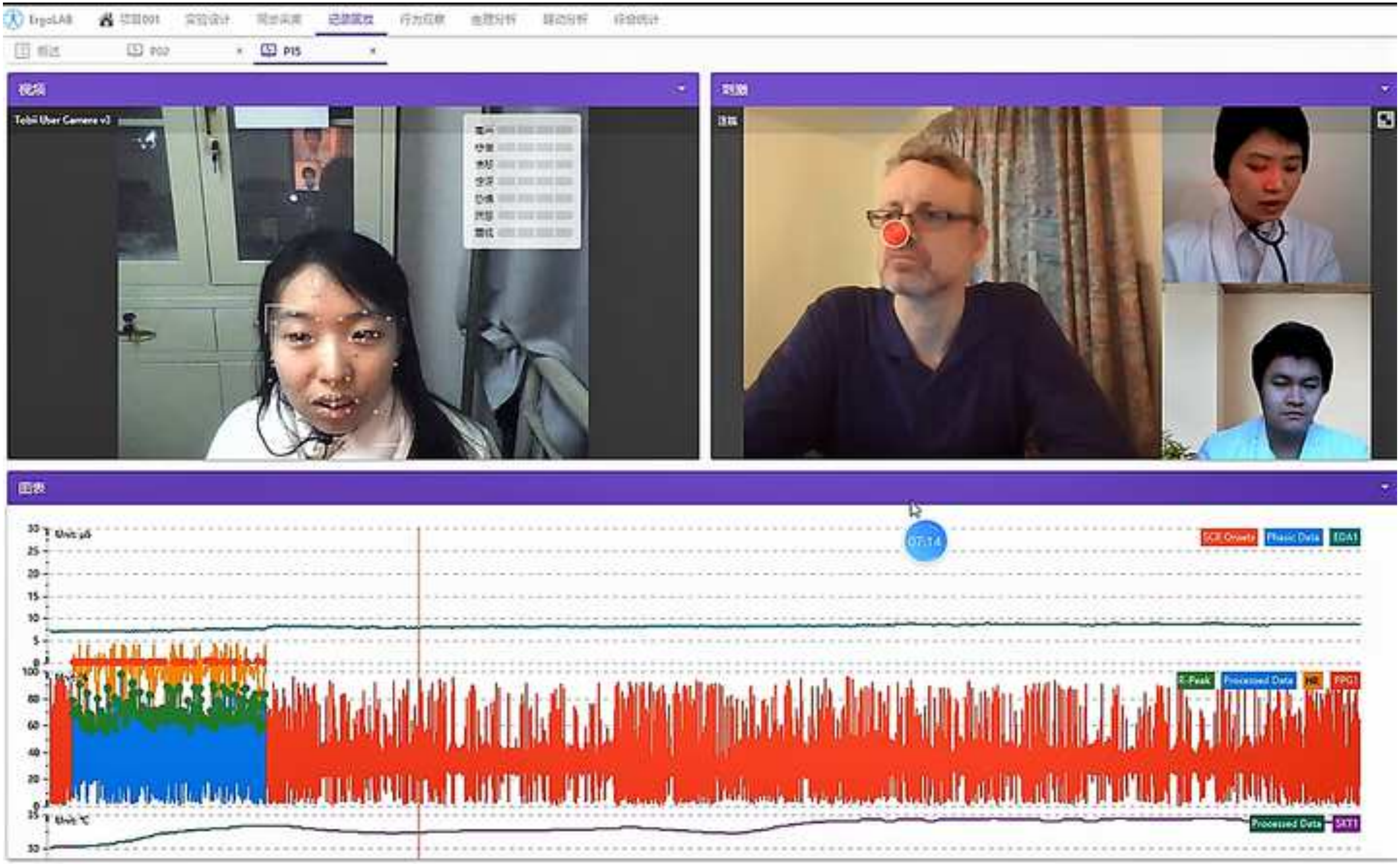
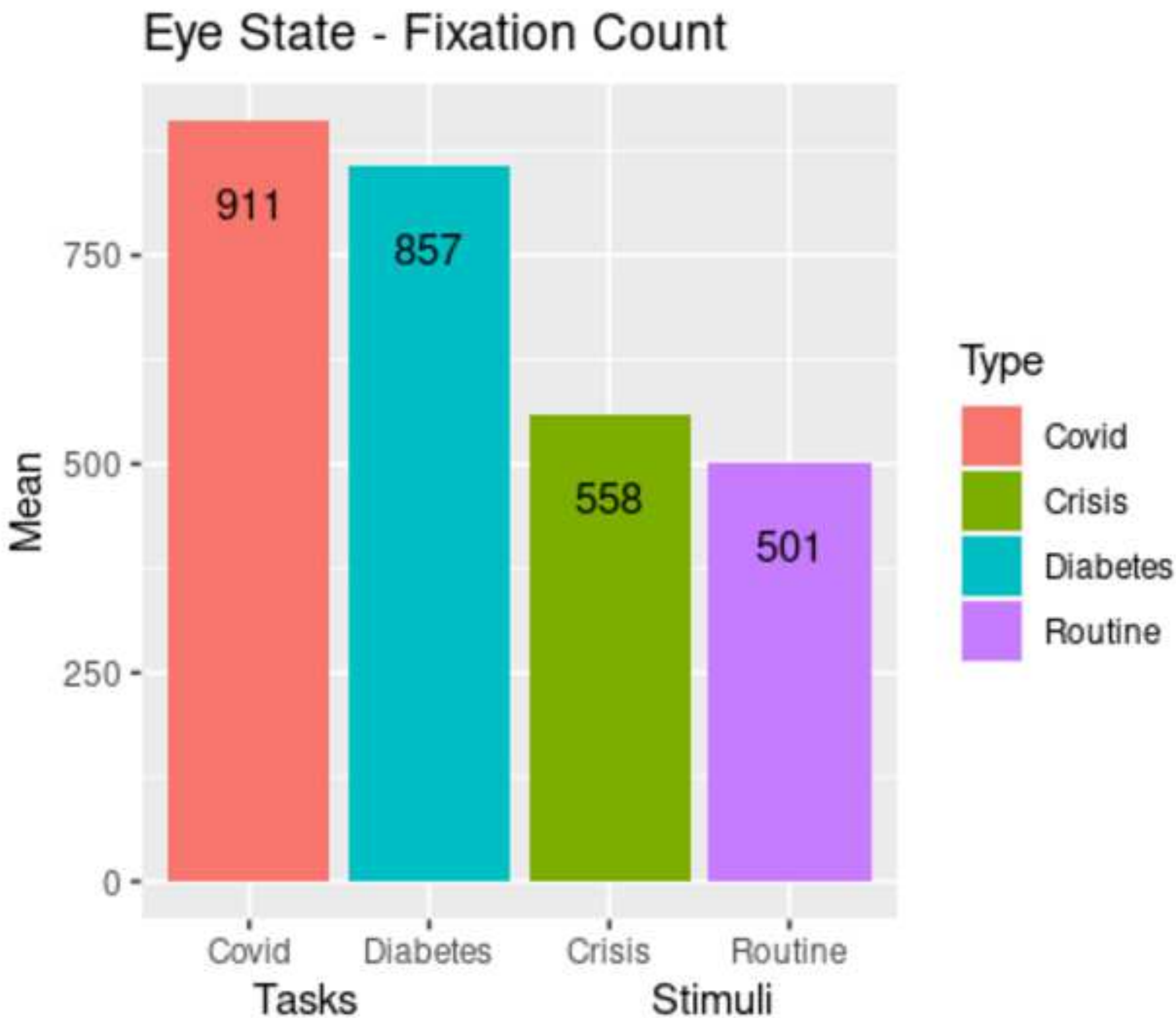


Figure 3



Eye State - Fixation Count
Mean
750
500
250
0
911
857
558
501
Covid
Diabetes
Crisis
Routine
Tasks
Stimuli
Type
Covid
Crisis
Diabetes
Routine

Figure 4

Click here to access/download;Figure;Fig4.png

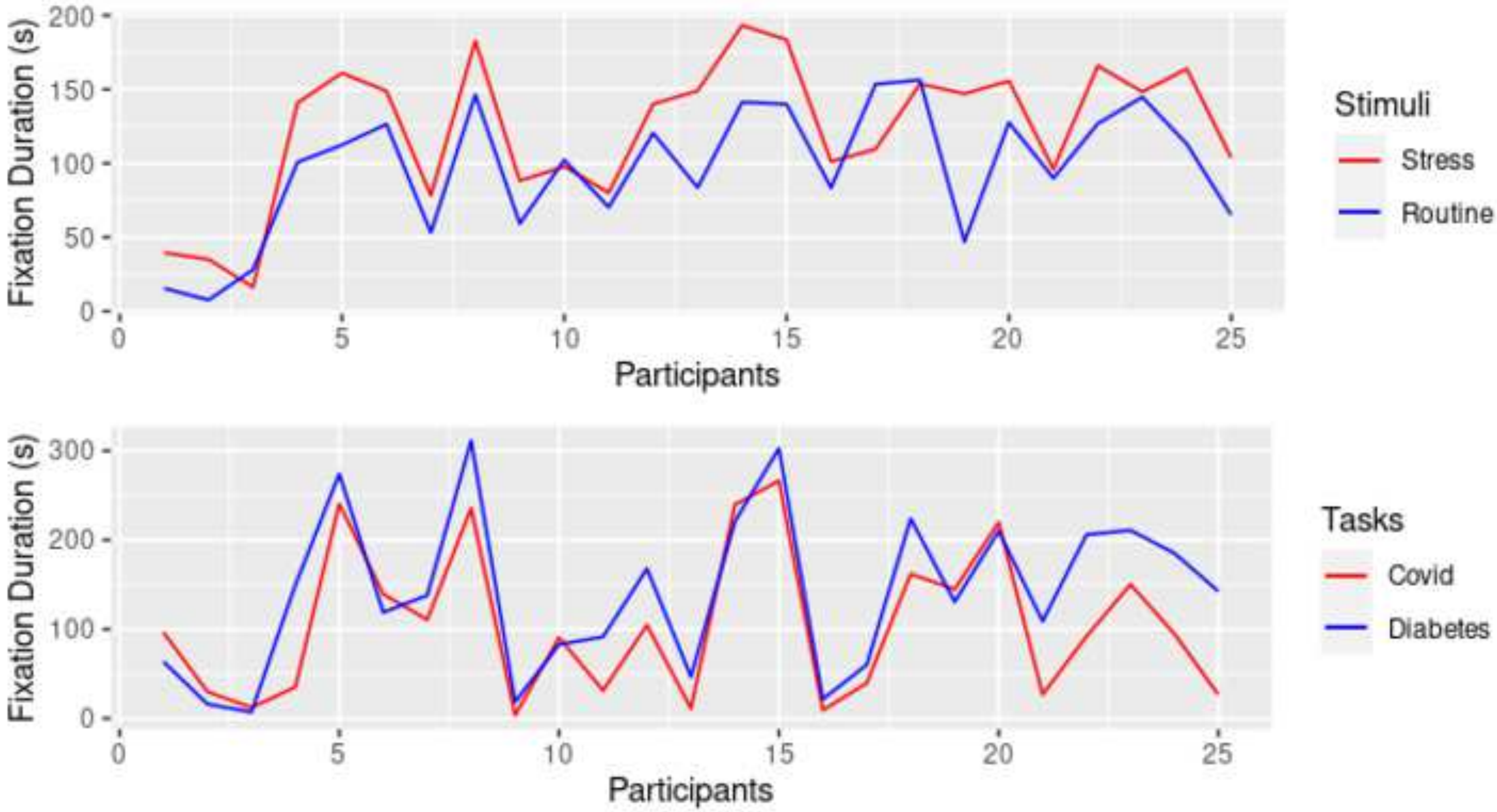
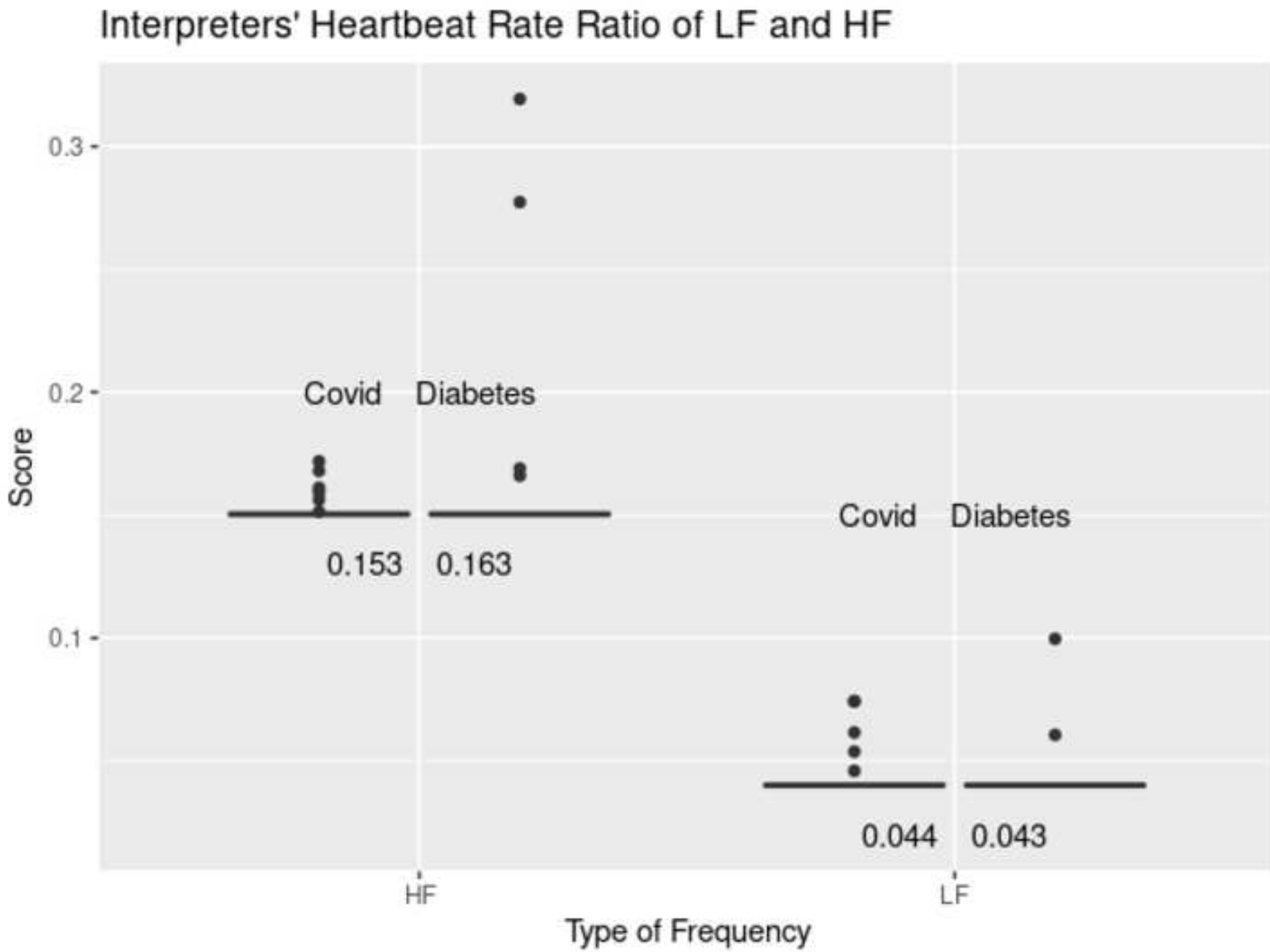


Figure 5

	Matrix	t-value	df	95% Confidence Interval	Mean of the Differences	p-value
Stimuli: Crisis vs. Routine	Total Fixation Count	4.7054	24	(16.92492, ∞)	26.5948	0.00004392
	Number of Fixations	−3.205	24	(−204.17929, −44.22071)	−124.2	0.003794
Tasks: Covid vs. Diabetes	Total Fixation Count	−2.5392	24	(−0.021753604, −0.002246396)	−0.012	0.01801
	Mean Fixation Count	3.897	24	(−∞, −20.13328)	−5.89	0.0003417
	Heart Rate Total Power	−2.2701	24	(−18220478.4, −867039.1)	−9543759	0.03246
	Level of Skin Temperature	−3.8644	24	(−∞, −0.5784431)	−1.038	0.0003709

Figure 6


Interpreters' Heartbeat Rate Ratio of LF and HF
0.3
0.2
0.1
Score
Covid
Diabetes
0.153
0.163
Covid
Diabetes
0.044
0.043
HF
LF
Type of Frequency

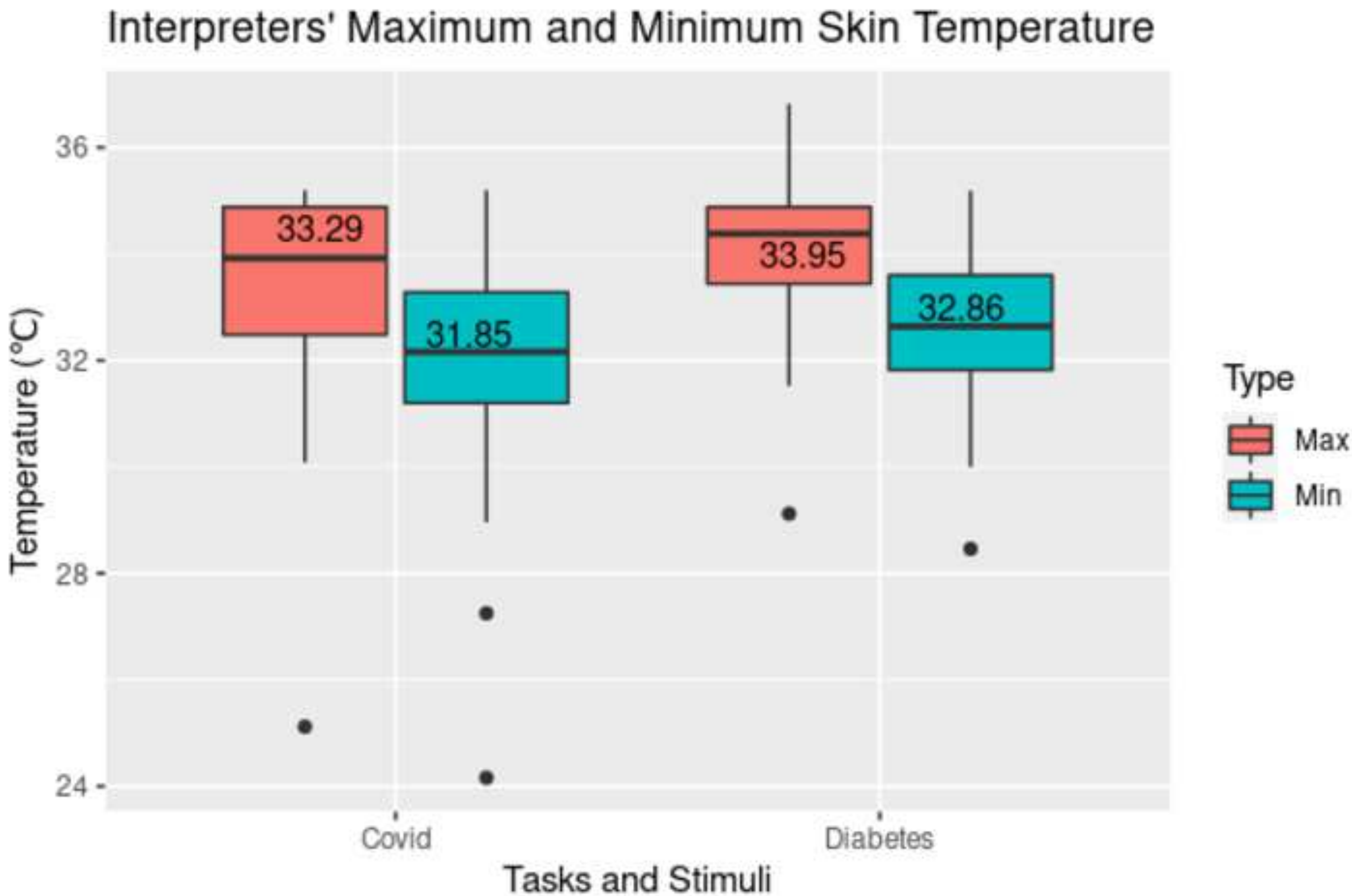

Interpreters' Maximum and Minimum Skin Temperature
33.29
31.85
33.95
32.86
36
32
28
24
Temperature (°C)
Covid
Diabetes
Tasks and Stimuli
Type
Max
Min

Figure 8

Click here to access/download;Figure;Fig8.png

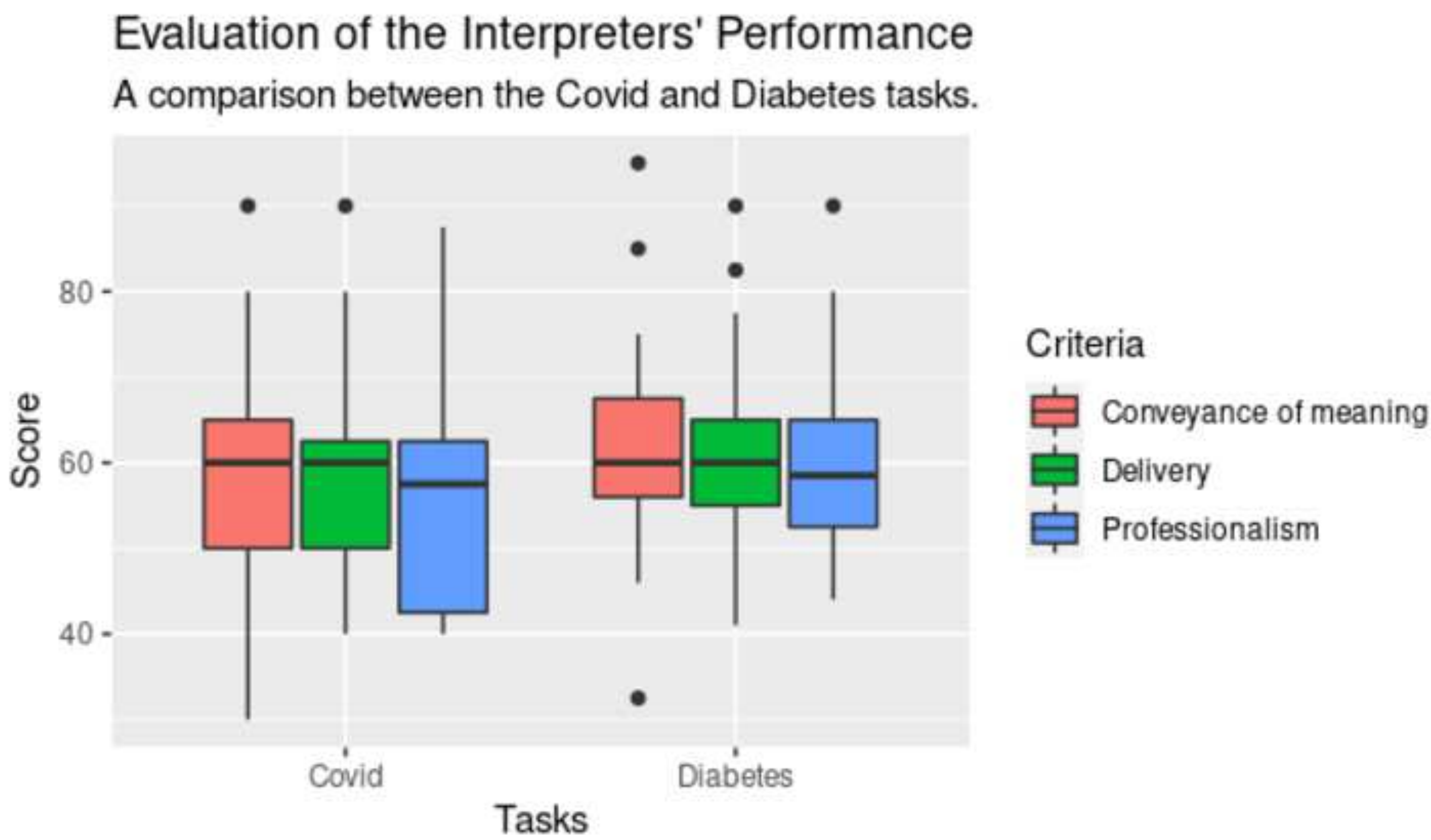


Figure 9

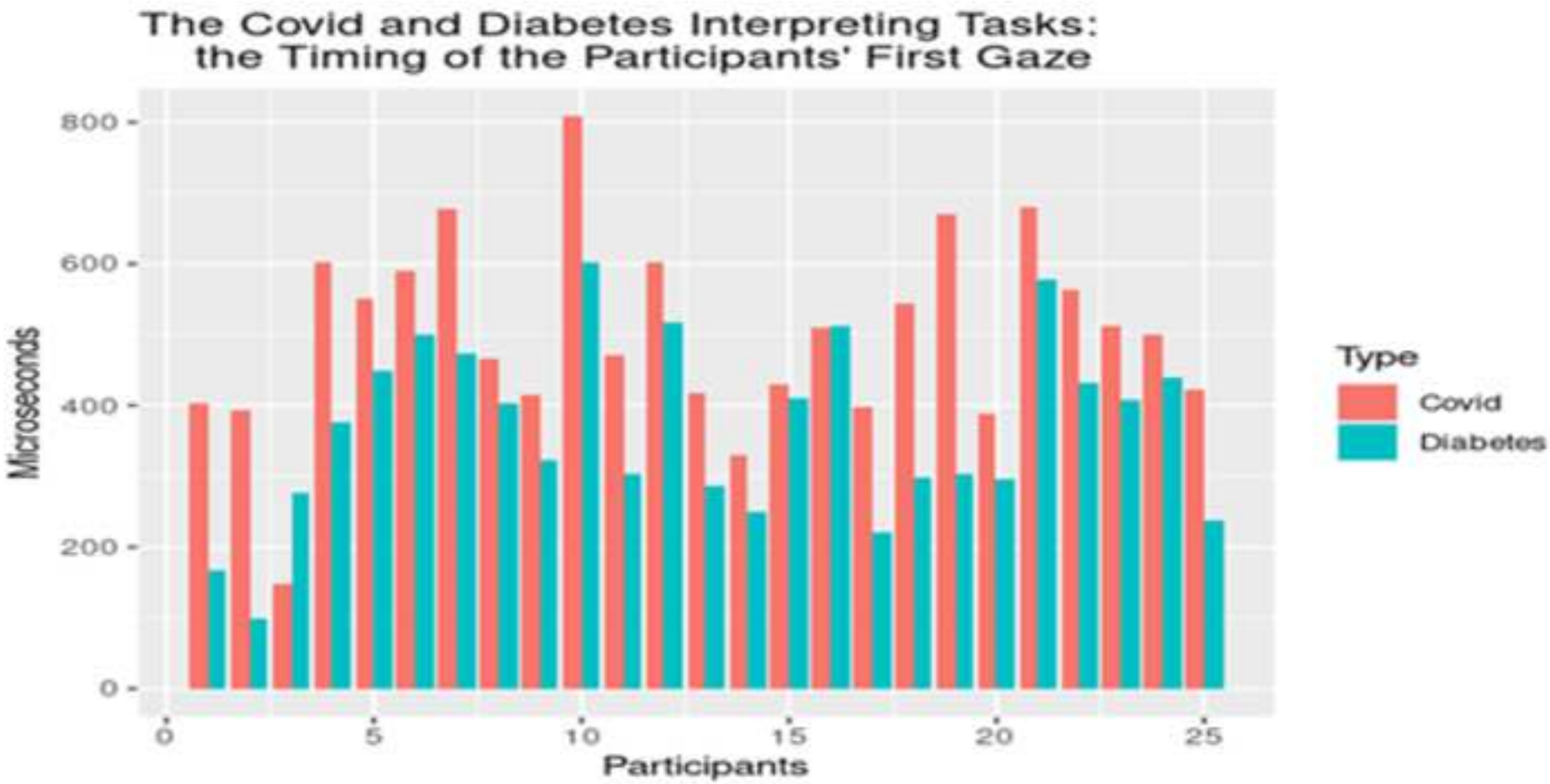

The Covid and Diabetes Interpreting Tasks:
the Timing of the Participants' First Gaze
Microseconds
800
600
400
200
0
0
5
10
15
20
25
Participants
Type
Covid
Diabetes

Figure 10

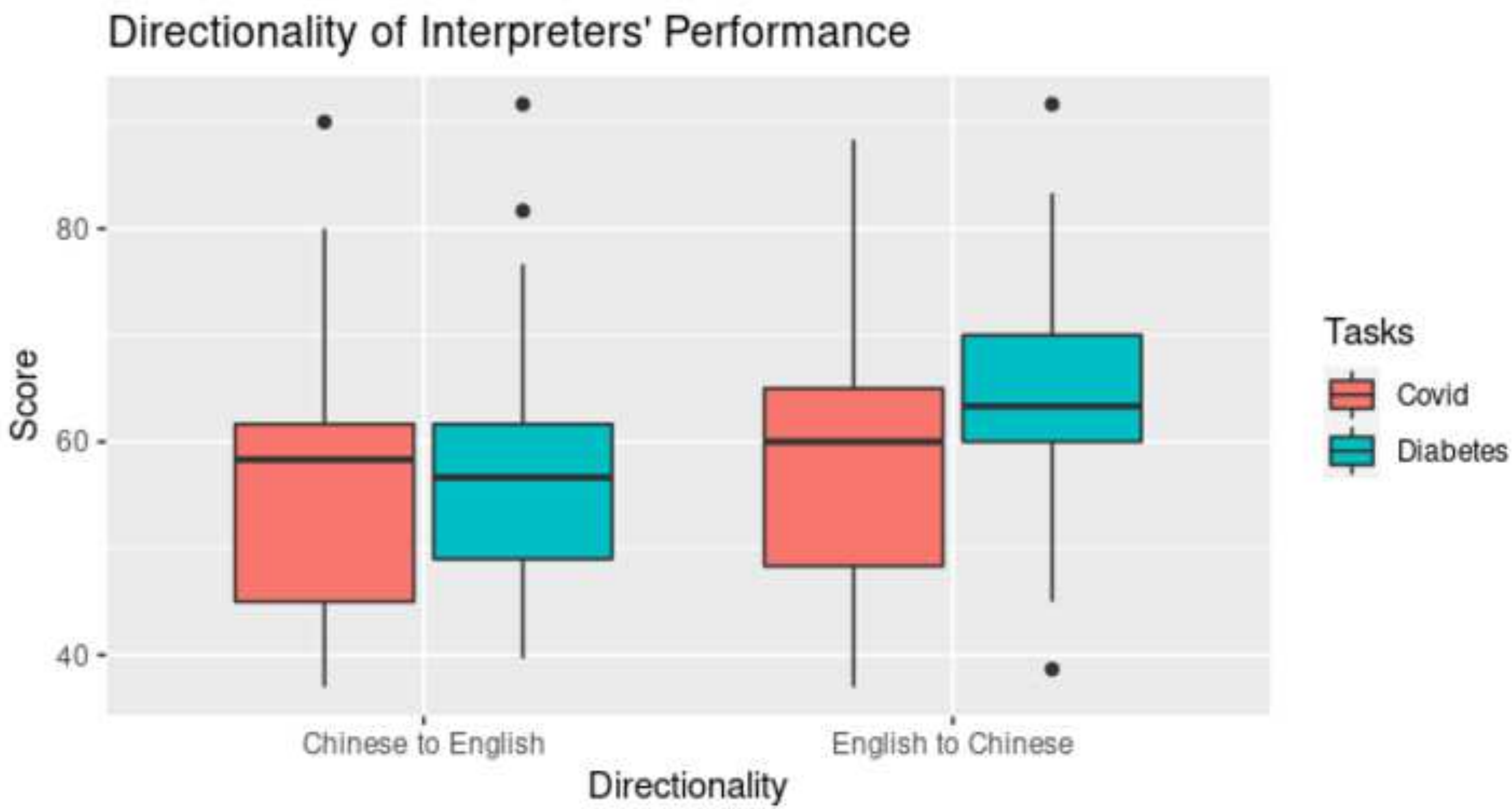

Directionality of Interpreters' Performance
Score
80
60
40
Chinese to English
English to Chinese
Directionality
Tasks
Covid
Diabetes

Figure 11

Correlations of Interpreters' Stress and Performance in a Crisis Situation			
Factors		Psychological Stress in Crisis Situations	Crisis (Covid) Interpreting Performance
Psychological Stress in Crisis Situations	Pearson Correlation	1	0.000682
	Sig. (2-Tailed)		< 0.001
	Number of Participants	25	25
Crisis (Covid) Interpreting Performance	Pearson Correlation	0.000682	1
	Sig. (2-Tailed)	< 0.001	
	Number of Participants	25	25
Correlations of Interpreters' Stress and Performance in a Routine Situation			
Factors		Psychological Stress in Routine Situations	Routine (Diabetes) Interpreting Performance
Psychological Stress in Routine Situations	Pearson Correlation	1	−0.133
	Sig. (2-Tailed)		0.0526
	Number of Participants	25	25
Routine (Diabetes) Interpreting Performance	Pearson Correlation	−0.133	1
	Sig. (2-Tailed)	0.0526	
	Number of Participants	25	25

Certification

This is to confirm that ‘基于眼动、击键和反省式有声思维法的平行病例写作培训过程研究’ is internally funded and ethically approved as an education and teaching reform project (教育教学改革项目) by the Institute of Medical Humanities, Peking University in 2019. Dr. Yifang Wang is the project leader and co-authors of one of the project outputs entitled ‘Studying Interpreters’ Stress in Crisis Communication: Evidence from Multimodal Technology of Eye-tracking, Heart Rate and Galvanic Skin Response’.

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