“There Is No (Where a) *Face* Like Home”: Recognition and Appraisal Responses to Masked Facial *Dialects* of Emotion in Four Different National Cultures

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This manuscript is dedicated to beautiful little Clara Margarita Bascuñán Kausel

Abstract

The theory of universal emotions suggests that certain emotions such as fear, anger, disgust, sadness, surprise and happiness can be encountered cross-culturally. These emotions are expressed using specific facial movements that enable human communication. More recently, theoretical and empirical models have been used to propose that universal emotions could be expressed via discretely different facial movements in different cultures due to the non-convergent social evolution that takes place in different geographical areas. This has prompted the consideration that own-culture emotional faces have distinct evolutionary important sociobiological value and can be processed automatically, and without conscious awareness. In this paper, we tested this hypothesis using backward masking. We showed, in two different experiments per country of origin, to participants in Britain, Chile, New Zealand and Singapore, backward masked own and other-culture emotional faces. We assessed detection and recognition performance, and self-reports for emotionality and familiarity. We presented thorough cross-cultural experimental evidence that when using Bayesian assessment of non-parametric receiver operating characteristics and hit-versus-miss detection and recognition response analyses, masked faces showing own cultural dialects of emotion were rated higher for emotionality and familiarity compared to other-culture emotional faces and that this effect involved conscious awareness.

Introduction

Cross-cultural emotional communication is an important aspect of contemporary societal settings (Castells, 2004). In our contemporary world we are in contact with individuals from other cultures for professional collaborations and for socialization (Bochner, 2013). Cross-cultural contact has increased due to the emergence of easy-to-use technologies that allow us to meet *face-to-face* with individuals from other cultures and countries using computer software (Martin & Nakayama, 2013). It has also increased because on-line professional opportunities and, in certain cases, favourable inter-country/cultural immigration financial opportunities and social change have made our contemporary societies more plural. It is reasonable, therefore, and possibly helpful and valuable, for our professional, political, and social interactions, to consider whether we can emotionally communicate equally well with individuals from our own culture and individuals from other cultures.

Classical psychological theory and research suggest that we can because there are universals in the expression of emotion (Ekman & Friesen, 1971). These universals can – arguably (see Solomon & Stone, 2002) – be encountered in every society because they have evolutionary important expression and response, and communicational value (Ekman, 2004). These include basic emotional expressions, such as fear, anger, surprise, sadness, disgust and happiness (see also Ortony & Turner, 1990; Biehl et al., 1997). These emotions are expressed via facial movements called *Facial Action Units* (Ekman & Friesen, 1978; Essa & Pentland, 1997). These action units combine to form recognizable facial expressions of emotion that enable social interaction and communication within and between human cultures.

One perspective in the area of emotional communication is that although basic emotions could be a universal *language* of human communication, there are also culture-specific *dialects* that could – to some extent (Russell, Bachorowski & Fernández-Dols, 2003; Elfenbein, 2015)

– recognizably differentiate facial expressions and responses of emotion between different cultures (Elfenbein, Beaupre, Levesque & Hess, 2007). Researchers that support this perspective suggest that the non-convergent social evolution that takes place in different geographical areas contributes to the formulation of culture specific expressive display and decoding rules (see for example, Elfenbein & Ambady, 2003; Coan & Gottman, 2007; Matsumoto, Frank, & Hwang, 2013).

Culture-specific display and decoding rules refer to the suggested phenomenon that different cultures involve certain expectations regarding the expression and recognition of certain emotions, particularly negative emotions (Hwang & Matsumoto, 2015). These norms are suggested to be imposed to regulate and inhibit the automatic display or decoding of emotion in cases in which such display or decoding could be harmful to social harmony (Elfenbein & Ambady, 2003). This approach is underlined by the proposition of a culture-specific biological affect program. This is suggested to include specific and diverse culturally imposed inhibitory mechanisms to inappropriate facial expressions. It is also suggested to include non-imposed communication rules that occur colloquially, naturally and possibly unintendingly between members of the same cultural environment (see Elfenbein, Beaupre, Levesque & Hess, 2007).

Due to these culture-specific display and decoding rules, several researchers have proposed and empirically and meta-analytically illustrated (Elfenbein & Ambady, 2002a; 2002b) that own-culture emotional dialects of emotion are subject to an own-group emotional recognition advantage (Elfenbein, Beaupré, Lévesqueb & Hess, 2007; see also Hess, Blaison & Kafetsios, 2016). The own-group emotional recognition advantage refers to the ability to recognize emotional expressions from our own culture more accurately than emotional expressions from other cultures (Elfenbein & Ambady, 2002a). This advantage can result in higher emotional recognition rates for freely-expressed own-culture faces. This advantage – arguably (Matsumoto, 2002) – does not occur in response to instructed or mimicked emotional expressions. This is due to the suggestion that instructed portrayal of facial action units impose universally recognized patterns of expression (Ekman, 2004) that can eliminate the discrete and discernible characteristics of cultural emotional dialects (Elfenbein & Ambady, 2003).

The own-culture emotional recognition advantage has been suggested to be influenced by certain *proxies* in the relationship between actors and responders/participants. These include characteristics such as the geographical distance between cultures and the cross-cultural communicational experience of the actors and the responders (Elfenbein & Ambady, 2002b). Based on these seminal – but not uncontentious (see Hwang & Matsumoto, 2019) – arguments, researchers have proposed that own-culture emotional expressions can be processed without conscious awareness because they have culture-specific sociobiological value and high evolutionary importance. Therefore, they activate automatic and subcortical neural response pathways more potently than other-culture emotional expressions (Chiao et al., 2008; Smith, Dijksterhuis & Chaiken, 2008).

For example, Chiao and colleagues (2008) found that Japanese and Caucasian participants responded via subcortical automaticity in the right amygdaloid nucleus when exposed for one second to own-culture fearful faces. Previous research (Eberhardt, Goff, Purdie & Davies, 2004; Smith et al., 2008) has also found that own-culture and own-race faces presented either for very brief durations (e.g., 33.33 milliseconds), suppressed by separately presenting colour patterns to the dominant eye (Tong, Meng, & Blake, 2006) or rendered *invisible* using continuous flash suppression (see Yang, Zald & Blake, 2007) result in subliminal processing effects. In this context, subliminal processing effects refer to higher familiarity appraisal responses and increased positive affect related responses to imperceptible faces showing own culture dialects of emotions. These also include responses such as higher liking ratings for subsequently overtly presented own culture faces and positive words after exposure to imperceptible own-culture facial emotional dialects (see, for example, Zebrowitz, White, & Wieneke, 2008; but see also Cunningham et al., 2004).

In a previous publication we contested this notion (Tsikandilakis et al., 2019; see also Amihai, Deouell & Bentin, 2011). We created and validated a facial dataset with freely-expressed and Facial Action Units Coding System (FACS; Ekman, Friesen & Hager, 2002) instructed emotional expression using actors from Britain, Chile, New Zealand and Singapore (Tsikandilakis et al., 2019; p. 922-926; see also https://osf.io/3z97s/). We presented British participants with backward masked freely-expressed and instructed own and other-culture emotional expressions and assessed detection, emotional recognition and familiarity rating responses. We found that the own-group recognition advantage was preserved during the masking process: British participants recognized emotional expressions from British actors more accurately than expressions from actors from other cultures. We also showed that British actors were rated higher for familiarity. This effect was significant only for hits for detecting a presented face and provided Bayesian evidence for null differences for familiarity responses for misses for detection, such as false negative responses for not having seen a presented face. These findings suggested that a single *glimpse* could be sufficient to allow us to evaluate whether a face and/or emotional expression originated from our own cultural background. It also suggested that conscious perception and meta-awareness, such as reporting seeing a presented masked face during a post-trial task (see Bargh & Morsella, 2008), were involved in the appraisal of cultural dialects of emotion (see also Tsikandilakis et al., 2019).

In the current studies we presented a set of studies conducted in four international universities that tested further these outcomes. We presented own and other culture freely-expressed and instructed fearful, sad and neutral emotional expressions for 33.33 ms with backward masking to a black and white pattern for 125 ms to participants from and in Britain, Chile, New Zealand and Singapore. We followed our previous methodology for assessing responses to masked faces, such as Bayesian analysis for chance-level detection and recognition performance (Tsikandilakis & Chapman, 2018), using unbiased non-parametric receiver operating characteristics (Tsikandilakis, Chapman & Peirce, 2018; Tsikandilakis, Bali & Chapman, 2019) and analysis for hits and misses for detection (Tsikandilakis, Bali, Derrfuss & Chapman, 2020a, 2020b; Tsikandilakis, Bali, Haralabopoulos, Derrfuss & Chapman, P. 2020) and recognition responses (Haralabopoulos, Tsikandilakis, Torres & McAuley, 2020; Tsikandilakis et al., 2021a). We assessed the post-trial experience of emotionality and familiarity using self-reports in two different experimental sessions per institution with rigorously controlled non-convergent international population samples. Our exploratory hypotheses for the current studies were that FACS instructed and freely-expressed own-culture emotional faces will be detected and recognized more accurately (Elfenbein & Ambady, 2002a, 2002b), and will be rated higher for familiarity and emotionality, compared to other-culture emotional faces (Tsikandilakis et al., 2019). We also hypothesized that these effects would involve conscious awareness, such as higher familiarity and emotionality rating responses for own-culture emotional faces compared to other-culture emotional faces only for hits for meta-awareness in a post-trial signal detection engagement task.

Study One: Emotionality

Aims: The current study had two aims. The first aim was to test whether the own-culture emotional recognition advantage can be preserved under conditions of backward masking. The second aim was to test whether there would be differences in emotionality ratings between own and other cultural dialects of emotion and freely-expressed and instructed expressions, and whether these differences are due to subliminal processing.

Participants: A power calculation based on medium effect sizes (partial eta-squared = .06; f =.25) and within-subject trial repetitions (n = 480) revealed that twenty participants per culture would be required for $P_{(1-\beta)} \geq .8$ (Faul et al., 2009). A total of eighty-seven participants (forty-five females) from Britain, New Zealand, Chile, and Singapore volunteered to participate in this study in institutions in their country of origin. All participants reported normal or corrected-to-normal vision. The inclusion criteria for the current study were having been born in the country of interest, having attended primary, secondary, and higher education in the country of interest and in the language of the country of interest; having previously resided only and currently residing permanently in the country of interest; and characterising themselves as part of the culture of the country of interest (Yes/No). Participants were additionally screened with the Somatic and Psychological Health Report Questionnaire (SPHRQ; Hickie et al., 2001) and an online Alexithymia-Emotional Blindness questionnaire (Alexithymia, 2020). Data from two participants were excluded due to SPRHQ scores that indicated a possible psychiatric diagnosis. Data from one participant were excluded due to scores that indicated possible traits for alexithymia. Data from two participants were excluded due to having a joint nationality. The final sample consisted of eighty-two participants (forty-three females) with mean age 21.59 years (SD = 1.83; see Table 1).

After the initial screening processes, participants were asked to complete the Hofstede Cultural Dimensions Questionnaire (CDQ; Hofstede, 2003) and the Emotional Regulation Questionnaire (ERQ; Gross & John, 2003). All participants gave informed consent to participate in the study and for their data to be used for further research purposes. This study took place at universities in Britain, New Zealand, Chile, and Singapore. Questionnaires and instruction material were provided in the participants' native language. The experiment was approved separately by the Ethics Committee of the School or Department of Psychology or Medicine of each contributing institution.

Table 1: Demographic Characteristics and Questionnaire Comparisons for Study One

Country of Origin	n (female)	Age Mean (SD)	CDQ Mean (SD)					ERQ Mean (SD)	
			PD	IND	MAS	U-A	LTO	CR	ES
Britain	22 (10)	21.17 (1.71)	45.39 (13.75)	62.25 (14.41)	46.48 (10.92)	69.94 (17.22)	53.94* (12.13)	25.83* (5.88)	8.11* (2.31)
Chile	20 (12)	22.4 (2.7)	55.48 (8.56)	40.46* (5.54)	37.31* (5.65)	68.44 (9.31)	39.07 (8.3)	34.49 (6.15)	16.55* (4.64)
New Zealand	20 (11)	21.76 (1.78)	35.13 (7.84)	69.54 (11.41)	51.04 (11.78)	57.09* (13.51)	41.06 (6.19)	30.15 (5.61)	11.64 (2.91)
Singapore	20 (10)	21.25 (1.65)	72.66* (11.22)	25.95* (2.16)	42.67 (8.32)	20.27* (8.54)	65.67* (9.99)	33.55 (7.61)	17.75* (4.32)
Bayes Factor, ANOVA and Effect Sizes for Each Category									
B Factor (p-value)			+∞ (< .001)	+∞ (< .001)	> 3 (< .001)	+∞ (< .001)	+∞ (< .001)	> 3 (< .001)	+∞ (< .001)
η^2_p			.74	.89	.35	.84	.73	.28	.59

Table 1: This table includes participant n and age. It also includes mean and standard deviation percentiles for the Hofstede Cultural Dimensions Questionnaire (CDQ) with scores for power distance (PD), individualism (IND), masculinity (MAS), uncertainty-avoidance (U-A) and long-term orientation per country of origin (LTO; see Hofstede, 2003). It also includes scores for the emotional regulation questionnaire (ERQ) with scores for cognitive re-appraisal (CR) and emotional suppression (ES) per country of origin (see Gross & John, 2003). In the bottom part of the table, we present comparisons per country of origin using both Bayesian and ANOVA analysis. Bayesian analysis was performed using the Dienes calculator with B < .33 signifying evidence for the null, .33 < B < 3 signifying anecdotal evidence and B > 3 signifying evidence for the alternate hypothesis (Dienes, 2016). Partial eta-squared scores for every analysis are also included in the bottom row. Asterisks (*) in score columns indicate scores that are significantly different after applying Bonferroni corrections at p < 001 to all other items of the same category. See also https://osf.io/3z97s/ and https://osf.io/cdvhz/. These outcomes suggest that there were cultural differences between the different cultural groups (see Tsikandilakis et al., 2019; p. 921-922, Russell, Bachorowski & Fernández-Dols, 2003, p. 331–337).

Procedure: The stimuli were created and validated in a previous international collaboration between the current universities (see Tsikandilakis et al., 2019). The stimuli were presented on 60Hz HD monitors. The presentation was programmed in the coder and builder components of PsychoPy (Peirce, 2007). To ensure that brief stimuli were correctly presented, iPad PRO cameras with 120 Hz refresh rate (8.33 milliseconds) recorded two pilot runs in each institution . The stimuli presentation was assessed frame by frame; no instances of dropped frames were detected. A self-developed dropped frames script report with one frame (16.67 milliseconds) tolerance threshold was coded in Python and two pilot experimental diagnostic sessions were run. The presenting monitors reported no dropped frames; prognostic estimate 1/5,000 trials. Experimental studies were subsequently run using dropped frames diagnostics; no instances of dropped frames were reported.

Each experimental trial started with a fixation cross for 2 seconds (±1 second). After the fixation cross, a non-facial blur or a single freely-expressed or instructed face from Britain or New Zealand or Chile or Singapore showing a fearful or sad or neutral expression was presented at fixation for 33.33 milliseconds; order randomised. The target was immediately followed by a black and white pattern mask for 125 milliseconds. After the mask, a blank screen interval was presented for five seconds. A total of 240 masked faces, including sixty faces from each culture, thirty faces for each type of expression (freely-expressed and instructed) and twenty faces for each expression (fearful, sad and neutral), and an equal number of masked non-facial blurs were presented during the experiment (see Tsikandilakis et al., 2019; p. 6-11).

After the presentation, participants were asked to reply to three on-screen questions with order randomised using the keyboard or the mouse as they preferred. They were asked "Did you see a face? (Y/N)." After this task, we used conditional branching. If the response was "Yes," an on-screen message asked participants "What kind of emotion was the face expressing? (fear (f), sad (s), neutral (n), or other (o))." To balance the task length when using conditional branching, if the participants' response was "No," an on-screen message asked participants "What kind of emotion best describes the presentation? (fear (f), sadness (s), neutral (n), or other (o))." This task was included to disallow participants to make their choice based on shorter engagement task length criteria. Participants were asked by an on-screen message “How emotional did you experience the presentation?” (1: very unemotional to 10: very emotional). A blank screen interval was presented for five seconds before the next trial (Figure 1).

Figure 1: Experimental Sequence

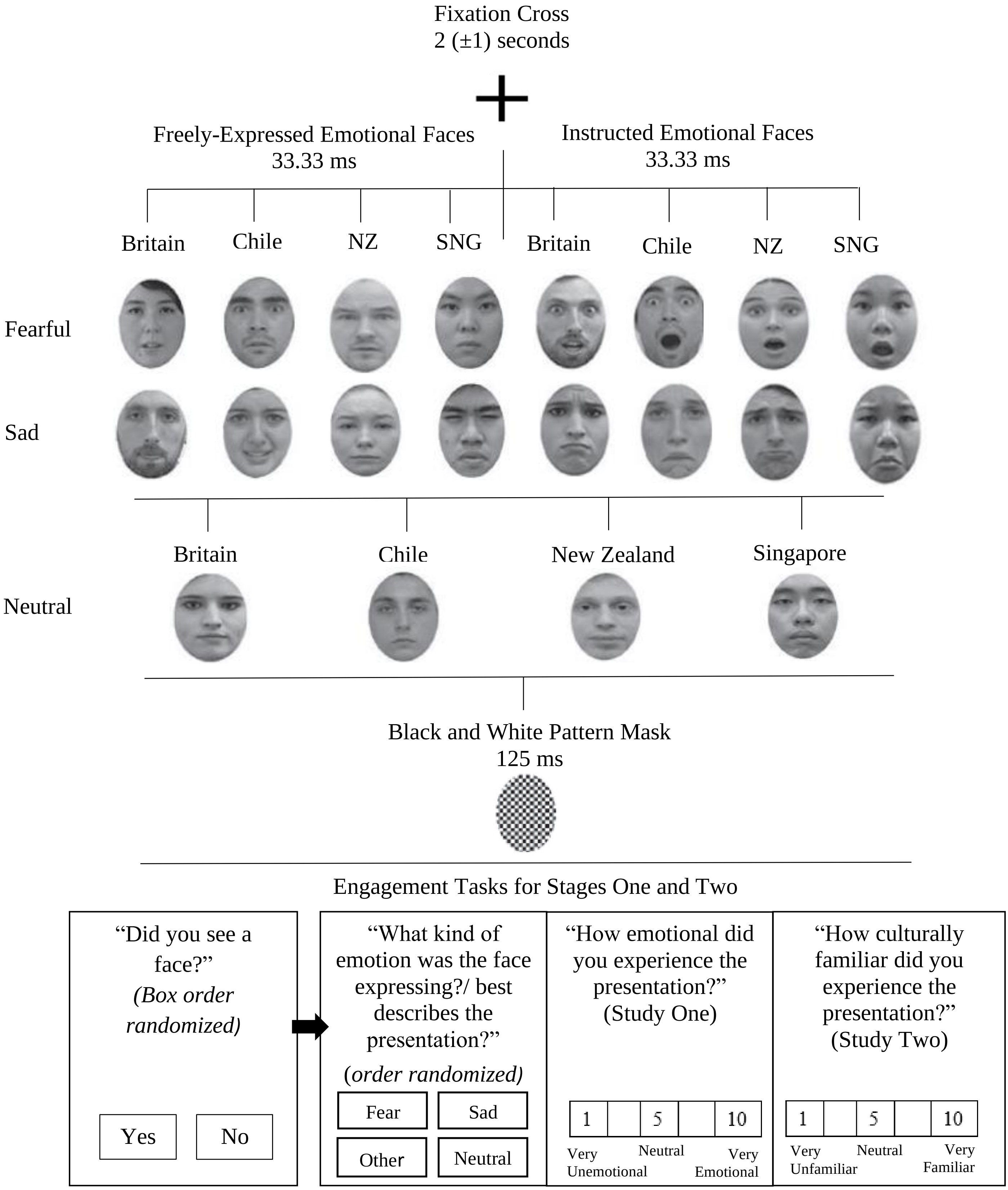

Figure 1: Example experimental sequence for studies one and two with engagement tasks for each study.

Analysis and Discussion: Detection and Recognition. We used non-parametric sensitivity index A – e.g., True Positive Rate = $\frac{\mathrm{TP}}{\mathrm{TP} + \mathrm{FN}} = 1 - \text{False Negative Rate (FNR)}$ (for a comprehensive review see Krupinski, 2017) – for the measurement of detection and recognition performance (Zhang & Mueller, 2005). This choice was based on advantages that A has compared to hit rates (Stanislaw & Todorov, 1999; p. 137-141) and sensitivity indexes d' (Macmillan & Creelman, 2004; p. 45-57), A' and A'' (Pastore et al., 2003; p. 556-559)[1].

To explore whether the own-culture advantage was cross-culturally preserved under conditions of backward masking an analysis of variance with independent variables Culture (Own and Other), Type of Expression (Instructed and Freely -Expressed) and Type of Emotion (Fear, Sadness and Neutral) was run with dependent variables detection performance (A). The analysis revealed a significant effect of Culture ($F (1, 81) = 8.83$, $p = .008$; $\eta^2_p = .317$) and a significant effect of Type of Expression ($F (1, 81) = 212.77$, $p < .001$; $\eta^2_p = .92$). Further comparisons revealed that own-culture faces ($M = .558$, $SD = .019$) were detected more accurately than other-culture faces ($M = .548$ $SD = .018$; $d = .54$). Instructed expressions of faces ($M = .569$, $SD = .013$) were detected more accurately than freely-expressed faces ($M = .537$, $SD = .019$; $d = 1.97$).

A similar pattern of findings was revealed for post-detection emotional recognition performance (A). The analysis revealed a significant effect of Culture ($F (1, 81) = 35.71$, $p <$ 001; $\eta^2_p = .65$), a significant effect of Type of Expression ($F (1, 81) = 362.21$, $p < .001$; $\eta^2_p = .95$) and a significant interaction ($F (1, 81) = 71.99$, $p < .001$; $\eta^2_p = .79$). Further comparisons

[1] Compared to hit rates, A is not susceptible to noise variance due to response strategies, such as conservative or liberal biases for signal detection (Tsikandilakis, Bali, Derrfuss & Chapman, 2019a). Compared to d', A is a nonparametric sensitivity index and does not involve any assumptions concerning the shape of the underlying distributions and their interactions (Swets, 2014; but see also Hajian-Tilaki et al., 1997). A can also provide a sensitivity index for zero values, such as zero hits or miss responses, and provides diagonal Euclidean corrections to the A' and A'' algorithms for scores that lie in the upper left quadrant of the ROC curve (see Robin et al., 2011).

revealed that own-culture faces (M = .625, SD = .021) were recognised more accurately than other-culture faces (M = .605, SD = .013; d = 1.12). Instructed expressions of faces (M = .643, SD = .018) were recognised more accurately than freely-expressed faces (M = .587, SD = .016; d = 3.29).

Bonferroni corrected comparisons revealed that instructed own-culture faces (M = .642, SD = .019) and other-culture faces (M = .643, SD = .019, p = .93; d = .05) were not recognized with different acuity and provided Bayesian evidence for similar recognition sensitivity (SE = .003, B = .04). Instructed own-culture faces were higher for recognition than freely-expressed own-culture faces (M = .613, SD = .018, $p < .001$; d = 1.57) and freely-expressed other-culture faces (M = .592, SD = .019, $p < .001$; d = 2.63). The same pattern was revealed for instructed other-culture faces compared to freely-expressed own-culture ($p < .001$; d = 1.57) and other culture faces ($p < .001$; d = 2.62). Critically, freely-expressed own-culture faces were recognised more accurately than freely-expressed other-culture faces ($p < .001$; d = 1.13).

The same pattern of results was revealed per culture. Freely-expressed own-culture expressions were detected and recognized more accurately by British (Detection: F (3, 79) = 5.08, p = .003 ; η^2_p = .19; Recognition: F (3, 79) = 32.91, $p < .001$; η^2_p = .64), Chilean (Detection: F (3, 79) = 18.85, $p < .001$; η^2_p = .49; Recognition: F (3, 79) = 31.79, $p < .001$; η^2_p = .63), New Zealand (Detection: F (3, 79) = 13.68, $p < .001$; η^2_p = .42; Recognition: F (3, 79) = 40.66, $p < .001$; η^2_p = .68) and Singaporean participants (Detection: F (3, 79) = 15.33, $p < .001$; η^2_p = .45; Recognition: F (3, 79) = 18.15, $p < .001$; η^2_p = .49). Instructed emotional expressions were not different between cultures (F (3, 79) = 1.02, p = .39 ; η^2_p = .05) and provided Bayesian evidence for similar detection (SE = .005; B = .1) and recognition performance (SE = .007; B = .2). Post-hoc comparisons per culture can be seen in Table 2. No effects of gender were found. These findings suggest that the own-culture advantage was preserved for freely-expressed emotional dialects for the detection and recognition of faces under conditions of backward masking for all the assessed cultural groups (see Table 2).

Table 2: Detection, Recognition (A) and Post-Hoc Comparisons per Culture

A. Means and Standard Deviations per Culture

		BRT		CHL		NZ		SNG	
		FE	INS	FE	INS	FE	INS	FE	INS
BRT	DTC	.552 (.024)	.564 (.022)	.53 (.021)	.577 (.03)	.536 (.019)	.581 (.031)	.527 (.023)	.569 (.032)
	RCG	.621 (.026)	.658 (.037)	.576 (.023)	.654 (.037)	.571 (.02)	.667 (.033)	.549 (.023)	.665 (.043)
CHL	DTC	.524 (.017)	.579 (.031)	.563 (.019)	.564 (.025)	.53 (.019)	.54 (.019)	.526 (.017)	.531 (.021)
	RCG	.579 (.019)	.661 (.033)	.574 (.025)	.596 (.24)	.563 (.021)	.585 (.023)	.523 (.015)	.546 (.025)
NZ	DTC	.519 (.024)	.533 (.025)	.519 (.016)	.523 (.018)	.55 (.026)	.56 (.029)	.522 (.02)	.53 (.026)
	RCG	.576 (.028)	.591 (.029)	.587 (.022)	.599 (.027)	.625 (.025)	.636 (.032)	.545 (.015)	.57 (.018)
SNG	DTC	.53 (.023)	.54 (.023)	.539 (.023)	.539 (.022)	.512 (.013)	.523 (.013)	.552 (.017)	.554 (.021)
	RCG .	.573 (.019)	.588 (.027)	.575 (.022)	.592 (.026)	.575 (.025)	.591 (.029)	.611 (.017)	.616 (.022)

B. Bonferroni Corrected Comparisons and Effect Size Cohen's d per Culture

			BRT		CHL		NZ		SNG	
			FE	INS	FE	INS	FE	INS	FE	INS
BRT	DTC	FE		.13 (-.52)	.01 (.98)	.01 (- .92)	.04 (.74)	.001 (- 1.46)	.001 (1.06)	.06 (- .6)
		INS			.001 (1.58)	.07 (- .49)	.001 (1.36)	.05 (- .63)	.001 (1.64)	.49 (- .18)
	RCG	FE		.001 (-1.16)	.001 (1.83)	.001 (- 1.03)	.001 (2.72)	.001 (- 1.55)	.001 (2.93)	.001 (- 1.24)
		INS			.001 (2.66)	.72 (.11)	.001 (2.93)	.32 (- .25)	.001 (3.54)	.54 (- .17)
CHL	DTC	FE	.001 (2.16)	.05 (- .62)		.64 (- .04)	.001 (1.74)	.01 (1.2)	.001 (2.05)	.001 (1.59)
		INS	.001 (1.87)	.11 (- .53)			.001 (1.53)	.01 (1.08)	.001 (1.78)	.001 (1.43)
	RCG	FE	.45 (-.26)	.001 (- 3.23)		.001 (- 1.02)	.19 (. 54)	.16 (- .52)	.001 (2.97)	.001 (1.26)
		INS	.02 (.71)	.001 (- 2.25)			.001 (1.46)	.24 (.47)	.001 (3.65)	.001 (2.64)
NZ	DTC	FE	.001 (1.24)	.01 (.67)	.001 (1.44)	.001 (1.21)		.31 (- .36)	.001 (1.21)	.01 (.77)
		INS	.01 (1.53)	.01 (.99)	.01 (1.75)	.01 (1.53)			.001 (1.53)	.01 (1.09)
	RCG	FE	.001 (2.04)	.001 (1.26)	.001 (1.61)	.01 (.99)		.01 (- .38)	.001 (3.88)	.001 (2.52)
		INS	.001 (1.99)	.001 (1.47)	.001 (1.78)	.001 (1.25)			.001 (3.64)	.001 (2.54)
SNG	DTC	FE	.01 (.96)	.07 (.52)	.04 (.57)	.05 (.57)	.001 (2.14)	.001 (1.55)		.55 (- .09)
		INS	.001 (1.09)	.02 (.63)	.05 (.68)	.05 (.69)	.001 (2.4)	.001 (1.78)		
	RCG	FE	.001 (2.11)	.01 (1.02)	.001 (1.83)	.01 (.87)	.001 (1.68)	.01 (1.17)		.16 (- .25)
		INS	.001 (2.09)	.001 (1.14)	.001 (1.86)	.01 (.99)	.001 (1.74)	.01 (.97)		

Table 2: Detection (DTC) and recognition (RCG) performance for British (BRT). Chilean (CHL), New Zealand (NZ) and Singaporean (SNG) participants for freely-expressed (FE) and Instructed (INS) expressions. In A. means and standard deviations in B. Bonferroni corrected p-values and effect size Cohen's d for comparisons for each culture. Alpha values of .001 signify $p \leq .001$. Alpha values of .01 signify $.01 \geq p \geq .001$ (see American Psychological Association, 2016; p. 47-53).

Analysis and Discussion: Emotionality. To explore whether there were differences in emotionality ratings – under conditions of backward masking – between different emotional dialects and for freely-expressed and instructed emotional faces an analysis of variance with independent variables Culture (Own and Other), Type of Expression (Instructed and Freely-Expressed) and Type of Emotion (Fear, Sadness and Neutral) was run with dependent variables emotionality ratings. The analysis revealed a significant effect of Culture ($F (1, 81) = 251.63$, $p < .001$; $\eta^2_p = .93$), a significant effect of Type of Expression ($F (1, 81) = 411.6$, $p < .001$; $\eta^2_p = .96$) and a significant effect of Type of Emotion ($F (2, 80) = 10.56$, $p = .004$; $\eta^2_p = .96$). Significant interactions were also revealed between Culture and Type of Expression ($F (1, 81) = 85.58$, $p < .001$; $\eta^2_p = .82$) and Culture and Type of Emotion $(2, 80) = 6.49$. $p = .02$; $\eta^2_p = .26$). Further comparisons revealed that own-culture faces (M = 6.06, SD = .32) were rated as more emotional compared to other-culture faces (M = 5.53, SD = .15; d = 3.72). Instructed expressions of faces (M = 6.33, SD = .25) were rated as more emotional than freely-expressed faces (M = 5.26, SD = .26; d = 4.19). Bonferroni corrected comparisons revealed a trend for fearful faces (M = 5.86, SD = .24) being rated as more emotional than sad faces (M = 5.73, SD = .23, $p = .04$; d = .55). Fearful faces were rated as more emotional than neutral faces (M = 4.73, SD = .21, $p < .001$; d = 5.01). Sad faces were rated as more emotional than neutral faces ($p < .001$; d = 4.54). Critically freely-expressed own-culture emotional expressions (M = 5.68, SD = .19) were rated as more emotional than freely-expressed other-culture emotional expressions (M = 4.78, SD = .08, $p < .001$; d = 6.17). Instructed own-culture expressions (M = 6.35, SD = .24) were not significantly different compared to instructed other-culture emotional expressions (M = 6.29, SD = 13, $p = .32$; d = .3) and provided Bayesian evidence for similar emotionality ratings (SE = .03; B = .28; see also Figure 2).

Freely-expressed own-culture faces were rated as more emotional by British (F (3, 79) = 254.53 $p < .001$; $\eta^2_p = .92$), Chilean (F (3, 79) = 155.96, $p < .001$; $\eta^2_p = .89$), New Zealand (F (3, 79) = 198.22, $p < .001$; $\eta^2_p = .91$) and Singaporean participants (F (3, 79) = 54.75, $p < .001$; $\eta^2_p = .74$). Instructed emotional expressions were not different between cultures (F (3, 79) = .296, $p = .83$; $\eta^2_p = .01$) and provided Bayesian evidence for similar emotional ratings (SE = .12; B = .1). See Figure 2. No effects of gender were found. These findings suggest that own-culture freely-expressed dialects of emotion were rated as more emotional under conditions of backward masking overall and for all the assessed cultural groups (see Figure 2).

Figure 2: Emotionality Ratings per Culture

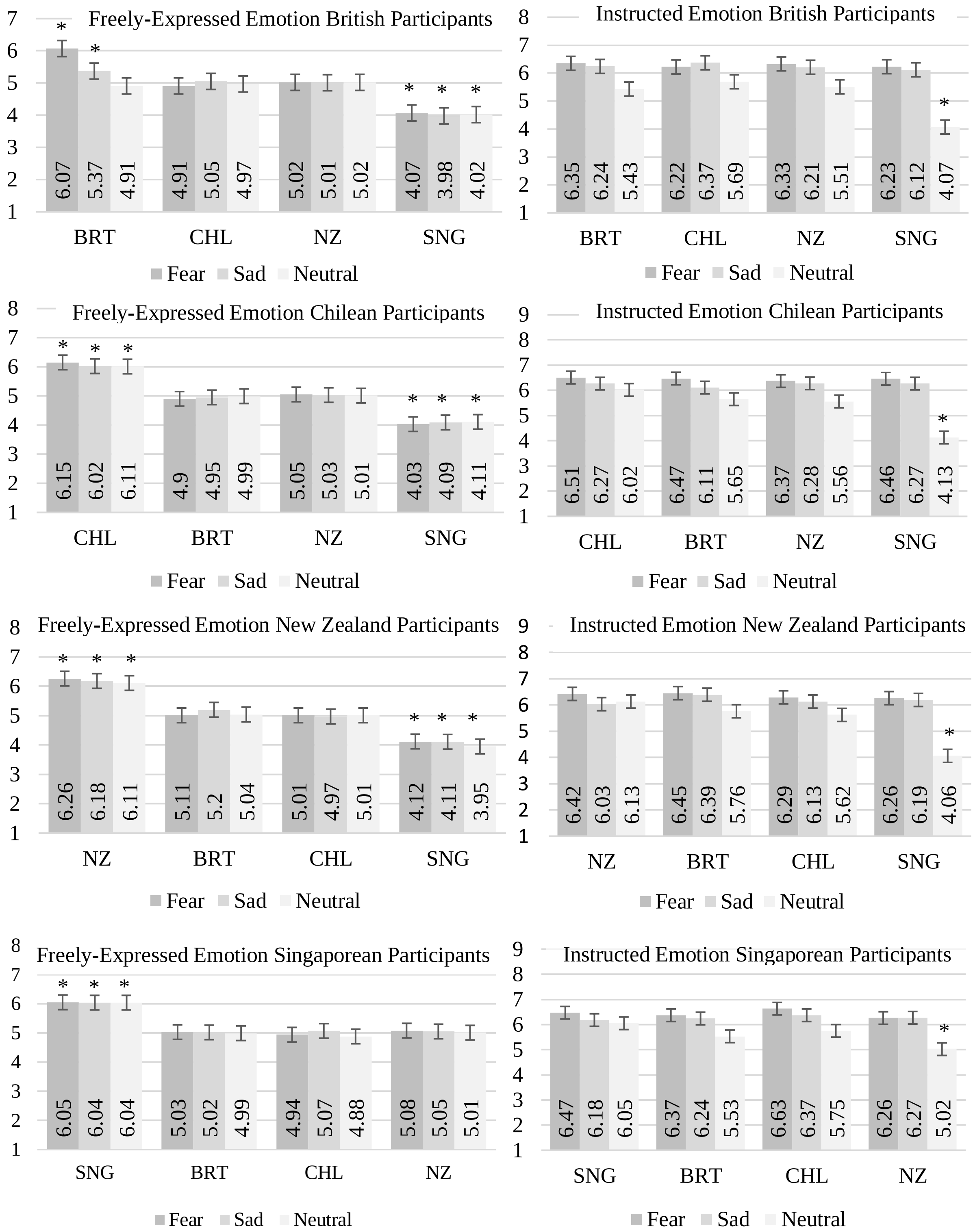

Figure 2: Emotionality ratings for instructed and freely-expressed own and other cultural dialects of emotion for study one. Bars indicate ±2 standard errors of the mean. Asterisk (*) signifies Bonferroni corrected statistically significant differences at $p \leq .001$ (see https://osf.io/3z97s/ and https://osf.io/cdvhz/).

Analysis and Discussion. Subliminality. Part One. We wanted to explore whether the differences in emotionality rating for own and other culture emotional expressions were due to subliminal processing. The contemporary canon for subliminality is that participants should detect (Brooks et al., 2012) or recognize (Pessoa et al., 2005) the presented faces at chance to report subliminal presentation (Tsikandilakis, Bali, Derrfuss & Chapman, 2019; p. 6-8; Erdelyi, 2004; p. 74). Previous research has used a one-sample t-test methodology for inferring this criterion. According to this statistical approach the reported detection or recognition performance is compared to absolute chance (e.g., A = .5). In case of non-significant findings, the researchers claim that the reported detection or recognition performance were not significantly different to chance and, therefore, that this was evidence for unconscious processing. The problem with this approach is that not significantly different to chance – lack of evidence for the alternate hypothesis – is interpreted as evidence for the null (see Dienes, 2014). In the current section, we present the results of this method. We also present results using Bayesian analysis. Bayesian analysis can be used to define the lower and upper bounds for chance-level performance (e.g., Lower Bound A = .45 and Higher Bound A = .55) and provide a calculation for a Bayes factor that would indicate at B < .33 evidence for the null hypothesis, meaning that detection or recognition performance were within a-priori criteria for subliminality (see also, Dienes, 2019).

To explore if detection performance was at-chance (A = .5) one-sample t-test analyses and uniform Bayesian analyses, uncorrected for degrees of freedom (n ≥ 30; Berry, 1996), with lower bounds set at -.5 (A = .45) and higher bounds set at .5 (A = .55) with 0 (A = .5) representing chance-level performance (Zhang & Mueller, 2005) were run for freely-expressed and instructed own-culture and other-culture signal detection receiver operating characteristics. Freely-expressed own-culture faces (M = .543, SD = .21) were not processed at-chance (t (1,

81) = 11.37, $p < .001$; SE = .004; B = +∞). The same effects were revealed for freely-expressed other culture faces (t (1, 81) = 15.56, $p < .001$; M = .529, SD = .14, SE = .003; B = +∞), instructed own-culture faces (t (1, 81) = 18.25, $p < .001$; M = .571, SD = .19, SE = 004; B = +∞) and instructed other culture faces (t (1, 81) = 22.13, $p < .001$; M = .566, SD = .012, SE = .003; B = +∞). A similar pattern of results was revealed for recognition performance (chance-level criterion corrected for multiple choices at A = .25; Tsikandilakis et al., 2019; p. 14-17) for freely-expressed own culture (t (1, 81) = 27.71, $p < .001$; M = .613 , SD = .018, SE = .003; B = +∞), freely-expressed other culture (t (1, 81) = 25.51, $p < .001$; M = .592, SD = .019, SE = .004; B = +∞) and instructed own (t (1, 81) = 30.98, $p < .001$; M = .642, SD = .019, SE = .004; B = +∞) and other culture faces (t (1, 81) = 31.46, $p < .001$; M = .643, SD = .019 , SE = .004; B = +∞; see also Figure 3). These results suggest that using both Frequentist and Bayesian analyses of receiver operating characteristics (see Pessoa et al., 2005), detection and recognition performance did not provide evidence for subliminal presentation (see Figure 3).

Figure 3: ROC Curves per Culture

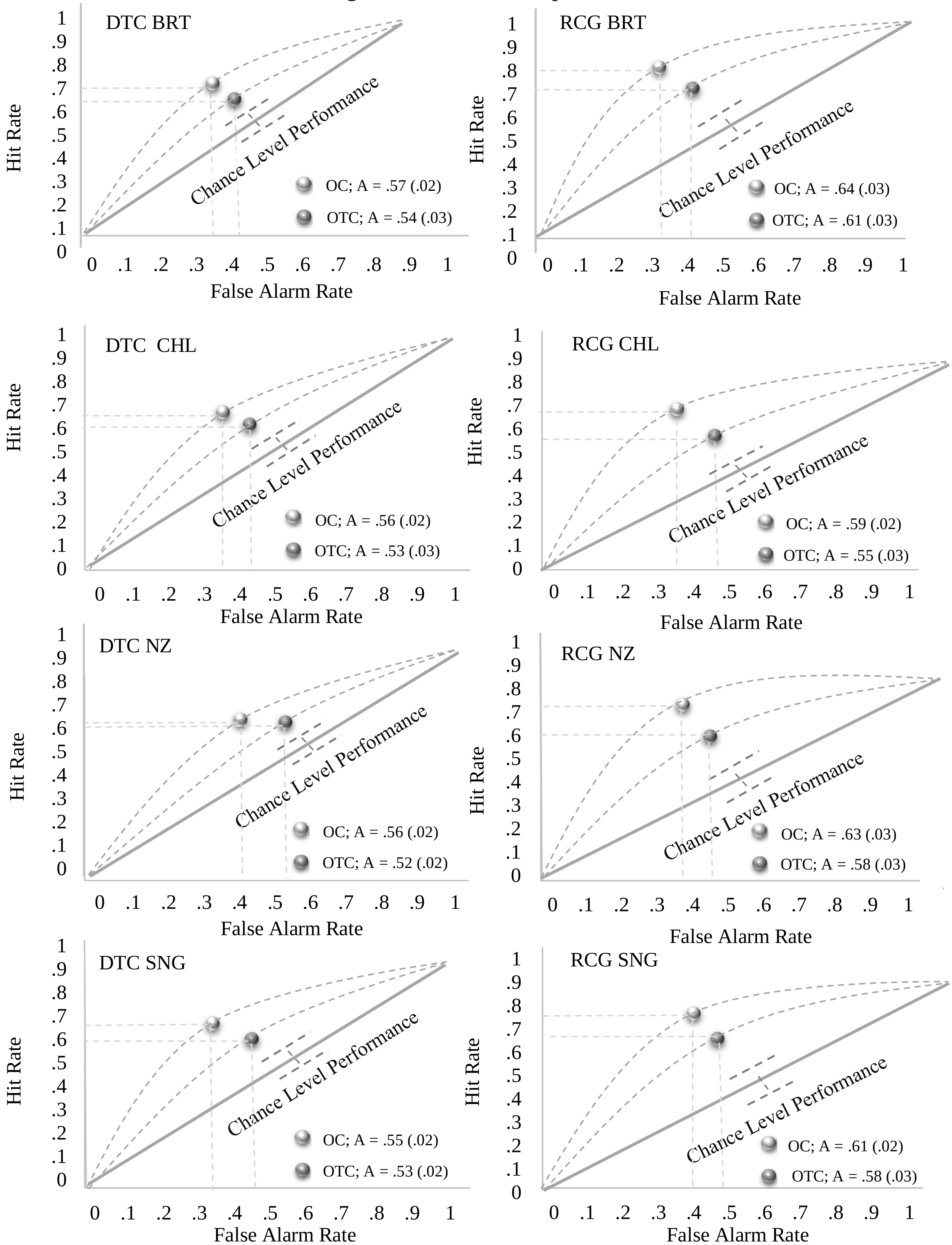

Figure 3: Detection (DTC; A = .5) and recognition (RCG; A = .25) for own (OC) and other-culture (OTC) expressions Bold interspersed mid-lines show Bayesian C.I.'s (see Dienes, 2019).

Analysis and Discussion. Subliminality. Part Two. To further explore whether the differences in emotionality rating for own and other culture emotional expressions were due to subliminal processing, we ran an analysis of hits (correct) and miss (erroneous) responses for detection and recognition of a presented face (see Tsikandilakis et al., 2019; pp 14-16). An analysis of variance with independent variables Detection Response (Hit and Miss), Culture (Own and Other), Type of Expression (Instructed and Freely-Expressed) and Type of Emotion (Fear, Sadness and Neutral) was run with dependent variable emotionality ratings. The analysis revealed that there was evidence for highly significant (F (1, 81) = 2642.17, p < .001; $\eta^2_p = .99$) emotionality rating differences between hit (M = 5.61, SD = .21) and miss (M = 4.67, SD = .19; d = 4.69) responses. Significant effects were also revealed for Culture (F (1, 81) = 5271.96, p < .001; $\eta^2_p = .99$) and Type of Expression (F (1, 81) = 714.13, p < .001; $\eta^2_p = .97$), and a significant interaction of Detection Performance to Culture to Type of Expression (F (1, 81) = 50.21, p < .001; $\eta^2_p = .73$) was revealed. Critically, hit responses were different for own (M = 6.21, SD = .13) compared to other-culture (M = 5.02, SD = .12, p < .001; d = 9.51) emotional expressions. Miss responses were not different for emotionality ratings between own (M = 4.88, SD = .22) and other (M = 4.85, SD = .24, p = .51; d = .13) emotional expressions and provided Bayesian evidence for similar and baseline responses (SE = .016; B = .08). These results suggest that detection of a presented face was a necessary condition for higher emotionality ratings to own-culture dialects of emotion (see Figure 4).

A partially different pattern of results was revealed for recognition performance. The analysis again revealed highly significant emotionality rating differences (F (1, 81) = 4136.44, p < .001; $\eta^2_p = .99$) between hit (M = 6.23, SD = .16) and miss (M = 5.27, SD = .15; d = 6.19) recognition responses. Highly significant effects were revealed for Culture (F (1, 81) = 4517.62, p < .001; $\eta^2_p = .99$) and Type of Expression (F (1, 81) = 714.13, p < .001; $\eta^2_p = .97$), and a significant interaction of Recognition Performance to Culture to Type of Expression (F (1, 81) = 933.29, $p < .001$; $\eta^2_p = .98$) was revealed. Recognition hit responses were different for own (M = 6.79, SD = .17) compared to other culture (M = 5.67, SD = .18, $p < .001$; d = 6.39) emotional expressions. In these data, nevertheless, recognition miss responses were also different for emotionality ratings between own (M = 5.81, SD = .19) and other (M = 4.74, SD = .18, $p < .001$; d = 5.78) emotional expressions. A Bayesian analysis confirmed the effect (SE = .014; B = +∞). These results suggest that recognition of the emotion shown by a presented face increased emotionality but was not a necessary condition for higher emotionality ratings in response to own-culture dialects of emotion (see Figure 4).

Figure 4: Emotionality Hits and Miss Responses Study One

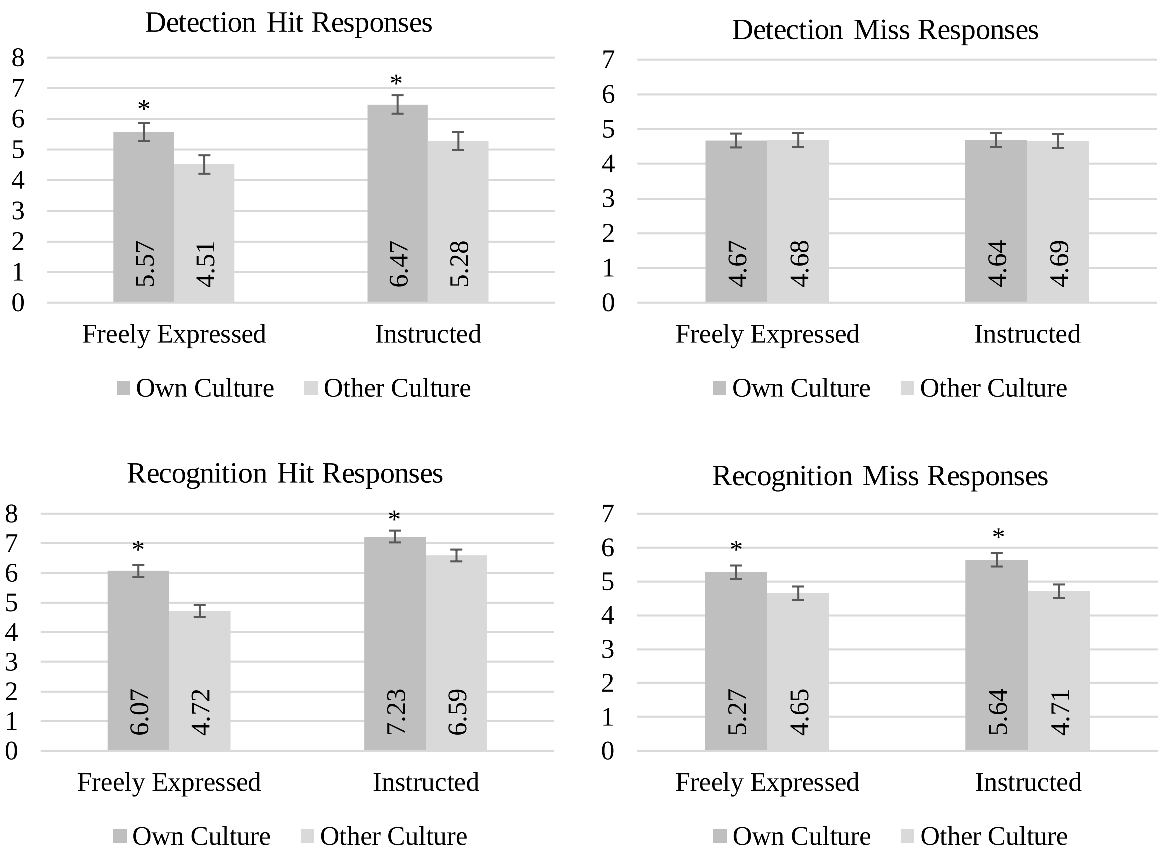

Figure 4: Emotionality ratings for hit and miss responses for detection and recognition performance for instructed and freely-expressed own and other cultural dialects of emotion. Bars indicate ±2 standard errors of the mean. Asterisk (*) signifies Bonferroni corrected statistically significant differences at $p \leq .001$ (see https://osf.io/3z97s/ and https://osf.io/cdvhz/).

The same pattern of results was revealed per culture. For British participants, the analysis revealed that there was evidence for highly significant higher familiarity rating for own compared to other culture faces for hits for detection responses ($F(3, 79) = 1412.25$, $p < .001$; $\eta^2_p = .99$). The same effect was revealed for recognition responses ($F(3, 79) = 1949.05$, $p < .001$; $\eta^2_p = .99$). Chilean participants also responded with higher emotionality ratings for hits for detection ($F(3, 79) = 614.99$, $p < .001$; $\eta^2_p = .97$) and recognition performance for own-culture emotional faces ($F(3, 79) = 2821.77$, $p < .001$; $\eta^2_p = .99$). Participants from New Zealand provided a similar pattern for results for detection ($F(3, 79) = 1169.99$, $p < .001$; $\eta^2_p = .99$) and recognition ($F(3, 79) = 2798.26$, $p < .001$; $\eta^2_p = .99$). Finally, participants from Singapore also provided a similar pattern for hit responses for detection ($F(3, 79) = 1009.5$, $p < .001$; $\eta^2_p = .98$) and recognition ($F(3, 79) = 1690.12$, $p < .001$; $\eta^2_p = .99$). Critically, for participants from Britain (SE = .03; B = .15), Chile (SE = .029; B = .16), New Zealand (SE = .018; B = .27) and Singapore (SE = .31; B = .14) miss responses for detection performance provided Bayesian evidence for similar and baseline ratings between own and other cultural faces (see Figure 5). These results suggest that detection of a presented face was a necessary condition for higher emotionality ratings to own-culture dialects of emotion for each included culture.

Figure 5: Emotionality Hits and Miss Responses for Each culture for Study One

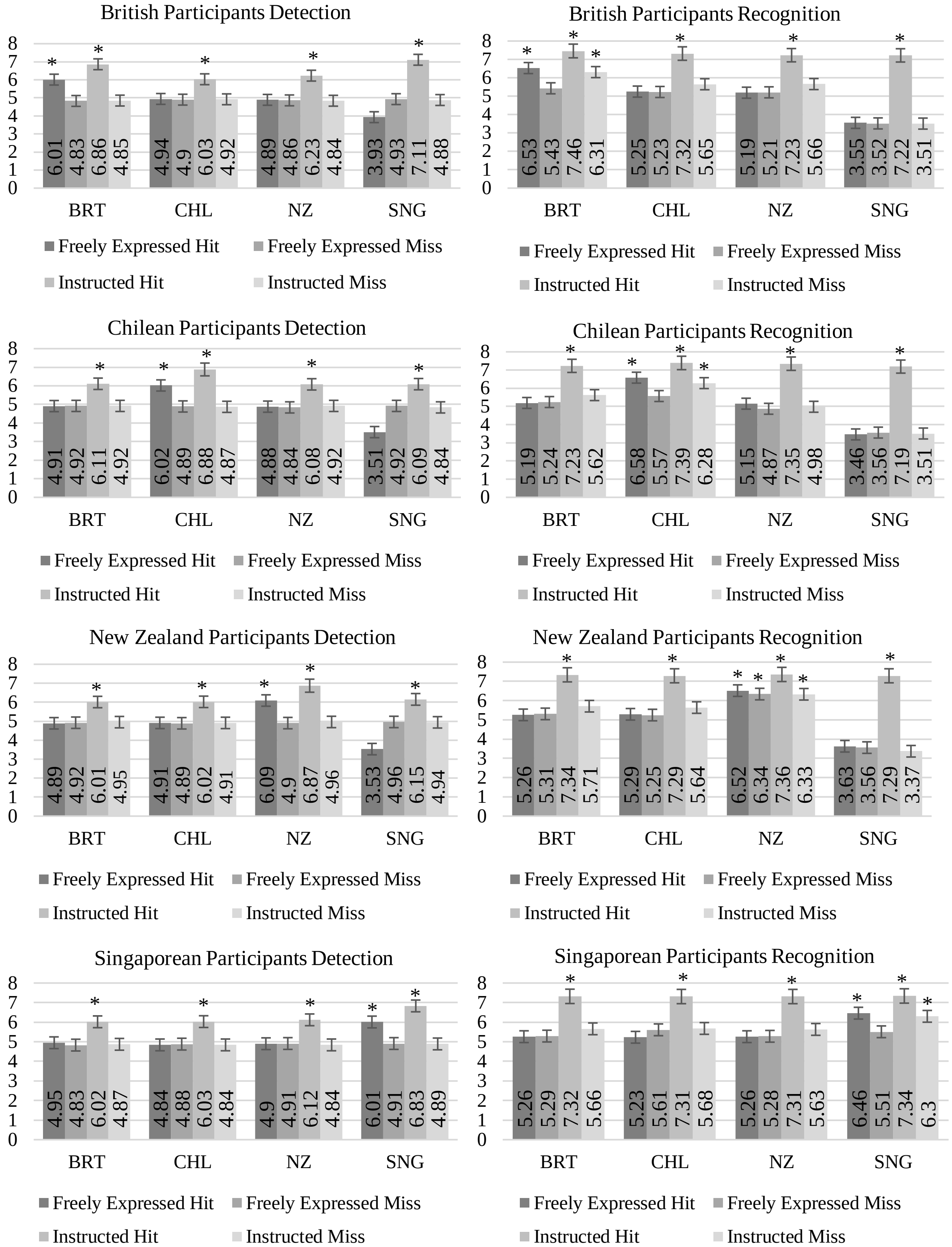

Figure 5: Emotionality ratings for hit and miss responses for detection and recognition performance for instructed and freely-expressed own and other cultural dialects of emotion. Bars indicate ±2 standard errors of the mean. Asterisk (*) signifies Bonferroni corrected statistically significant differences at p ≤ .001.

Study Two: Familiarity

Aims: The current study had two aims. The first aim was to test whether the own-culture emotional detection and recognition advantage can be replicated in this study. The second aim was to test whether there would be differences in familiarity ratings between own and other cultural dialects of emotion and freely-expressed and instructed expressions and whether these differences are due to subliminal processing.

Participants: A power calculation revealed that twenty participants per culture would be required for $P_{(1-\beta)} \geq .8$ (Faul et al., 2009). Ninety-four participants (forty-eight females) from Britain, Chile, New Zealand and Singapore who were not part of study one volunteered to participate in this study in institutions of their country of origin. All participants reported normal or corrected-to-normal vision. The inclusion criteria were the same as study one. Participants were screened with the same assessments as study one. Data from a single participant were excluded due to SPHRQ scores that indicated a possible psychiatric diagnosis. The final sample consisted of ninety-three participants (forty-eight females) with overall mean age 21.25 years (SD = 1.93; see Table 3).

All participants gave informed consent to participate in the study and for their data to be used for further research purposes. This study took place at universities in Britain, New Zealand, Chile, and Singapore. Questionnaires and instruction material were provided in the participants' native language. The experiment was approved separately by the Ethics Committee of the School or Department of Psychology or Medicine of each contributing institution.

Table 3: Demographic Characteristics and Questionnaire Comparisons for Study Two

Country of Origin	n (female)	Age Mean (SD)	CDQ Mean (SD)					ERQ Mean (SD)	
			PD	IND	MAS	U-A	LTO	CR	ES
Britain	23 (10)	21.51 (1.96)	49.31 (9.69)	66.09 (12.81)	45.78 (8.64)	66.84 (12.57)	55.9* (11.49)	26.05 (7.32)	11.26 (2.49)
Chile	21 (9)	22.41 (2.63)	55.59* (8.07)	46.09* (13.19)	41.99 (11.89)	61.51 (11.77)	42.36 (12.17)	30.26 (5.11)	17.22* (4.05)
New Zealand	23 (12)	22.03 (1.92)	36.83 (7.84)	66.95 (8.94)	56.59* (11.32)	58.01* (12.34)	40.85 (8.99)	34.84 (8.76)	11.57 (4.09)
Singapore	26 (17)	20.19 (1.55)	78.54* (9.03)	24.88* (2.25)	45.46 (11.88)	20.01* (6.07)	66.34* (6.64)	32.53 (5.53)	18.25* (4.05)
Bayes Factor, ANOVA and Effect Sizes for Each Category									
B Factor (p-value)			+∞ (< .001)	+∞ (< .001)	> 3 (< .001)	+∞ (< .001)	+∞ (< .001)	> 3 (< .001)	+∞ (< .001)
η^2_p			.75	.79	.23	.84	.61	.21	.45

Table 3: Between cultures demographics and comparisons for study two. See also https://osf.io/3z97s/ and https://osf.io/cdvhz/.

Procedure: The same stimuli, equipment, programming methods and dropped frames controls were used as in study one. No instances of dropped frames were reported. The experimental sequence was the same as in study one with a single difference. Each trial started with a fixation cross for 2 seconds (±1 second). After the fixation cross, a non-facial blur or a single freely-expressed or instructed face from Britain or Chile or New Zealand or Singapore showing a fearful or sad or neutral expression was presented at fixation for 33.33 milliseconds; order randomised. The target was immediately followed by a black and white pattern mask for 125 milliseconds. After the mask, a blank screen interval was presented for five seconds. After the presentation, participants were asked to reply to three on-screen questions with order randomised. They were asked “Did you see a face? (Y/N).” After this task, we used conditional branching. If the response was “Yes,” an on-screen message asked participants “What kind of emotion was the face expressing? (fear (f), sad (s), neutral (n), or other (o)).” If the participants’ response was “No,” an on-screen message asked participants “What kind of emotion best describes the presentation? (fear (f), sadness (s), neutral (n), or other (o)).” Participants were asked by an on-screen message “How culturally familiar did you experience the presentation?” (1: very unfamiliar to 10: very familiar). A blank screen interval was presented for five seconds before the next trial.

Analysis and Discussion: Detection and Recognition. To explore whether the own-culture advantage was cross-culturally preserved under conditions of backward masking an analysis of variance with independent variables Culture (Own and Other), Type of Expression (Instructed and Freely-Expressed) and Type of Emotion (Fear, Sadness and Neutral) was run with dependent variables detection performance. The analysis revealed a significant effect of Culture (F (1, 92) = 5.9, p = .02; $\eta^2_p = .23$) and a significant effect of Type of Expression (F (1, 92) = 43.84, p < .001 ; $\eta^2_p = .67$). Further comparisons revealed that own-culture faces (M = .589, SD = .017) were detected more accurately than other-culture faces (M = .572, SD = .012; d = 1.16). Instructed expressions of faces (M = .608, SD = .024) were detected more accurately than freely-expressed faces (M = .553, SD = .014; d = 2.79).

A similar pattern of findings was revealed for recognition performance. The analysis revealed a significant effect of Culture (F (1, 92) = 17.11, p < 001; $\eta^2_p = .44$), a significant effect of Type of Expression (F (1, 92) = 112.8 p < .001 ; $\eta^2_p = .84$) and a significant interaction (F (1, 92) = 84.47, p < .001 ; $\eta^2_p = .79$). Further comparisons revealed that own-culture faces (M = .611, SD = .012) were recognised more accurately than other-culture faces (M = .601, SD = .011; d = .89). Instructed expressions of faces (M = .62, SD = .013) were recognised more accurately than freely-expressed faces (M = .592, SD = .012; d = 1.67).

Bonferroni corrected comparisons revealed that instructed own-culture faces (M = .621, SD = .013) and other-culture faces (M = .624. SD = .012, p = .69; d = .2) were not recognized differently and provided Bayesian evidence for similar recognition sensitivity (SE = .003, B =

.06). Instructed own-culture faces were higher for recognition than freely-expressed own-culture faces (M = .611, SD = .013, $p < .01$; d = .79) and freely-expressed other-culture faces (M = .575, SD = .012, $p < .001$; d = 3.68). The same pattern was revealed for instructed other-culture faces compared to freely-expressed own-culture ($p < .001$; d = 1.04) and other culture faces ($p < .001$; d = 3.92). Critically, freely-expressed own-culture faces were recognised more accurately than freely-expressed other-culture faces ($p < .001$; d = 2.88).

The same pattern of results was revealed per culture. Freely-expressed own-culture expressions were detected and recognized more accurately by British (Detection: $F (3, 90) = 16.47$, $p < .001$; $\eta^2_p = .43$; Recognition: $F (3, 90) = 37.03$, $p < .001$; $\eta^2_p = .63$), Chilean (Detection: $F (3, 90) = 16.22$, $p < .001$; $\eta^2_p = .45$; Recognition: $F (3, 90) = 21.2$, $p < .001$; $\eta^2_p = .52$), New Zealand (Detection: $F (3, 66) = 35.48$, $p < .001$; $\eta^2_p = .62$; Recognition: $F (3, 90) = 12.91$, $p < .001$; $\eta^2_p = .37$) and Singaporean participants (Detection: $F (3, 90) = 27.31$, $p < .001$; $\eta^2_p = .52$; Recognition: $F (3, 90) = 33.59$, $p < .001$; $\eta^2_p = .57$). Instructed emotional expressions were not different between cultures ($F (3, 90) = .41$, $p = .75$; $\eta^2_p = .02$) and provided Bayesian evidence for similar detection (SE = .005; B = .03) and recognition performance (SE = .006; B = .08). Post-hoc comparisons per culture can be seen in Table 4. No effects of gender were found. These findings suggest that the own-culture advantage was replicated and preserved for freely-expressed emotional dialects for the detection and recognition of faces under conditions of backward masking for all the assessed cultural groups in study two (see Table 4).

Table 4: Detection, Recognition (A) and Post-Hoc Comparisons per Culture for Study Two

A. Means and Standard Deviations

		BRT		CHL		NZ		SNG	
		FE	INS	FE	INS	FE	INS	FE	INS
BRT	DTC	.549 (.012)	.575 (.021)	.521 (.032)	543 (.034)	.532 (.031)	.538 (.027)	.529 (.025)	.549 (.029)
	RCG	.622 (.021)	.653 (.028)	.545 (.033)	.644 (.025)	.541 (.029)	.648 (.028)	.549 (.023)	.651 (.056)
CHL	DTC	.522 (.028)	.531 (.025)	.551 (.016)	.561 (.018)	.53 (.019)	.54 (.019)	.541 (.019)	.546 (.028)
	RCG	.553 (.039)	.664 (.029)	.612 (.023)	.642 (.25)	.551 (.024)	.651 (.026)	.551 (.024)	.649 (.052)
NZ	DTC	.52 (.034)	.533 (.019)	.521 (.024)	.535 (.027)	.596 (.015)	.562 (.034)	.525 (.028)	.542 (.012)
	RCG	.556 (.031)	.649 (.026)	.546 (.025)	.634 (.027)	.629 (.032)	.631 (.031)	.543 (.028)	.642 (.045)
SNG	DTC	.523 (.027)	.535 (.028)	.518 (.029)	.537 (.019)	.536 (.031)	.532 (.023)	.54 (.015)	.556 (.033)
	RCG.	.549 (.026)	.651 (.024)	.543 (.032)	.633 (.02)	.546 (.033)	.656 (.027)	.631 (.027)	.638 (.019)

B. Bonferroni Corrected Comparisons and Effect Size Cohen's d

			BRT		CHL		NZ		SNG	
			FE	INS	FE	INS	FE	INS	FE	INS
BRT	DTC	FE		.001 (- 1.55)	.001 (1.16)	.29 (.023)	.022 (.72)	.04 (.57)	.04 (.56)	.94 (.01)
		INS			.001 (1.99)	.01 (1.13)	.001 (1.63)	.001 (1.53)	.001 (1.99)	.01 (1.03)
	RCG	FE		.001 (-1.25)	.001 (2.78)	.01 (- 95)	.001 (3.19)	.01 (- 1.05)	.001 (3.31)	.032 (-.68)
		INS			.001 (3.53)	.36 (.33)	.001 (3.93)	.57 (.17)	.001 (4.06)	.89 (.02)
CHL	DTC	FE	.001 (1.27)	.01 (.92)		.04 (- .58)	.001 (1.19)	.032 (.62)	.031 (.57)	.25 (.22)
		INS	.001 (1.66)	.001 (1.38)			.001 (1.64)	.01 (1.13)	.01 (1.08)	.03 (.64)
	RCG	FE	.001 (1.84)	.001 (- 1.99)		.001 (- 1.25)	.001 (2.59)	.001 (- 1.58)	.001 (2.59)	.01 (- .92)
		INS	.001 (2.72)	.01 (- .82)			.001 (3.71)	.38 (- .35)	.001 (3.71)	.84 (- .17)
NZ	DTC	FE	.001 (2.89)	.001 (3.68)	.001 (3.75)	.001 (2.79)		.001 (1.29)	.001 (3.16)	.001 (3.98)
		INS	.001 (1.23)	.01 (1.05)	.001 (1.39)	.01 (.088)			.001 (1.19)	.021 (.78)
	RCG	FE	.001 (2.32)	.021 (- .69)	.001 (2.89)	.56 (- .17)		.31 (- .38)	.001 (2.86)	.35 (- .33)
		INS	.001 (2.42)	.021 (- .62)	.001 (3.02)	.87 (.1)			.001 (- 2.98)	.39 (- .28)
SNG	DTC	FE	.019 (.78)	.21 (.68)	.001 (1.24)	.86 (.17)	.88 (.16)	.29 (.41)		.2 (- .62)
		INS	.01 (1.09)	.023 (.62)	.001 (1.24)	.021 (.71)	.01 (.84)	.023 (.62)		
	RCG	FE	.001 (3.09)	.019 (- .78)	.001 (2.97)	.95 (- .01)	.001 (2.82)	.01 (- .92)		.37 (- .29)
		INS	.001 (3.91)	.02 (- .6)	.001 (3.61)	.34 (.25)	.001 (3.49)	.02 (- .77)		

Table 4: Detection (DTC) and recognition (RCG) performance for British (BRT). Chilean (CHL), New Zealand (NZ) and Singaporean (SNG) participants for freely-expressed (FE) and Instructed (INS) expressions. In A. means and standard deviations in B. Bonferroni corrected p-values and effect size Cohen's d for comparisons for each culture.

Analysis and Discussion: Familiarity. To explore whether there were differences in cultural familiarity ratings – under conditions of backward masking – between different emotional dialects and for freely-expressed and instructed emotional faces an analysis of variance with independent variables Culture (Own and Other), Type of Expression (Instructed and Freely-Expressed) and Type of Emotion (Fear, Sadness and Neutral) was run with dependent variables familiarity ratings. The analysis revealed a significant effect of Culture ($F (1, 92) = 320.32$, $p < .001$; $\eta^2_p = .94$) and a significant effect of Type of Expression ($F (1, 92) = 1627.74$, $p < .001$; $\eta^2_p = .99$). A significant interaction was also revealed between Culture and Type of Expression ($F (1, 92) = 282.95$, $p < .001$; $\eta^2_p = .93$). Further comparisons revealed that own-culture faces ($M = 6.26$, $SD = .29$) were rated as more culturally familiar compared to other-culture faces ($M = 5.57$, $SD = .14$; $d = 3.72$). Instructed expressions of faces ($M = 6.33$, $SD = .21$) were rated as more familiar than freely-expressed faces ($M = 6.59$, $SD = .19$; $d = 6.79$). Critically freely-expressed own-culture emotional expressions ($M = 5.89$, $SD = .25$) were rated as more familiar than freely-expressed other-culture emotional expressions ($M = 4.57$, $SD = .11$, $p < .001$; $d = 6.83$). Instructed own-culture expressions ($M = 6.62$, $SD = .32$) were not significantly different compared to instructed other-culture emotional expressions ($M = 6.57$, $SD = 14$, $p = .44$; $d = .2$) and provided Bayesian evidence for similar familiarity ratings ($SE = .03$; $B = .04$). Freely-expressed own-culture faces were rated as more familiar by British ($F (3, 90) = 179.53$; $p < .001$; $\eta^2_p = .89$), Chilean ($F (3, 90) = 118.95$, $p < .001$; $\eta^2_p = .86$), New Zealand ($F (3, 90) = 231.71$, $p < .001$; $\eta^2_p = .91$) and Singaporean participants ($F (3, 90) = 159.86$, $p < .001$; $\eta^2_p = .86$). Instructed emotional expressions were not different between cultures ($F (3, 90) = .437$, $p = .73$; $\eta^2_p = .02$) and provided Bayesian evidence for similar familiarity ratings ($SE = .09$; $B = .13$). No effects of gender were found (see also Figure 6).

Figure 6: Familiarity Ratings per Culture for Faces in Study Two

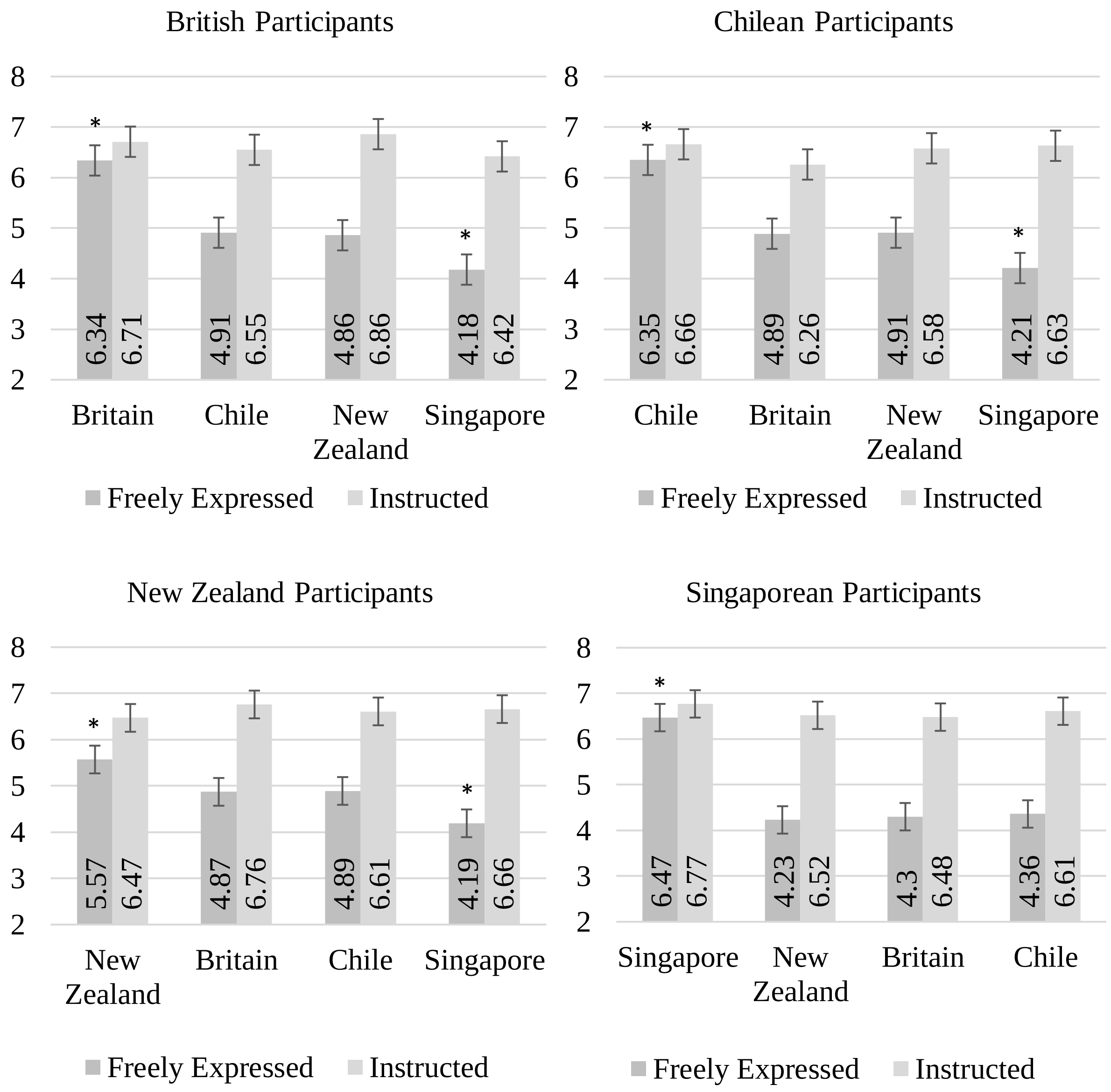

Figure 6: Familiarity ratings for instructed and freely-expressed own and other cultural faces for each culture. Bars indicate ±2 standard errors of the mean. Asterisk (*) signifies Bonferroni corrected statistically significant differences at $p \leq .01$ to other freely-expressed or instructed cultural faces respectively (see https://osf.io/3z97s/ and https://osf.io/cdvhz/).

Analysis and Discussion. Subliminality. Part One. To explore if detection performance was at-chance (A = .5) one-sample t-test analyses and uniform Bayesian analyses, uncorrected for degrees of freedom ($n \geq 30$; Berry, 1996), with lower bounds set at -.5 (A = .45) and higher bounds set at .5 (A = .5) with 0 (A = .5) representing chance-level performance (Zhang &

Mueller, 2005) were run for freely-expressed and instructed own-culture and other-culture signal detection receiver operating characteristics. Freely-expressed own-culture faces (M = .611, SD = .013) were not processed at-chance (t (1, 92) = 4.16, p < .001; SE = .002; B = +∞). The same effects were revealed for freely-expressed other culture faces (t (1, 92) = 14,02, p < .001; M = .575, SD = .012, SE = .001; B = +∞), instructed own-culture faces (t (1, 92) = 22.39, p < .001; M = .621, SD = .013, SE = 002; B = +∞) and instructed other culture faces (t (1, 92) = 43.6, p < .001; M = .624, SD = .012, SE = .001; B = +∞). A similar pattern of results was revealed for recognition performance (chance-level criterion corrected for multiple choices at A = .25) for freely-expressed own culture (t (1, 92) =115.16, p < .001; M = .611 , SD = .013, SE = .002; B = +∞), freely-expressed other culture (t (1, 92) = 12.61, p < .001; M = .575, SD = .012, SE = .001; B = +∞) and instructed own (t (1, 92) = 116.98, p < .001; M = .621, SD = .013, SE = .002; B = +∞) and other culture faces (t (1, 92) = 141.28, p < .001; M = .624, SD = .013 , SE = .002; B = +∞). These results suggest that detection and recognition performance did not provide evidence for subliminal presentation (see Figure 7).

Figure 7: ROC Curves per Culture and Type of Expression for Study Two

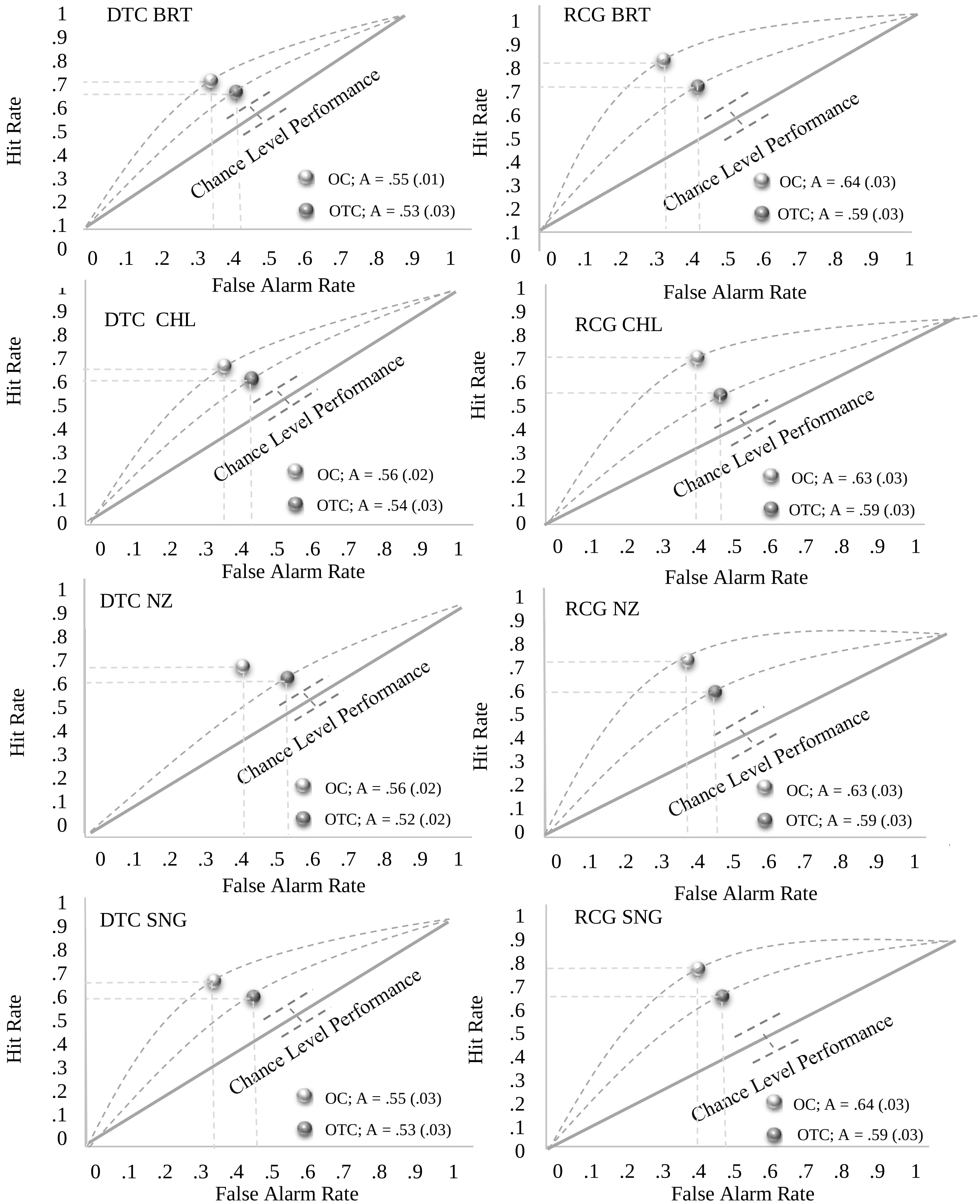

Figure 7: Detection (DTC; A = .5) and recognition (RCG; A = .25) for own (OC) and other-culture (OTC) expressions Bold interspersed mid-lines show Bayesian C.I.'s (see Tsikandilakis et al., 2019; Dienes, 2019).

Analysis and Discussion. Subliminality. Part Two. An analysis of variance with independent variables Detection Response (Hit and Miss), Culture (Own and Other), Type of Expression (Instructed and Freely-Expressed) and Type of Emotion (Fear, Sadness and Neutral) was run with dependent variable familiarity ratings. The analysis revealed that there were evidence for very highly significant (F (1, 92) = 2598.71, p < .001; η^2_p = .99) familiarity rating differences between hit (M = 6.05, SD = .23) and miss (M = 4.19, SD = .25; d = 7.74) responses. Significant effects were also revealed for Culture (F (1, 92) = 481.74, p < .001; η^2_p = .99) and Type of Expression (F (1, 92) = 144.77, p < .001; η^2_p = .97), and a significant interaction of Detection Performance to Culture to Type of Expression (F (1, 92) = 44.64, p < .001; η^2_p = .71) was revealed. Critically, hit responses were different for own (M = 6.08, SD = .34) compared to other-culture (M = 4.97, SD = .31, p < .001; d = 3.41) emotional expressions. Miss responses were not different for familiarity ratings between own (M = 4.93, SD = .24) and other (M = 4.92, SD = .27, p = .89; d = .01) emotional expressions and provided Bayesian evidence for similar and baseline responses (SE = .028; B = .03). These results suggest that detection of a presented face was a necessary condition for higher familiarity ratings to own-culture dialects of emotion (see Figure 8).

A partially different pattern of results was revealed for recognition performance. The analysis again revealed highly significant familiarity rating differences (F (1, 92) = 3991.51, p < .001; η^2_p = .95) between hit (M = 6.91, SD = .34) and miss (M = 5.23, SD = .32; d = 5.89) recognition responses. Highly significant effects were revealed for Culture (F (1, 92) = 4517.62, p < .001; η^2_p = .99) and Type of Expression (F (1, 92) = 354.95, p < .001; η^2_p = .94), and a significant interaction of Recognition Performance to Type of Expression (F (1, 92) = 186.04, p < .001; η^2_p = .81) was revealed. Recognition hit responses were different for own (M = 6.91, SD = .31) compared to other culture (M = 5.28, SD = .34, p < .001; d = 5.01) emotional expressions. In these data, nevertheless, recognition miss responses were also different for familiarity ratings between own (M = 5.74, SD = .29) and other (M = 4.89, SD = .31, $p < .001$; d = 2.83) emotional expressions. A Bayesian analysis confirmed the effect (SE = .036; B = $+\infty$). These results suggest that recognition of the emotion shown by a presented face increased familiarity but was not a necessary condition for higher familiarity ratings in response to own-culture dialects of emotion (see Figure 8).

A similar pattern of results was revealed per culture. For British participants, the analysis revealed that there was evidence for highly significant higher familiarity rating for own compared to other culture faces for hits for detection responses ($F(3, 90) = 847.44$, $p < .001$; $\eta^2_p = .98$). The same effect was revealed for recognition responses ($F(3, 90) = 1970.68$, $p < .001$; $\eta^2_p = .99$). Chilean participants also responded with higher familiarity ratings for hits compared to misses for detection to own culture faces ($F(3, 90) = 1331.98$, $p < .001$; $\eta^2_p = .97$) and recognition performance ($F(3, 90) = 1811.78$, $p < .001$; $\eta^2_p = .99$). Participants from New Zealand provided a similar pattern for results for detection ($F(3, 90) = 986.23$, $p < .001$; $\eta^2_p = .98$) and recognition ($F(3, 90) = 1661.04$, $p < .001$; $\eta^2_p = .99$). Finally, participants from Singapore also provided a similar pattern for hit responses for detection ($F(3, 90) = 756.22$, $p < .001$; $\eta^2_p = .97$) and recognition ($F(3, 90) = 536.16$, $p < .001$; $\eta^2_p = .96$). Critically, for participants from Britain (SE = .027; B = .13), Chile (SE = .023; B = .11), New Zealand (SE = .027; B = .12) and Singapore (SE = .027; B = .12) miss responses for detection performance provided Bayesian evidence for similar and baseline ratings between own and other culture dialects of emotion. These results suggest that detection of a presented face was a necessary condition for higher familiarity ratings to own-culture dialects of emotion for each included culture (see Figure 8).

Figure 8: Familiarity Hits and Miss Responses for Study Two

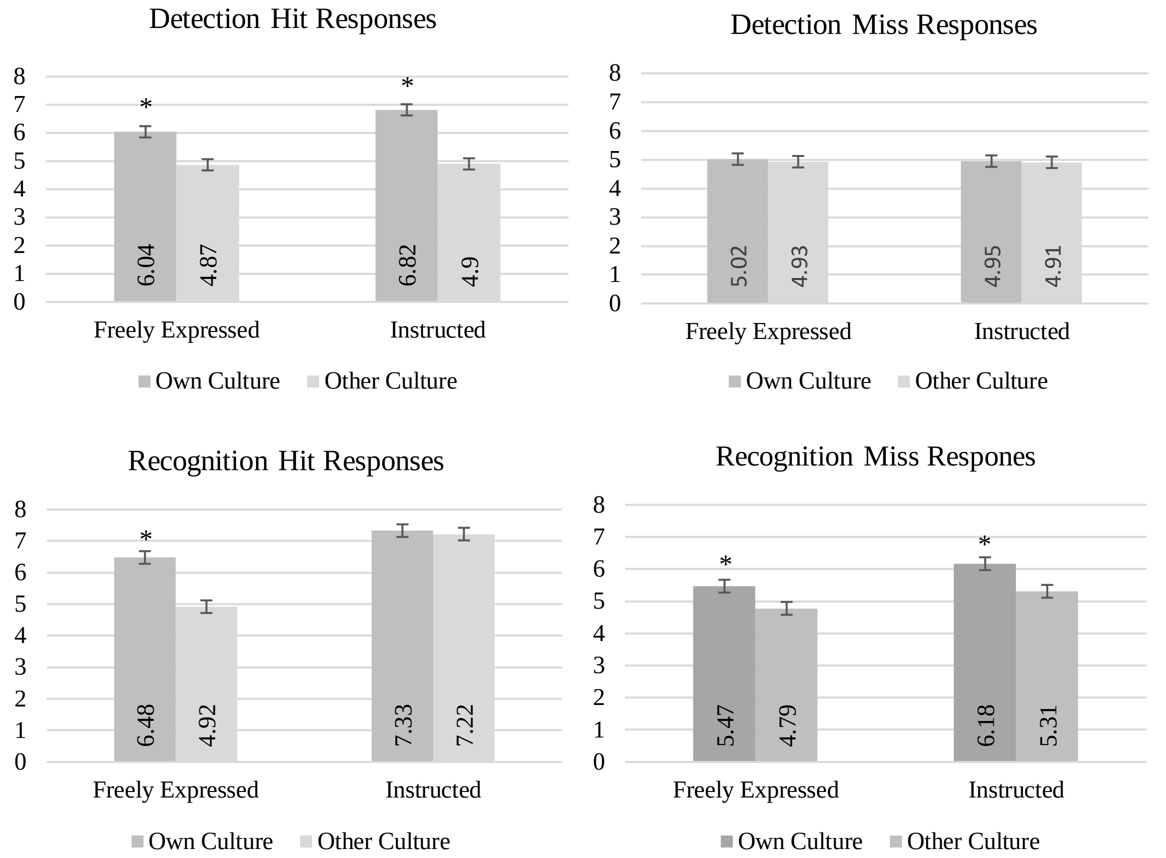

Figure 8: Familiarity ratings for hit and miss responses for detection and recognition performance for instructed and freely-expressed own and other cultural dialects of emotion. Bars indicate ±2 standard errors of the mean. Asterisk (*) signifies Bonferroni corrected statistically significant differences at $p \leq .001$ (see https://osf.io/3z97s/ and https://osf.io/cdvhz/).

Discussion

Summary of Findings

In this manuscript we explored whether own-culture emotional dialects can be recognized more accurately under conditions of visual ambiguity such as backward masking. We explored if emotionality and familiarity can be appraised for own-culture emotional dialects without conscious awareness, such as for miss responses for not seeing a presented own-culture emotional face. We found that, indeed, when presented for 33.33 ms and masked with an overt non-facial stimulus (125 ms) freely-expressed own-culture faces were recognized more accurately than freely-expressed other-culture faces. A similar effect, for higher emotional recognition rates, was revealed cross-culturally for FACS instructed emotional faces compared to all other included facial-stimulus types. This finding suggests that prototypical expressions of emotion are universally recognized but that they eliminate the own-culture emotional recognition advantage even under conditions of backwards masking. Critically, we showed that Bayesian analyses of non-parametric receiver operating characteristics and hit-versus-miss response analyses revealed that the appraisal of emotionality and familiarity from freely-expressed own-culture faces required correct post-trial detection of the presented face. Further Bayesian analyses provided evidence for null responses to imperceptible faces irrespective of culture and type of expression suggesting that conscious awareness is involved in the appraisal of emotionality and familiarity for freely-expressed own-culture dialects of emotion.

General Discussion

Classical psychological theory and research suggest that basic emotional expressions of anger, disgust, fear, surprise, sadness and happiness are a universal language of facial communication. These emotions are suggested to have important evolutionary value and can be encountered cross-culturally due to the utility that they confer for social communication. In more recent years several theoretical and empirical models have proposed and experimentally illustrated that, although, basic facial-emotional expressions are a universal language of communication, there are culture-specific dialects in the expression of emotion. These dialects recognizably differentiate the expression of basic emotions within each culture and confer an own-culture emotional recognition advantage for understanding emotional expressions. Due to the suggestion that these dialects have increased evolutionary important sociobiological value for own-culture members, several researchers have proposed that they can be processed automatically via subcortical neural pathways and do not require conscious awareness for affective appraisals.

In the current study, we tested this hypothesis using backward masking. We presented own and other-culture freely-expressed and Facial Action Units Coding system instructed fearful, sad and neutral faces, and non-facial blurs (see Figure 1) for 33.33 ms (see Brooks et al., 2012) followed by an overt pattern mask for 125 ms (see Kim et al., 2010). We assessed detection and recognition performance, and – in different sessions per included culture (Britain, Chile, New Zealand and Singapore) – self-reports for emotionality and familiarity for the presented faces. Our results confirmed that own-culture faces have increased sociobiological value for communication. Despite the masking process and the presentation of the facial stimuli for $1/30^{th}$ (33.33 ms) of a second, participants in each culture were able to detect and recognize own-culture expressions more accurately than other-culture expressions. This provides support for at-least an ontogenetic argument (see Elfenbein & Ambady, 2002a, 2002b) for an own-cultural emotional recognition advantage. In this context this finding signifies that via developmental processes and higher in-group social contact, own-culture emotional dialects are more accurately recognized even when presented for brief durations (but see also Matsumoto, 2002).

This finding was revealed for all involved cultures. In the current context this is important because in the current studies we paid particular attention to two important possible confounding factors that often influence results in relevant research (see Elfenbein & Ambady, 2002a). Firstly, we sampled participants and offered two experimental-replication sessions for the own-culture emotional recognition advantage for four cultures in four different continents. This was implemented to avoid the *geographical contact proxy* (see Elfenbein & Ambady, 2002b) that is suggested to influence the own-culture emotional recognition advantage. This influence is suggested to take place due to the geographical proximity of two or more cultures and, therefore, the presence of higher social contact and evolutionary similarities between them. Secondly, we provided rigorous and thorough pilot experimental evidence for each culture (see Tables 1 & 3) that the participants showed cultural differences between each group. Therefore, the reported effects cannot be attributed to age, socioeconomic and educational differences (Tsikandilakis et al., 2019). In simpler terms, “the reported differences between cultures were due to cultural differences” (see Russell, Bachorowski & Fernández-Dols, 2003; p. 331-337). They cannot be attributed to random sampling differences or other confounding variables. These aspects of the current research, and the replication for the own-culture emotional recognition advantage in each culture, offer increased validity to that own-culture emotional faces do, indeed, have increased sociobiological recognition value for ingroup communication compared to other-culture emotional faces (Elfenbein, 2013).

Further to these and concerning – possibly – the most contentious outcome of the current research (see Brooks et al., 2012), we provided evidence that own-culture emotional dialects are not processed subliminally. The same result was revealed for FACS instructed emotional faces. This finding is important because in the current research we followed exactly the same experimental parameters for masking as previous research that reported subliminal findings. These included the presentation of the masked stimuli for 33.33 ms (Kiss & Eimer, 2008; Pegna, Landis & Khateb, 2008; Rule & Ambady, 2008; Pegna, Darque, Berrut & Khateb, 2011; Freeman, Stolier, Ingbretsen & Hehman, 2014; Parkinson, Garfinkel, Critchley, Dienes & Seth, 2017; Jiang, Wu, Saab, Xiao & Gao, 2018; Peláez, Ferrera, Barjola, Fernandes & Mercado, 2019; Gunther et al., 2020; Schütz, Güldenpenning, Kester & Schack, 2020), corrections and adjustments for luminance between the mask and masked stimuli, and explicit post-trial self-reports (for thorough and comprehensive reviews, and meta-analyses, see

Costafreda, Brammer, David & Fu, 2008; Brooks et al., 2012; van der Ploeg et al., 2017). We changed only the statistical analyses of the experimental outcomes. In this manner, using frequentist and Bayesian analyses (Dienes, 2016) of non-parametric receiver operating characteristics (Zhang & Mueller, 2005) – as opposed to hit rates (see Stanislaw & Todorov, 1999) – and hit-versus-miss response analyses for detection and discrimination performance (see Pessoa et al., 2005), we showed that own-culture faces and FACS instructed faces were detected and discriminated above chance level (Erdelyi, 2004).

Critically, although, we found that, indeed, own-culture faces are rated higher for both emotionality and familiarity than other-culture faces, this effect required the correct detection of the presented face during a post-trial detection task (see also Tsikandilakis, Chapman & Peirce, 2018). Trials in which own and other-culture, and FACS instructed faces were not detected correctly revealed Bayesian evidence for null differences for emotionality and familiarity between different cultures (see Dienes, 2014; 2015). These findings point possibly towards to that there is higher evolutionary sociobiological value for ingroup communication in consciously recognizing an own-culture emotional face (see Tsikandilakis et al., 2021a, 2021b), than for relying on a possibly unconscious and subcortical system for the emotional and cognitive processing, and the initiation of behavioural responses to emotional information (see Pessoa & Adolphs, 2010). It should be emphasized that these findings mean that effective elicitors, such as faces that resulted in higher own compared to other-culture familiarity and emotionality ratings, were subject to meta-awareness (Bachmann & Francis, 2013). This included the ability to correctly recall that they were presented during the trial in a post-trial engagement task (Dehaene, Lau & Kouider, 2017). Non-detected but presented own and other-culture faces did not show differences between different cultures (Tsikandilakis et al., 2019). According to these findings and according to this definition for unconsciousness (see Dehaene, Changeux, Naccache, Sackur & Sergent, 2006), the presented faces that resulted in higher own compared to other-culture rating responses were not processed subliminally (see also Tsikandilakis, Bali, Derrfuss & Chapman, 2019).

Although these findings in themselves are very important we must also address several secondary findings that the sample size, cultural diversity and stimuli variability of the current research allowed us to report. As regards a previous seminal disagreement in the current area (see Elfenbein & Ambady, 2002a; Matsumoto, 2002) the current findings offer two formative results. Firstly, prototypical (FACS instructed) expressions are detected, recognised and rated higher for emotionality and – at-least for brief durations such as 33.33 ms (see Elfenbein & Ambady 2002b) – familiarity compared to own and other-culture emotional expressions. That means that they are a very salient language of emotional communication. The current findings suggest that they are even more salient than freely-expressed own-culture emotional dialects. This effect occurs most likely due to the intensity of the portrayed emotions (see Elfenbein, 2013). Secondly, this effect is present and reported for FACS instructed faces irrespective of culture. This suggests that although prototypical expressions of emotion are universally recognized more accurately than own-culture dialects of emotions they do eliminate the own-culture emotional recognition advantage.

The final consideration that stems from these findings is that – exactly along the lines of our findings for own-culture emotional dialects – conscious perception is involved in the processing of prototypical emotions. FACS instructed faces were detected and discriminated above chance (Erdelyi, 2004) and required correct post-trial detection of the presented face to outcome to higher emotionality and familiarity ratings compared to other stimulus types. That means that they were not processed subliminally. This can be interpreted to signify that both own-culture faces and prototypical FACS instructed faces are perceived very accurately and have sociobiological importance for communication, but that their processing involves conscious awareness.

Limitations

The dataset (https://osf.io/3z97s/) for facial expressions used in this study was created and validated in a previous work (Tsikandilakis et al., 2019). It contains actors from Britain, Chile, New Zealand and Singapore. The actors portray freely-expressed, instructed and mimicked (Gur et al., 2002) emotions of anger, fear, happiness, sadness, surprise, disgust, and neutral and calm expressions. The ethical consensus between the participating institutions for the current study was the allowance of a maximum of ninety minutes exposure to backward masked faces. Therefore, the current study included own and other-culture, freely-expressed and instructed fearful, sad and neutral faces (n = 240) and an equal number of randomly generated masked blurs (n =240). Future research could benefit from testing the current effects using additional emotional expressions. The current population samples were chosen based on the inter-continental availability of the funding body (U21). African participants and collaborators were not available, and the current study contained a single Asian group. We strongly emphasize that the exploration of different racial-facial characteristics in relation to detection and discriminations of own and other-culture faces, was not part of the objectives of the current research, and neutral faces, in both experimental studies, did not show evidence for higher own-culture detection and recognition performance. Nevertheless, it is possible that emotional dialects of emotion as well as the culture-specific facial characteristics of the presented actors could confer an influence on participant responses. Future research could benefit from using different country of origin proportions, additional cultures and mixed assessment, such as masked images of own-culture actors showing other-culture emotional dialects, to explore whether culture-specific facial characteristics have an effect on detection, recognition responses, and emotionality and familiarity ratings.

Conclusions

In the current manuscript we presented eight experiments in four different cultures based in four different continents. We used strictly non-convergent populations samples and thorough and rigorous criteria for culturation. We explored whether participants could recognize emotions expressed by their own cultural group more accurately than emotions presented by other cultural groups under conditions of visual ambiguity such as backward masking. We also explored if the appraisal of emotionality and familiarity for own-culture faces can be evaluated without conscious awareness. We presented findings from each involved culture in each experimental study that, using unbiased non-parametric receiver operating characteristics analyses, own-culture emotional faces are recognized more accurately than other-culture faces when presented for 33.33 ms and masked with an overt non-facial pattern for 125 ms. We also further illustrated that, using Bayesian analyses and hit and miss response analyses, own-culture emotional faces were rated higher for emotionality and familiarity compared to other-culture emotional faces only when participants reported correct post-trial detection of a presented face. This suggested that conscious perception was involved in the appraisal of own-culture dialects of emotion and that the latter did not occur subliminally. Our findings suggested that conscious awareness was also involved cross-culturally in the appraisal of prototypical emotions, such as Facial Action Units System instructed emotional faces.

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Compliance with Ethical Standards

Ethical approval for the current studies was granted by the School of Psychology or Medical School of each participating university. This work has no conflicts of interest. The current work did not include research involving animals. The current work included research with human participants. All participants gave informed consent for participating in the current studies. All participants were debriefed after the completion of the studies. All participants were provided with the contact details of the researchers, for further correspondence as regards the current studies, after the completion of the current studies.

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