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研究課題名（和文）Multilingual Socio-Emotional Communication Support for Improving Foreign Student Adjustment and Mental Health Outcomes

研究課題名（英文）Multilingual Socio-Emotional Communication Support for Improving Foreign Student Adjustment and Mental Health Outcomes

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研究成果の概要（和文）：本研究では、留学生を対象としたテキストコミュニケーションの媒体における感情伝達、社会的サポートの交換を支援することを目的として、テキストコミュニケーションにおいて感情情報を伝達する新規システムを開発した。感情的なフォントや吹き出しの形状を用いて、テキストチャットにおける感情伝達を支援するアプリケーションを開発し、テキストチャットにおいて感情が伝わりやすくなる事を評価実験で確認した。学術論文は情報処理学会インタラクション2022にプレミアム発表として選ばれた他、ヒューマンコンピュータインタラクション分野のトップ国際会議CHI2022でBest Paper Award（上位1%)を受賞した。

研究成果の学術的意義や社会的意義
The research results contribute to social information processing (SIP) theory by increasing our understanding on the role and effects of paralinguistic cues in text-based communication. The practical applications can increase quality of text-based multilingual socio-emotional communication.

研究成果の概要（英文）：Novel systems to convey emotional information in text-based communication were developed with a goal to support socio-emotional information exchange, interpersonal relationship building and the exchange of emotional and social support in text-based mediums for foreign students. In the first iteration of the system design, emotional Western typefaces are used to convey emotional valence in text-based messages by automatically detecting the emotional information from text.
The approach taken in the second iteration of system development was to design an automated method to generate unique speech balloons that match and convey a message sender's level of emotional arousal to the receiver. The system design was first introduced in IPSJ INTERACTION as a Premium Track presentation. The results from evaluation experiments confirming the efficacy of the approach were disseminated in a top international conference publication, CHI 2022, where it received the Best Paper Award (top 1%).

研究分野：Human-Computer Interaction

キーワード：computer-mediated　socio-emotional　multilingual　text-based communication　paralinguistic cues

１．研究開始当初の背景

The aim of this research was to improve the cultural adjustment processes and mental health outcomes of foreign students via the design and development of software tools for supporting foreign students in socio-emotional information exchange, interpersonal relationship building and the exchange of emotional and social support in text-based mediums.

Acculturative stress and reduced social support are major factors in the onset of mental health disorders among foreign students (Bhugra 2003). In the beginning of their sojourn, foreign students with positive mental health outcomes tend to receive increased emotional support from friends and family in their home country via computer-mediated communication (CMC) mediums, such as audio or video calls. After the initial adjustment period this type social support which 'buffers' the negative feelings and acculturative stress is delegated to friends in the host country, while family and friends back home are perceived as "being there" rather than as direct sources of support (Hautasaari et al., 2017).

However, if foreign students are unable to build and maintain a social support network in the host country, they instead keep relying on distant friends and family for social support for the duration of their sojourn (Hautasaari et al. 2017). This type of support-seeking can have a detrimental effect on foreign students' mental and physical well-being as the distant social ties are not able or willing to provide prolonged 'buffering' support that foreign students need due to factors such as time difference or the unavailability of rich CMC mediums (Wang & Kanungo 2004, Shklovski et al. 2008). Foreign students without a social support network in the host country may find themselves in a vicious cycle, where they try to reach out to distant loved ones for support in times of stress, but instead end up feeling lonely, isolated and disconnected, which can lead to negative mental health outcomes (Hautasaari et al., 2017).

The difficulties in building and maintaining relationships in the host country are closely related to language and cultural differences in interpersonal communication (Yuan et al., 2013), and in particular, problems in socio-emotional communication with individuals who do not speak the same native language (Hautasaari et al. 2018). In order to overcome the language barriers between users, popular social media sites with text-based communication channels used to build and maintain modern relationships, such as Facebook, have already implemented machine translation (MT) support for translating messages from one natural language to another. However, socio-emotional communication via text-based mediums (Slack, Line, Facebook chat, etc.) is challenging for two reasons. Firstly, text-based mediums often lack rich emotional cues, such as facial expressions, which makes accurate emotion detection difficult (Dennis & Kinney, 1998). Despite the lack of emotional cues, Social Information Processing (SIP) theory postulates that communicators actively develop social relationships via text-based CMC if they expect further opportunities to interact over time even if it takes longer than in face-to-face interactions (Walther, 1992).

Secondly, multilingualism introduces a dimension to social information processing, which has only recently garnered attention in the Human-Computer Interaction (HCI) field. The emerging challenges stem from findings highlighting that non-native speakers of a language, or bilinguals, perceive emotion words differently from native speakers of the shared language (Romney et al., 1997). This effect carries also to text-based communication, where non-native speakers of a language perceive emotional messages as more negative than native speakers based on the same emotional cues (Hautasaari et al., 2018). Thus, direct translation of a message to the receiver's native language does not guarantee that the sender and receiver perceive its emotional tone similarly. For example, native speakers of two languages (e.g., Japanese speaker and English speaker) may have different perceptions about the emotional nuances in literal translations of corresponding emotion terms (e.g., 嬉しい vs. happy) (Moore et al. 1999, Romney et al. 1997). That is, even if individual emotion words would be accurately translated, the sender and the receiver may have different perceptions on the emotional tone in a message regardless of whether they have similar understanding of its content and meaning. This problem can be further exasperated by culturally different interpretations of paralinguistic emotional cues, such as emoticons, which are used by communicators to compensate for the lack of non-verbal cues in text-based mediums (Hautasaari et al. 2014). The above problems can in turn hinder the formation of interpersonal relationships between individuals who do not speak the same native

language due to misunderstandings about the emotional tone in text-based messages that may lead to misperceptions regarding the partner's intent and personality.

The key research question in this project focuses on answering how to overcome these challenges in multilingual socio-emotional communication with the development of novel supporting tools, and how the use of these tools may aid foreign student adjustment and mental health outcomes via relationship and social support network building in the host country.

２．研究の目的

The goal of this research is to improve the cultural adjustment process and mental health outcomes of foreign students in the host country. The research approach focuses on the iterative design and development of software tools for supporting foreign students in multilingual socio-emotional information exchange, interpersonal relationship building and the exchange of emotional and social support between fellow foreign students and host country nationals over text-based computer-mediated communication (CMC) mediums.

３．研究の方法

This research aims to answer how to resolve discrepancies between sender (speaker) and receiver (listener) regarding the emotional tone of messages in multilingual text-based communication, where misunderstandings about the sender's tone may lead to misperceptions about the communicative partner's personality and deterioration of interpersonal relationships. To this end, this research will develop novel supporting technology for mediated multilingual socio-emotional communication by designing novel paralinguistic cues and using technologies such as automated emotion detection. Then, the goal is to explore how the use of such supporting technology affects the accuracy of emotion detection in text-based socio-emotional communication.

In order to support the foreign students' socio-emotional communication processes and cultural adjustment in the host country, this research focused on the iterative design and development of supporting tools for text-based socio-emotional communication. As related research results on the utilization of paralinguistic cues to convey emotional nuances in text-based computer-mediated communication suggested that language and cultural background of the interlocutors may influence their perceptions about existing cues, such as emoticons, the direction of this research was oriented towards developing novel cues to communicate emotional information specifically in multilingual communicative settings. That is, evidence from related research suggested that native and non-native speakers would perceive the emoticons commonly used in text chats differently depending on their language and cultural background. Secondly, previous research suggested that the two dimensions of emotional expression, emotional valence and arousal, are both communicated simultaneously with existing cues (i.e., emoticons). This research took an approach to support these dimensions individually, as particularly the emotional arousal dimension (i.e., calm vs. excited) and how to accurately convey the level of arousal in multilingual text-based communication has not been addressed in detail in other works.

The iterative design of the socio-emotional communication support system first focused on the design for a method to display an abstraction of the polarity and strength of message sentiment (i.e., emotional valence; positive-negative) to non-native speakers who may have difficulties detecting the emotional nuances in second language messages. Based on previous research, emotional typefaces (i.e., fonts) were chosen as a cue to convey emotional valence in a way that may be less culture-specific than the use of just words and emoticons. The second iteration of the proposed system focused on the design for a method to display an abstraction of the level of emotional arousal in text-based messages. Taking inspiration from Japanese manga and how speech balloons are used to convey characters' emotional tone along with speech text, this research took an approach to manipulate the speech balloon shapes in text-based chats to more accurately convey the level of emotional arousal from the message sender to the receiver.

The proposed systems are implemented as prototypes, and the efficacy of the emotional cues are first evaluated through non-interactive settings (e.g., crowdsourcing). Based on the results of these evaluations, the proposed paralinguistic cues are implemented in interactive systems (i.e., text-chat applications) and evaluated via controlled laboratory experiments. During the research period, interactive experiments were temporarily suspended, and evaluations were conducted primarily on online platforms with Japanese participants due limitations imposed on recruiting and experiment organization by to the global COVID-19 pandemic during the research period.

４．研究成果

The first iteration of the proposed system to support text-based socio-emotional communication was designed to automatically detect the emotional valence (i.e., positive-negative) and the strength of the emotional sentiment in text-based messages. The system then matches the valence information to an emotional typeface corresponding to same valence and similar sentiment strength score and displays the original text-based message written in the emotional font to the receiver. The first prototype focused on the use of Western typefaces as emotional cues in multilingual text-based communication and was evaluated with Japanese non-native English speakers. The evaluation results suggested that the non-native speakers perceived text-based messages as more emotional when displayed with an emotional font matching to a higher emotional valence sentiment score. The details of the system design and evaluation results were published in an IEICE technical report (Yonekura et al., 2019). Figure 1 illustrates an example of emotional fonts conveying emotional valence in a text-based chat conducted in English. The research on Western typefaces is on-going where the evaluation of the fonts as cues to convey emotional valence in multilingual text-based communication is refined with both native and non-native speakers of English with a goal to implement the approach as a novel text-chat interface that reduces the negativity and neutrality effects in socio-emotional communication between native and non-native speakers of English.

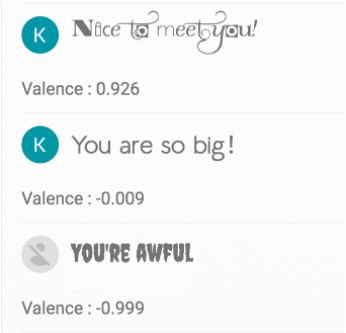

Figure 1: Emotional fonts used in text-based chat to convey emotional valence in English (Yonekura, Choi, Yoshihashi, Matsui & Hautasaari, 2019).

In order to investigate the effects of using Japanese fonts as emotional cues in text-based communication, a dataset matching Japanese typefaces with ratings for emotional valence, emotional arousal, categorical emotion and level of confidence was created. This dataset was utilized in an experiment to explore the effects of using emotional fonts as cues in decision-making tasks via text-based communication. The details of the dataset, typeface evaluations and the experiment results were disseminated in a journal paper which is under review at the time of writing.

The second iteration of the software tool development focused on the design for a method to display an abstraction of the level of emotional arousal in text-based messages. To this end, a system that uses voice-input in text chats to display sender's utterance intensity to receivers with a novel method using speech balloons as emotional cues was developed. Details of the initial system design and evaluation results were published in IPSJ INTERACTION as a Premium Track presentation (Aoki et al., 2020).

In the third iteration of the software tool, the efficacy of speech balloons used as emotional paralinguistic cues to convey emotional arousal was evaluated. The approach taken in the prototype development was to design an automated method to generate unique speech balloons with ACGAN that match and convey a message sender's level of emotional arousal to the receiver. As a first step in our system development the relationship between emotional arousal and valence, and the shape of speech balloons in Japanese manga was investigated using the Manga109 dataset developed in previous work by Aizawa and colleagues (2020). As a result, a dataset of speech balloon shapes and the associated speech text was created. In the evaluation of the dataset, it was discovered that more explosion-like speech balloon shapes were associated with speech text with higher emotional arousal levels. This dataset was then used as training data for ACGAN to realize a system that generates speech balloons to specifically convey emotional arousal in text-based messages.

The efficacy of the approach to convey emotional arousal with speech balloon shapes was first confirmed through a crowdsourcing experiment with native Japanese speakers. Then, to investigate the effects of using speech balloon shapes as paralinguistic cues in text-chats, a controlled experiment was conducted. The system was implemented as a text-chat application, EmoBalloon, which allows users to input text-based messages either with voice-input or by traditional keyboard input. The speech balloon shape to convey emotional arousal is either automatically generated based on the sender’s speaking volume (voice-input), or manually selected by the sender (keyboard input). An illustration of the system, EmoBalloon, is depicted in Figure 2.

The results suggested that speech balloon shapes are an effective method to convey emotional arousal in text-based communication, and to decrease the differences between message senders' and receivers on their perceptions regarding the level of emotional arousal conveyed in a message. This research was the first to report on the efficacy of speech balloon shapes to convey emotional arousal in text-based messages, and in particular the efficacy of speech balloon shapes as emotional cues that can be used to convey arousal without affecting the communicators' perceptions regarding the emotional valence of a message (as with emotional typefaces). The research also reported on the "negative emotional leak" that message senders may perceive when automated emotion detection is used to generate emotional paralinguistic cues in text-based communication, which informs the design of future systems to support multilingual socio-emotional communication in text-based mediums.

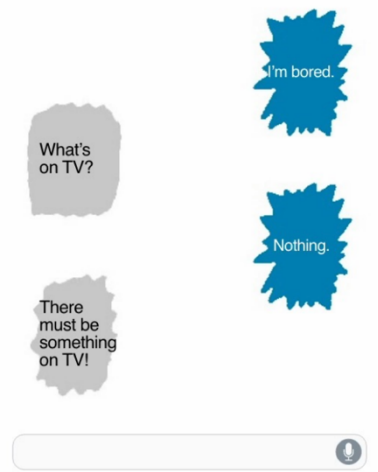

Figure 2: EmoBalloon – Emotional speech balloons convey emotional arousal in text-based communication (Aoki, Chujo, Choi, Matsui & Hautasaari, 2022).

The system evaluation and experiment results were published in the top international conference (ACM CHI'22) where the paper received the Best Paper Award (top 1%). This research also received media coverage in Japan and was featured in newspaper tech articles and television programs in 2022.

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５．主な発表論文等

〔雑誌論文〕　計3件（うち査読付論文　2件／うち国際共著　1件／うちオープンアクセス　0件）

１．著者名 Aoki Toshiki、Chujo Rintaro、Matsui Katsufumi、Choi Saemi、Ari Hautasaari	４．巻 1
２．論文標題 EmoBalloon - Conveying Emotional Arousal in Text Chats with Speech Balloons	５．発行年 2022年
３．雑誌名 Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems (CHI ' 22)	６．最初と最後の頁 article no. 527
掲載論文のDOI（デジタルオブジェクト識別子） 10.1145/3491102.3501920	査読の有無 有
オープンアクセス オープンアクセスではない、又はオープンアクセスが困難	国際共著 該当する

１．著者名 青木 俊樹，川村 慧，中條 麟太郎，Choi Saemi，松井 克文，Hautasaari Ari	４．巻 1
２．論文標題 音声入力テキストチャットにおける発話強度に基づいた吹き出し形状自動選択システムの提案	５．発行年 2020年
３．雑誌名 情報処理学会 インタラクション2020論文集	６．最初と最後の頁 607-610
掲載論文のDOI（デジタルオブジェクト識別子） なし	査読の有無 有
オープンアクセス オープンアクセスではない、又はオープンアクセスが困難	国際共著 －

１．著者名 米倉 遼太，崔 セミ，吉橋 亮太，松井 克文，ハウタサーリ アリ	４．巻 vol. 118, no. 502
２．論文標題 英語のテキストチャットにおけるメッセージの感情価に基づく自動フォント選択システムの提案	５．発行年 2019年
３．雑誌名 信学技報	６．最初と最後の頁 131-136
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〔学会発表〕　計3件（うち招待講演　0件／うち国際学会　1件）

１．発表者名 Aoki Toshiki、Chujo Rintaro、Matsui Katsufumi、Choi Saemi、Ari Hautasaari
２．発表標題 EmoBalloon - Conveying Emotional Arousal in Text Chats with Speech Balloons
３．学会等名 The 2022 CHI Conference on Human Factors in Computing Systems (CHI ' 22)（国際学会）
４．発表年 2022年

１．発表者名
青木 俊樹，川村 慧，中條 麟太郎，Choi Saemi，松井 克文，Hautasaari Ari

２．発表標題
音声入力テキストチャットにおける発話強度に基づいた吹き出し形状自動選択システムの提案

３．学会等名
情報処理学会 インタラクション2020（プレミアム発表）

４．発表年
2020年

１．発表者名
米倉 遼太

２．発表標題
英語のテキストチャットにおけるメッセージの感情価に基づく自動フォント選択システムの提案

３．学会等名
電子情報通信学会MVE研究会

４．発表年
2019年

〔図書〕　計0件

〔産業財産権〕

〔その他〕

EmoBalloon project page
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ACM CHI 2022 Best Paper Award
https://programs.sigchi.org/chi/2022/program/content/69010

６．研究組織

	氏名 （ローマ字氏名） （研究者番号）	所属研究機関・部局・職 （機関番号）	備考

７．科研費を使用して開催した国際研究集会

〔国際研究集会〕　計0件

８．本研究に関連して実施した国際共同研究の実施状況

共同研究相手国	相手方研究機関