Are need for affect and cognition culture dependent? Implications for global public health campaigns: a cross-sectional study

Min Zhang1, Bei Zhu2, Chunlan Yuan1, Chao Zhao3, Jiaofeng Wang1, Qingwei Ruan1, Chunlan Yuan2, Chao Han1, Zhijun Bao1,3, Jie Chen1*, Kevin (Vin) Arceneaux4, Ryan Vander Wielen4 and Greg J. Siegle5

Abstract

Background: Cultural differences in affective and cognitive intrinsic motivation could pose challenges for global public health campaigns, which use cognitive or affective goals to evoke desired attitudes and proactive health-promoting actions. This study aimed to identify cross-cultural differences in affective and cognitive intrinsic motivation and discuss the potential value of this information for public health promotion.

Methods: A cross-sectional survey using cross-culturally validated need for affect (NFA) and need for cognition (NFC) scales was carried out among 1166 Chinese participants, and the results were compared with published data from 980 American participants. Additionally, we assessed a highly prevalent symbolic geriatric health condition, hearing loss, in 500 Chinese community-dwelling seniors. The Chinese NFA scale was developed following the translation-back-translation procedure, and the psychometric evaluation was performed by applying confirmatory factor analysis (CFA), exploratory structural equation modeling (ESEM), correlation analysis and multigroup invariance test. MANOVA and Hedge's g statistic were employed to compare the NFA and NFC levels between individuals from different countries and between Chinese seniors with and without hearing loss. The relation of early hearing intervention intention to NFA and NFC was also explored in the Chinese sample.

Results: A basic two-factor model of NFA adequately fit the sample data from Chinese and American cultures. The questionnaire demonstrated reasonable invariance of the factor structure and factor loadings across the groups. Those in the primary Chinese sample had lower NFA and NFC than their American peers. This difference held in the senior sample. Moreover, Chinese seniors with hearing loss had even lower NFA and NFC than those without hearing loss. Their early hearing intervention intention was low but was associated with intrinsic motivation.

Conclusions: The Need for Affect (NFA) construct may be generalized beyond its Western origins. There was a general lack of affective and cognitive intrinsic motivation in Chinese individuals, particularly in seniors with hearing loss, compared with their American peers. These differences point to a potential challenge in framing effective messages for some cultures in the geriatric public health domain. Ideally, recognizing and understanding this challenge will inspire the consideration of novel persuasive strategies for these audiences.

Keywords: Intrinsic motivation, Need for affect, Need for cognition, Cultural differences, Global public health campaign

* Correspondence: laughchen@126.com
1Shanghai Key Laboratory of Clinical Geriatric Medicine, Huadong Hospital, Fudan University, 221 West Yan'an Road, Shanghai, China
Full list of author information is available at the end of the article

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Background

Many disciplines rely on persuasive communication with target audiences around affective goals (e.g., “do X to be happier”) or cognitive goals (e.g., “you will think more clearly”). An implicit assumption is that such affective goals are universal. Rather, affective and cognitive orientation (indexed by need for affect and need for cognition) differs across individuals and is associated with the effectiveness of messages in persuasive communication [1, 2] and consequent proactive behaviors [3]. Aquino et al. [4] explained the neural basis of this association by observing that the ventromedial prefrontal cortex (vMPFC) was specifically responsive when message receivers evaluated the match between a message and their affective and cognitive orientations. Affective and cognitive orientation may be particularly important for global persuasive communication efforts, e.g., public health campaigns, as similar campaign content might yield diverse outcomes across national cultures if there are cross-cultural differences in affective and cognitive orientation. In a review on structural matching effects in persuasive communication, Teeny et al. [5] pointed out that tailoring messages to cultural characteristics is a high-level matching strategy for persuasion enhancement.

Affective and cognitive orientations are indexed by self-report questionnaires. The Need for Affect (NFA) questionnaire assesses the tendency to approach or avoid emotion-inducing situations and activities. It focuses on the motivation to engage in the affective process rather than assessing emotional ability or emotional style [6]. People high in NFA tend to rely upon emotional information in attitude formation and the regulation of behavior [1, 2]. The Need for Cognition (NFC) questionnaire assesses the tendency to engage in and enjoy effortful thinking [7] and is related to rational decision-making [8] and effort expenditure [9]. Higher levels of NFA are associated with greater persuasion in response to an affect-based (but not cognition-based) persuasive message, whereas higher levels of NFC are associated with greater persuasion in response to a cognition-based (but not affect-based) persuasive message [1].

Geriatric health campaign messages are often geared towards affective goals (e.g., happiness, enjoyment), as evidence has shown that affective outcome expectancies have a significantly more positive impact on older people’s intentions to take proactive actions than rationale outcome expectancies [10]. However, cultural context may play a role in structuring affective goals. There are important differences across cultures in terms of the norms governing human engagement with emotions [11]. From the approach perspective of emotional engagement, East Asians – especially Chinese – differ from their Western counterparts in affective disposition [12]. For example, a unique study suggested that U.S. residents of Chinese descent tended to value high-arousal positive affect (e.g., excitement) less than Americans of specifically European descent [13]; they tended to want to maximize positive and minimize negative affect less than did Americans of European descent and therefore were more likely to feel the bad with the good, referred to as mixed affective experience [14]. From the avoidance perspective of emotional engagement, Chinese individuals are more affected by the perceived risk of potential losses than individuals from the Netherlands and the USA [15]. Compared to Americans, East Asians are less inclined to overestimate the emotional consequences of future events [16]. Additionally, there are differences across cultures in people’s engagement in thinking that might influence cognitive goal structures. The Confucian, Taoist and Buddhist philosophic traditions oppose public argumentation and debate [17] and focus on learning in a mechanical way without thought or meaning, which has evolved to the extent that people in such cultures are considered to lack abstract and critical thinking ability, to overemphasize concrete examples, and to lack originality and creativity [18].

Overall, these data suggest that the baseline levels of affective and cognitive intrinsic motivation may be low in certain cultures, so conventional emotion/cognition-based messaging is likely to be less effective. A prototypical example of diverse outcomes across cultures, given similar campaign content and service accessibility, is in the hearing healthcare domain. There are cross-cultural public health outreach efforts spanning China and the U.S. The prevalence of hearing loss in elderly individuals is 45 ~ 63% in both countries [19]. The WHO proposed a World Hearing Day (observed annually on March 3rd) to facilitate global hearing health campaigns. The themes of this day initially focused on the cognitive side, e.g., “Make listening safe: avoid noise-induced hearing loss”, “Earcare can avoid hearing loss”, “Proper use of hearing aids”, and “Act now, here is how”, while the more recent themes have emphasized the emotional side, e.g., “Hearing for life: don’t let hearing loss limit you”, “Hear the future”, “Make a sound investment”, and “Healthy hearing, happy life”. Although advocacy of early hearing intervention to reduce the long-term adverse effects of hearing loss has been carried out for over 2 decades using the same WHO messages, the hearing intervention rate in geriatrics remains low at < 2% in China [20], whereas it is approximately 16% in the U.S. [21]. Potentially, understanding differences in audiences’ affective and cognitive intrinsic motivation at a national level could help health professionals tailor persuasive messages to particular populations and hence facilitate successful campaigns globally.

The current study examines whether NFA and NFC differ systematically across relatively large Chinese and American samples. The objectives are to 1) develop a
Chinese NFA scale based on Appel et al.’s English language version [22] and establish the validity of this scale; 2) examine the differences in NFA and NFC between our Chinese and American general public samples and perform a comparison with the European samples from Appel et al.’s study; and 3) taking hearing loss as an example, explore whether community-based seniors with a public health condition in the Chinese sample have reasonably high NFA or NFC, as assumed by public health campaigns, and examine whether their early hearing intervention intention is related to NFA and NFC. We hypothesized that the Chinese sample would have different levels of NFA and NFC than the American sample. We also hypothesized that Chinese seniors with hearing loss would be similar to those with normal hearing in terms of NFA and NFC, as no evidence has shown that hearing loss alters individuals’ affective and cognitive intrinsic motivation. We expected to observe a correlation between early hearing intervention and NFA and/or NFC in Chinese seniors, given that the Chinese hearing health campaign messages consist of both affective-driven and cognitive-driven content.

Methods
Participants
We recruited 1195 Chinese adults to participate in the study from April to July 2019. This sample size was comparable to those in the original NFA scale development studies [6, 22]. Of the 1195 participants (age = 45.4 ± 17.6 yrs., range = 20 ~ 90 yrs., 65.6% female), 695 (age = 30.3 ± 13.3 yrs., range = 20 ~ 78 yrs., 65.7% female) were recruited through an online survey tool (TengXun Survey) and completed a web-based survey in return for an instant and direct deposit of RMB¥2 RMB (USD$0.3) to their WeChat payment account. Five hundred older participants (age = 65.7 ± 10.5 yrs., range = 44 ~ 90 yrs., 64.6% female) were recruited offline at a local community health center during their annual mandatory physical examination. The community-based participants completed hearing assessments in addition to the NFA and NFC surveys. They were reimbursed ¥20 RMB for their participation and travel. Our American sample (age = 49.43 ± 13.8 yrs., range = 19 ~ 88 yrs., 68.0% female) was from Arceneaux and Vander Wielen [23]. The 1006 individuals in their study completed a web-based survey through Qualtrics in return for their participation and travel. Our American sample (age = 65.4 ± 17.6 yrs., range = 20 ~ 90 yrs., 65.6% female) were recruited through an online survey tool (TengXun Survey) and completed a web-based survey in return for an instant and direct deposit of RMB¥2 RMB (USD$0.3) to their WeChat payment account. Five hundred older participants (age = 65.7 ± 10.5 yrs., range = 44 ~ 90 yrs., 64.6% female) were recruited offline at a local community health center during their annual mandatory physical examination. The community-based participants completed hearing assessments in addition to the NFA and NFC surveys. They were reimbursed ¥20 RMB for their participation and travel. Our American sample (age = 49.43 ± 13.8 yrs., range = 19 ~ 88 yrs., 68.0% female) was from Arceneaux and Vander Wielen [23].

Instruments
English need for affect scale
The English 10-item short version consists of approach and avoidance subscales with 5 items in each [22]. The scale uses a 7-point Likert scale for responses [−3 = Strongly disagree to 3 = Strongly agree, with 0 = Uncertain]. Some subsequent studies, including Arceneaux and Vander Wielen [23], used a 5-point Likert scale for responses (1 = Strongly disagree, 5 = Strongly agree). The mean score of the items was used as the overall score of the NFA scale/subscales, in line with Appel et al. [22]

Chinese NFA scale construction
The Chinese version of the NFA (see Appendix) was rigorously developed in line with state-of-the-art standards in cross-cultural research using the translation-back translation method. The English NFA was translated into Chinese by the first author with assistance from a faculty member in the Chinese language department of Fudan University. The initial translation was tested on two bilingual doctoral students for content equivalence. For some items, the direct translation and standard back-translation procedures may not have captured equivalent emotion concepts in Chinese, as addressed in the literature [24, 25]. Discrepancies were discussed and resolved by consensus, and modifications to the translation were made as needed. The response scale was a 7-point Likert scale (−3 = Strongly disagree to 3 = Strongly agree, with 0 = Uncertain). The final version was piloted in a sample of 3 undergraduate volunteers and 5 elderly volunteers. The volunteers indicated that the instructions and the items were easy to understand.

Need for cognition scale
Cacioppo et al.’s [7] 18-item scale was used to assess the NFC in an American sample. The Chinese NFC scale validated by Kuang et al. [26] was used in the Chinese sample. The Chinese NFC scale has an internal consistency of 0.89, a split reliability of 0.90, and a test-retest reliability of 0.86. It demonstrated a sound convergent validity in terms of a strong relationship with self-efficacy (r = 0.52, p < 0.01), which was in line with Cacioppo et al. [7]. The sum score was computed to index the overall score of the NFC scale, as suggested by Cacioppo et al. [7].

Hearing assessment
The purpose of assessing hearing impairment in the Chinese sample was to make claims regarding the extent to which, in Chinese culture, low levels of NFA are specifically present in the subpopulation that would be targeted by hearing campaigns. Two hearing-related assessments were administered to the community-based
seniors: 1) a simplified pure tone examination [27] using an audiometer (Interacoustics, MA52) and the 10-item Hearing Handicap Inventory for the Elderly-Screening Questionnaire [28], which were used to estimate hearing loss severity; 2) a multiple choice intention question, namely, “When do you think you will consider wearing hearing aids and take serious action?” The five choices were: ① When/if I have mild hearing loss; ② When/if I have moderate hearing loss; ③ When/if I have severe hearing loss and have difficulty communicating with others; ④ When/if I lose all my hearing; and ⑤ I will never consider wearing hearing aids because they are not helpful. This multiple-choice question was asked to measure an individual’s early hearing intervention intention, quantified by how early a proactive action might take place once the hearing problem is recognized, with the highest intention score being assigned to choice ① and the lowest intention score to choice ⑤.

Procedures
Chinese participants responded to the Chinese NFA questionnaire developed in the present study (on a 7-point Likert scale) and the Chinese NFC scale. The 500 community-based Chinese seniors completed the hearing assessments as well. Forty-seven of the 500 participants completed the battery twice with an interval of 3 ~ 4 weeks; on each occasion, they completed the NFA, NFC, and the single question about early hearing intervention intention. American participants in Arceneaux and Vander Wielen’s [23] study responded to the English NFA and NFC questionnaires.

Analysis methods
Only 5.9% of cases had missing data; overall, therefore, 0.25% of the values were missing in our samples. Missing values were managed via a full information maximum likelihood (FIML) approach. The psychometrics of the Chinese NFA questionnaire were examined in terms of test-retest reliability, internal consistency and Cronbach’s alpha. Convergent validity was indexed by the correlation between the NFA and NFC scales [22]. The construct validity of the NFA scale in the Chinese and American samples was examined by testing the one-level two-factor model (Fig. 1) via confirmatory factor analysis and exploratory structural equation modeling (ESEM) with AMOS 24.0. We split our samples into 4 subsamples (2 Chinese subsamples and 2 American subsamples) (Table 1) in a random manner for the purposes of internal verification and replication of the model fit testing. Splitting samples in CFA is recommended by Fokkema and Greiff [29] to minimize model overfit. Various cutoff levels for the model fit indices have been recommended in previous literature [30]. Recent studies have suggested that in order to be meaningful, the thresholds should be considered in combination with important parameters (e.g., sample size and standardized factor loadings) [31–33].

In the present study, the following cut-off values were adopted: 1) comparative fit index (CFI), comparative fit index (TLI), and Turker and Lewis’s Index of fit (NFI) of 0.90 [34, 35]; 2) root-mean-square error of approximation (RMSEA) of 0.10 [36]. These criteria have been used by other researchers [37–39]. The goodness-of-fit results of the ESEM, a modified CFA model (allowing cross-loadings) and a basic CFA model (no cross-loadings) were reported. Although models with cross-loadings generally fit to a stronger degree, we were particularly interested in whether a basic CFA model could adequately fit for the reason that, the basic CFA model not only maximizes the theoretical interpretability of the NFA scale, it also matches the unit-weighted scoring approach applied in the NFA literature and generally preferred both in practical use and research on comparisons across multiple samples [40].

The configural, construct-level metric and scalar invariance of the basic NFA model between the Chinese and American samples was tested following a stepwise procedure [41, 42]. Specifically, a series of nested restrictive models were established and compared based on the CFI change (ΔCFI) and RMSEA change (ΔRMSEA) significance tests (see Table 4). Ideally, the invariance test could be conducted among the 4 subsamples, however, due to the lack of a clear cut-off between Chen’s (2007) [43] invariance criterion for 2-group condition and Rutkowski and Svetina’s (2014) [44] liberal criterion for 10- and 20-group condition, our invariance test was performed between the Chinese sample and American sample without splitting. The criteria of ΔCFI no larger in magnitude than −0.01 and ΔRMSEA less than or equal to 0.015 were adopted as reasonable evidence of invariance [43].

To test our hypothesis about cultural differences in NFA, the scores of our samples and those of 4 independent European samples reported by Appel et al. [22] were compared using a meta-analysis approach. Effect sizes (Hedges’ g values) and associated 95% confidence intervals were calculated. Responses from the American sample to the 5-point English NFA scale were linearly transformed into 7-point scale values by using the formula $y = 3(x-3)/2$ to match the scale used in the Chinese sample and Appel et al.’s [22] European samples. Additionally, we compared the correlation between the two latent factors (approach and avoidance) across these samples via t-tests after transforming the distribution of the correlations to a normal distribution using Fisher’s z-transformation. The difference in NFC between the Chinese and American samples was also tested using Hedges’ g value.
To explore whether seniors with a highly prevalent public health problem (i.e., hearing loss) have reasonably high intrinsic motivation, as assumed by public health campaigns, we applied MANOVA to examine the differences in the NFA and NFC scores between Chinese seniors with and without hearing loss. Moreover, correlation analysis was conducted to explore the relationship between individuals’ NFA and NFC and the tendency toward early hearing intervention seeking. These analyses were performed using SW 24 (SPSS/IBM, Chicago, IL).

![Diagram of one-level two-factor model](image)

**Fig. 1** The one-level two-factor model of the 10-item Need for Affect scale. Items within each latent factor were allowed to correlate. Cross-loading was constrained to zero.

**Table 1** Demographics of the 4 subsamples split for the purpose of internal verification and replication of the model fit testing

|                      | Chinese sample (1166) Subsample1 (581) Subsample2 (585) | American sample (980) Subsample1 (507) Subsample2 (473) |
|----------------------|----------------------------------------------------------|----------------------------------------------------------|
| **Age range (years)**| 18–90                                                    | 20–84                                                    |
| **Age mean (SD)**    | 45.62 (21.55)                                            | 48.86 (14.32)                                            |
| **Female (%)**       | 63.3%                                                    | 69.0%                                                    |

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**Results**

Q1. Psychometric characterization of a Chinese version of the NFA

The short 10-item Chinese scale based on Appel et al. [22] showed a test-retest correlation and internal consistency of $r = .943$, $p < .001$, ICC = .942, $p < .001$, and Cronbach’s $\alpha = .829$, $F (9,10,485) = 54.580, p < .001$. Consistent with Kuang, Shi [26], the Chinese NFC scale had an internal consistency above .850, with a Cronbach’s $\alpha$ of .866, $F (17,9,19,805) = 99.992, p < .001$. The relationship between NFA and NFC was assessed as an index of convergent validity [22]. The correlation between NFA and NFC in the Chinese sample was .221 ($p < .001$), which was comparable with that reported by Appel et al. [22] ($r = .170, p < .001$), $Z = 1.19, p = .234$.

The confirmatory factor analysis indicated that a two-factor model for the 10-item NFA scale, without cross-loadings, had acceptable fit by our criteria in both the Chinese and American samples (Table 2) but did not fit more stringent criteria recommended by Hu and Bentler [45]. As expected, the ESEM and CFA models with cross-loadings yielded even stronger fit indices that passed these more stringent model fit criteria. Standardized factor loadings for the NFA items are shown in Table 3.

As shown in Table 4, the NFA measurement structure with two latent factors was invariant between the Chinese and American samples. When all factor loadings were constrained, multigroup analysis indicated noninvariance. Subsequent model tests comparing M4 and M1, and M4 and M0 in Table 4, identified a single non-invariant item (i.e., NFA_10) responsible for the overall noninvariance. Considering that this item only constitutes 1/10 of the model, we chose to relax this specific metric invariance requirement as proposed in the literature [46, 47] while maintaining the rest of the NFA scale. The results of the scalar equivalence and construct variance equivalence tests demonstrated satisfactory factorial invariance that supported comparing the construct means and the correlation of constructs between samples.

Q2. Cultural differences in NFA and NFC

The mean NFA approach scores and avoidance scores were computed and compared between the Chinese sample and American sample and were also contrasted with the scores of the 4 independent European samples from Appel et al.’s [22] study (see Fig. 2). As shown in Table 5, the effect sizes in terms of the Hedges’ $g$ values and the 95% CIs revealed that the Chinese general public sample had significantly lower NFA approach scores than the American and European samples and significantly higher NFA avoidance scores than people in other cultures. Compared to the European participants, the American adults had significantly lower NFA approach scores and higher avoidance scores. The Chinese general public had significantly lower NFC scores than their American peers.

Consistent with the finding of the noninvariant construct covariance shown in Table 4 (M7-M1), the correlation between the construct “Approach” and “Avoidance” was different between the Chinese and the American samples. The correlation between the NFA approach and avoidance scores in the Chinese sample was comparable with that reported by Appel et al. [22] study (see Fig. 2). As shown in Table 5, the effect sizes in terms of the Hedges’ $g$ values and the 95% CIs revealed that the Chinese general public sample had significantly lower NFA approach scores than the American and European samples and significantly higher NFA avoidance scores than people in other cultures. Compared to the European participants, the American adults had significantly lower NFA approach scores and higher avoidance scores. The Chinese general public had significantly lower NFC scores than their American peers.

### Table 2 Goodness-of-fit statistics of using Exploratory Structural Equation Modeling (ESEM), a modified Confirmatory Factor Analysis (CFA) model with cross-loadings and a basic CFA model without cross-loadings for the Appel et al.’s 10-item NFA scale in the 4 subsamples

| Model tested                  | $\chi^2$ | df   | $p$   | CFI | TLI | NFI | RMSEA | AIC    | ECVI  |
|-------------------------------|----------|------|-------|-----|-----|-----|-------|--------|-------|
| **ESEM**                      |          |      |       |     |     |     |       |        |       |
| Chinese subsample 1           | 79.325   | 22   | <.001 | 0.975 | 0.950 | 0.967 | 0.067 | 165.325 | 0.285 |
| Chinese subsample 2           | 90.266   | 22   | <.001 | 0.971 | 0.940 | 0.962 | 0.073 | 176.266 | 0.302 |
| American subsample 1          | 40.860   | 22   | <.001 | 0.988 | 0.969 | 0.974 | 0.041 | 126.86  | 0.251 |
| American subsample 2          | 52.681   | 22   | <.001 | 0.976 | 0.940 | 0.960 | 0.054 | 138.681 | 0.294 |
| **Modified CFA**              |          |      |       |     |     |     |       |        |       |
| Chinese subsample 1           | 19.299   | 14   | <.001 | 0.997 | 0.991 | 0.982 | 0.028 | 125.299 | 0.216 |
| Chinese subsample 2           | 26.168   | 14   | <.001 | 0.989 | 0.974 | 0.972 | 0.045 | 132.168 | 0.226 |
| American subsample 1          | 15.033   | 14   | <.001 | 0.999 | 0.997 | 0.989 | 0.013 | 117.033 | 0.248 |
| American subsample 2          | 24.746   | 14   | <.001 | 0.994 | 0.983 | 0.980 | 0.032 | 126.746 | 0.250 |
| **Basic CFA**                 |          |      |       |     |     |     |       |        |       |
| Chinese subsample 1           | 83.327   | 18   | <.001 | 0.971 | 0.912 | 0.965 | 0.089 | 187.327 | 0.323 |
| Chinese subsample 2           | 86.597   | 18   | <.001 | 0.969 | 0.908 | 0.964 | 0.090 | 190.597 | 0.326 |
| American subsample 1          | 28.122   | 14   | <.001 | 0.983 | 0.980 | 0.982 | 0.035 | 124.122 | 0.245 |
| American subsample 2          | 35.795   | 17   | <.001 | 0.982 | 0.957 | 0.973 | 0.046 | 131.795 | 0.279 |

**Criterion for goodness of fit**

$\geq 0.9$ $\geq 0.9$ $\geq 0.9$ $\leq 0.1$

**Note:** $\chi^2$ Normed chi-square, df Degree of freedom, CFI Comparative fit index, TLI Turker and Lewis’s Index of fit, NFI Normed fit index, RMSEA Root mean square error of approximation, AIC Akaike Information Criterion, ECVI Expected Cross-Validation Index
Table 3 Factor loadings of the short version NFA scale 10 items in the Chinese and American samples along with the factor loadings in a German adult sample from Appel et al.’s [22]

| Approach | NFA_3_Appr | NFA_4_Appr | NFA_6_Appr | NFA_18_Appr | NFA_19_Appr | NFA_1 | NFA_8 | NFA_9 | NFA_10 | NFA_11 |
|----------|------------|------------|------------|-------------|-------------|-------|------|------|-------|-------|
|          | Appel et al. [22] | Chinese | American | Appel et al. [22] | Chinese | American | Appel et al. [22] | Chinese | American | Appel et al. [22] | Chinese | American |
|          | .57* | .39* | .11 | -.01 | .42* | .51* | .66* | -.19 | .74* | .60* | .69* | .07 | .59* | .57* | .73* | .13 | .69* | .52* | .35* | -.00 |
| NFA_1  | .26 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| NFA_8   | -.22 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| NFA_9   | -.19 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| NFA_10  | -.05 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| NFA_11  | .02 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |

* p < .05

Table 4 Invariance tests of the basic CFA model between the Chinese group and American group

| Model | Description | \(\chi^2\) | df | p   | CFI | TLI | NFI | RMSEA | AIC | ECVI | Test | \(\Delta\)CFI | \(\Delta\)RMSEA |
|-------|-------------|------------|-----|-----|-----|-----|-----|-------|-----|-----|------|--------------|----------------|
| M0    | Baseline model, no constraints on model parameters | 263.124 | 26 | <.001 | 0.977 | 0.941 | 0.966 | 0.030 | 607.124 | 0.283 |           |               |
| M1    | All factor loadings constrained to be equal | 408.270 | 35 | <.001 | 0.959 | 0.922 | 0.947 | 0.047 | 704.270 | 0.329 | M1-M0 | -0.018 | 0.017 |
| M2    | "Approach" factor loadings constrained to be equal | 281.146 | 31 | <.001 | 0.971 | 0.949 | 0.963 | 0.032 | 654.146 | 0.296 | M2-M0 | -0.006 | 0.002 |
| M3    | "Avoidance" factor loadings constrained to be equal | 367.272 | 31 | <.001 | 0.962 | 0.943 | 0.948 | 0.042 | 720.272 | 0.655 | M3-M0 | -0.015 | 0.012 |
| M4    | All factor loadings constrained to be equal except item NFA_10 | 292.361 | 34 | <.001 | 0.969 | 0.945 | 0.951 | 0.039 | 679.025 | 0.309 | M4-M0 | -0.008 | 0.009 |
| M5    | All factor loadings and the vectors of item intercepts constrained to be equal | 335.565 | 73 | <.001 | 0.953 | 0.929 | 0.942 | 0.049 | 762.515 | 0.683 | M5-M1 | -0.006 | 0.002 |
| M6    | All factor loadings and the variances of constructs constrained to be equal | 320.461 | 41 | <.001 | 0.951 | 0.931 | 0.944 | 0.045 | 738.461 | 0.398 | M6-M1 | -0.008 | -0.002 |
| M7    | All factor loadings and the factor covariance constrained to be equal | 518.586 | 45 | <.001 | 0.946 | 0.908 | 0.939 | 0.061 | 822.586 | 0.703 | M7-M1 | -0.013 | 0.014 |

Criteria for accepting the null hypothesis of invariance (Chen et al. [43])

\(\geq -0.010\) \(\leq 0.015\)

\(\Delta\)CFI Change in CFI, \(\Delta\)RMSEA Change in RMSEA

M0: Testing configural invariance between groups, i.e., \(H_0\) = Both groups associate the same subsets of items with the same constructs;
M1-M0: Testing construct-level metric invariance between groups, i.e., \(H_0\) = The strength of the relationships between items and their underlying constructs are the same between groups;
M2-M0: Testing the metric invariance of "Approach" between groups, i.e., \(H_0\) = The strength of the relationships between 5 approach items and the construct "Approach" are the same between groups;
M3-M0: Testing the metric invariance of "Avoidance" between groups, i.e., \(H_0\) = The strength of the relationships between 5 avoidance items and the construct "Avoidance" are the same between groups;
M4-M0: Testing the metric invariance of item NFA_10 between groups, i.e., \(H_0\) = The strength of the relationship between NFA_10 and the construct "Avoidance" is the same between groups;
M5-M0: Testing the scalar equivalence of items between groups, i.e., \(H_0\) = The values of each item corresponding to the zero value of the underlying constructs are the same between groups;
M6-M1: Testing equivalence of construct variances between groups, i.e., \(H_0\) = The variances of "Approach" and "Avoidance" are the same between groups;
M7-M1: Testing the equivalence of construct covariance between groups, i.e., \(H_0\) = The covariance between "Approach" and "Avoidance" is the same between groups;
was significantly positive, $r = .44$, $p < .01$, in contrast to the negative correlations in the American sample ($r = -.30$, $p < .01$), $Z = 18.08$, $p < .001$ (see Fig. 3), German/Austrian students ($r = -.34$, $p < .01$), $Z = 19.79$, $p < .001$, German adults ($r = -.40$, $p < .01$), $Z = 18.11$, $p < .001$, Austrian couples ($r = -.46$, $p < .01$), $Z = 10.23$, $p < .001$, and UK adults ($r = -.44$, $p < .01$), $Z = 13.18$, $p < .001$. There was no significant difference in the approach-avoidance correlation between the American sample and the German/Austrian students ($Z = 1.03$, $p = .30$) or Austrian couples ($Z = 1.96$, $p = .05$). However, the correlation was significantly smaller in magnitude in the American sample than in the German adults, $Z = 2.23$, $p = .030$, or the UK adults, $Z = 2.25$, $p = .025$.

Fig. 2 Comparisons of the NFA subscale mean scores across different cultural samples. The $r$ values indicate the correlation between the approach and avoidance scores. * indicates significance at an $α$ level of .05

Table 5 The mean, standard deviation, sample size of NFA average subscale scores and NFC total scores in multinational samples, and the effect size indices of the scores comparisons across cultures

| Two samples being compared | Mean ± SD (N)                  | Cohen’s d | Hedges’ $g$ | Seg | 95% CI Lower limit | 95% CI Upper limit |
|----------------------------|--------------------------------|-----------|-------------|-----|-------------------|-------------------|
| Approach                   |                                |           |             |     |                   |                   |
| CA vs. AA                  | $.55 ± 1.54 (1186) vs. .91 ± .92 (980) | -.28      | -.28        | .04 | -.36              | -.19              |
| CA vs. GAS                 | $.55 ± 1.54 (1186) vs. 1.28 ± .96 (1160) | -.57      | -.57        | .04 | -.65              | -.48              |
| CA vs. GA                  | $.55 ± 1.54 (1186) vs. 1.29 ± .92 (627)  | -.54      | -.54        | .05 | -.64              | -.45              |
| CA vs. AC                  | $.55 ± 1.54 (1186) vs. 1.15 ± 1.07 (126) | -.40      | -.40        | .09 | -.58              | -.22              |
| CA vs. UKA                 | $.55 ± 1.54 (1186) vs. 1.02 ± 1.0 (236)  | -.32      | -.32        | .07 | -.46              | -.18              |
| AA vs. GAS                 | .91 ± .92 (980) vs. 1.28 ± .96 (1160)  | -.39      | -.39        | .04 | -.48              | -.31              |
| AA vs. GA                  | .91 ± .92 (980) vs. 1.29 ± .92 (627)  | -.41      | -.41        | .05 | -.51              | -.31              |
| AA vs. AC                  | .91 ± .92 (980) vs. 1.15 ± 1.07 (126)  | -.26      | -.26        | .09 | -.44              | -.07              |
| AA vs. UKA                 | .91 ± .92 (980) vs. 1.02 ± 1.0 (236)  | -.12      | -.12        | .07 | -.26              | .02               |
| Avoidance                  |                                |           |             |     |                   |                   |
| CA vs. AA                  | -.05 ± 1.29 (1186) vs. -.91 ± 1.15 (980) | .70       | .70         | .04 | .61               | .79               |
| CA vs. GAS                 | -.05 ± 1.29 (1186) vs. -1.39 ± 1.12 (1160) | 1.11      | 1.11        | .04 | 1.02              | 1.19              |
| CA vs. GA                  | -.05 ± 1.29 (1186) vs. -1.06 ± 1.18 (627) | .81       | .81         | .05 | .71               | .91               |
| CA vs. AC                  | -.05 ± 1.29 (1186) vs. -1.5 ± 1.07 (126) | 1.14      | 1.14        | .10 | .95               | 1.33              |
| CA vs. UKA                 | -.05 ± 1.29 (1186) vs. -55 ± 1.2 (236) | .39       | .39         | .07 | .25               | .53               |
| AA vs. GAS                 | -.91 ± 1.15 (980) vs. -1.39 ± 1.12 (1160) | .42       | .42         | .04 | .34               | .51               |
| AA vs. GA                  | -.91 ± 1.15 (980) vs. -1.06 ± 1.18 (627) | .13       | .13         | .05 | .03               | .23               |
| AA vs. AC                  | -.91 ± 1.15 (980) vs. -1.5 ± 1.07 (126) | .52       | .52         | .10 | .33               | .70               |
| AA vs. UKA                 | -.91 ± 1.15 (980) vs. -55 ± 1.2 (236) | -.31      | -.31        | .07 | -.45              | -.17              |
| NFC                        |                                |           |             |     |                   |                   |
| CA vs. AA                  | 44.90 ± 11.7 (1186) vs. 55.28 ± 11.87 (980) | -.08      | -.08        | .05 | -.097             | -.079             |

Note: CA Chinese adults, AA American adults, GAS German/Austria students, GA German adults, AC Austria couples, UKA UK adults
Sample CA and AA were from the current study, other samples were from Appel et al. [22]
Q3. Cultural features of NFA and NFC in a population targeted by affective motivation-based public health campaigns

The difference in NFA observed between the Chinese and American general public samples was also present in the older participants (≥60 yrs), with a significantly lower approach score in Chinese seniors ($M = −.57, SD = 1.28$) than in American seniors ($M = .93, SD = .81$), $F (1, 586) = 167.33, p < .001, \eta^2_p = .22$, and a significantly higher avoidance score in Chinese seniors ($M = −.42, SD = 1.29$) than in American seniors ($M = −.93, SD = 1.09$), $F (1, 586) = 16.93, p < .001, \eta^2_p = .03$.

Hearing loss was present in 62.6% of the Chinese seniors in the current study. As shown in Fig. 4, compared to seniors without hearing loss, those who had hearing loss had significantly lower NFA approach scores, $F (3, 482) = 9.00, p < .01, \eta^2_p = .05$, significantly lower avoidance scores, $F (3,482) = 26.13, p < .01, \eta^2_p = .05$, and significantly lower NFC scores, $F (3,482) = 14.66, p < .01, \eta^2_p = .08$. There was a small group of individuals ($n = 34$) who reported having normal hearing but failed the pure tone audiometric test and who had similar levels of NFA and NFC (see Table 6) as the normal hearing group.

Intention to avail themselves of early hearing intervention did not differ between groups, $F (3, 482) = 1.01, p = .39, \eta^2_p = .01$. Regardless of hearing status, participants tended to choose “when I have severe hearing loss and have difficulty communicating with others” in response...
to the question “When do you think you will consider wearing hearing aids and take serious action?” Of the 486 community-based participants, only 6.8 and 13.8% reported willingness to seek early intervention when they had mild and moderate hearing loss, respectively. Early hearing intervention intention was significantly predicted by NFC, $B = .174, t = 2.662, p = .008$, but not by the NFA approach score, $B = -.052, t = -.721, p = .471$, or by the NFA avoidance score, $B = .025, t = .339, p = .735$.

**Discussion**

Considering target audiences’ needs for affect and cognition in contexts involving persuasive communication, such as global public health campaigns, is important because matching messages with receivers’ affective and cognitive orientation can significantly improve the effectiveness of persuasive communication [1]. Cultural differences could be associated with different levels of intrinsic motivation and could pose challenges to public health campaigns aiming to evoke desired attitudes and proactive health-promoting actions. The current study demonstrated cultural differences.

We first developed a Chinese translation of the original English NFA scale [22], which demonstrated acceptable psychometric properties. Based on the results of the ESEM, confirmatory factor analysis and multigroup invariance tests, we found that even a conservative one-level two-factor NFA model was able to had reliability and cross-cultural validity in the Chinese and American samples and can thus be used as a culture-fair assessment of NFA.

Our second question regarded the presence of differences in affective and cognitive intrinsic motivation among the Chinese, American and European samples. The Chinese participants reported lower motivation to approach emotional events and activities and a greater tendency to avoid emotion-inducing events and activities than their American and European counterparts (Fig. 2). This finding is consistent with the literature suggesting that Chinese participants demonstrate more aversion to strong emotions than Americans [48] and value high-arousal affective states less than Americans [13, 14]. Cognitive motivation, or the inclination to engage in and enjoy in-depth thinking and the processing of issue-relevant information [49], was also low in the Chinese sample, as previously observed [17].

A key notion underlying the NFA is that it subsumes both a motivation to approach emotions and a motivation to avoid them [6]. These two motivations are considered somewhat distinct in that approach motivations are closely linked to the experience of positive affect (e.g., gain), while avoidance motivations are closely linked to negative affect (e.g., loss) [50, 51]. That said, NFA approach and avoidance both focus on people's attitude toward emotion as an end in itself, i.e., is emotion (positive and negative) something they want to approach or avoid? [22] In this way, they are different from emotion regulation. Behavior is regulated by these two distinct motivations, according to theories of individual differences in motivation [52–54]. People with a predominant approach orientation are more responsive to cues of reward, while people with a predominant avoidance orientation are more responsive to cues of threat and punishment [53]. Hence, it is valuable to examine emotion approach and emotion avoidance separately.

In the present study, whereas NFA approach and avoidance were negatively correlated in the American and European samples, they were positively correlated in the Chinese sample. This counterintuitive motivation to approach emotions might be explained by observations regarding differential reactions to emotions (e.g., strategies to regulate emotions) across cultures [55]. According to Maio [6], people do not approach emotions if they regard them as unproductive or uncomfortable. In other words, if emotions are not generally appreciated by a society, people may prefer to keep them to themselves; their intention to approach emotions may thus be low or, if it is high, may be accompanied by a high level of restraint. Cultures that have a long-term orientation, that have embeddedness values, and that are hierarchical (e.g., East Asian cultures) tend to have higher scores on emotion suppression, and the correlation between emotion reappraisal and suppression tends to be positive, whereas Western cultures demonstrate an inverse relationship between affective approach and avoidance. Potentially, Chinese people have higher emotional ambivalence [56], where emotion desire is often compromised by concerns about the consequences of emotional expression and by efforts to refrain from emotional experience and expression. The goal of these exchanges is to avoid interpersonal conflict and maintain harmony [57], given that Chinese culture places strong emphasis

| Hearing Status | Normal hearing | Mild hearing loss | Moderate-to-severe hearing loss | Hearing loss deniers |
|----------------|----------------|------------------|--------------------------------|---------------------|
| NFA approach   | $-0.62 \pm 1.02$ | $-1.08 \pm 1.05$ | $-0.94 \pm .88$ | $-0.34 \pm 1.31$ |
| NFA avoidance  | $-0.01 \pm 1.16$ | $-0.94 \pm 1.10$ | $-0.93 \pm 1.01$ | $-0.23 \pm 1.27$ |
| NFC            | $54.98 \pm 11.94$ | $47.49 \pm 13.54$ | $45.98 \pm 13.94$ | $52.88 \pm 11.60$ |
on a harmonious and balanced relationship with nature and in social interaction [58]. As a result, affect-based motivation in Chinese culture may vary along a mixed emotion-coping continuum from low approach and low avoidance to high approach and high avoidance (rather than from high approach to high avoidance), with a pre-condition of maintaining balance and harmony in interpersonal and social relationships, which is not typical in Western cultures. We did not assess other affective constructs, personality traits, or culture-representative characteristics (e.g., individualism vs. collectivism, analytic vs. holistic, independent vs. interdependent) due to our lack of a priori model involving these constructs. The current study’s focus was to illustrate overall differences in affective/cognitive intrinsic motivation in the Chinese public compared to American and European samples. Thus, mechanisms of the observed cultural differences in NFA remain an open question for future research.

The low correlations between NFC and NFA within the samples (~.2) but the reliable sample-related differences could also suggest that cultural factors are responsible for differences in NFC. When people value harmonious social relationships, they tend to put less effort into information search and deliberation and into the utilization of issue-relevant information to think, reason and form attitudes and behaviors different from the mainstream [18]. These social strategies reflect low cognitive intrinsic motivation and might be a barrier to persuasive communication [59]. Indeed, as the NFC is essentially an affective scale assessing how enjoyable cognition is to an individual, given that Chinese generally were only 50% certain about whether approaching/avoiding emotions was enjoyable or not (Fig. 2), they might benefit less from emotions and therefore may be less likely to approach cognition than people in other cultures.

Our third objective was to explore whether the intrinsic motivation level of community-based seniors in China with a specific highly prevalent public health condition (i.e., hearing loss) is high, which would warrant affectively motivated health campaigns. Given the reduction in NFA and NFC in Chinese seniors relative to American seniors, Chinese seniors with hearing loss showed even lower NFA and NFC than those without hearing loss. This result differed from our hypothesis that NFA and NFC would be similar in seniors with and without hearing loss. The particularly low level of NFA in seniors with hearing loss might be associated with the link between hearing loss and late-life depression [60], the latter typically indicating motivation disturbance [61]. The decreased level of NFC might be explained by Spotts [62], who reported that age-related declines in cognitive ability could affect NFC. Hearing loss is known to be associated with cognitive decline in older adults [63]; therefore, their cognitive motivations might be constrained by their cognitive capabilities.

Early hearing intervention intention was low regardless of hearing status; the majority of older Chinese people preferred to wait until their hearing condition became difficult to cope with. Our community-based geriatric sample was representative of the urban older population targeted by hearing health campaigns in China. It had a hearing loss prevalence of 62.6%, which is consistent with a previous report [64]. Low levels of NFA and NFC could help explain why geriatric hearing health campaigns in China are less successful than those in America, although Chinese campaigns have followed the American model [20]. A growing body of research in the U.S. has emphasized the importance of affective appeals in efficiently delivering health promotion messages [2]. However, perceptions of affective benefits (e.g., reduced anxiety, depression and stress; elevated self-confidence) and/or instrumental/cognitive outcomes (e.g., reduced risk of developing severe tinnitus and dementia) require a matching level of affective and/or cognitive intrinsic motivation in intended audiences. Our data suggest that this assumption should be questioned.

As the attempt to establish health goals by affective means has a relatively short history in China, the lack of a relationship between NFA (approach or avoidance) and intention to engage in early hearing intervention was not surprising. Given the numerous cultural differences associated with emotion [65], exploring strategies in which messaging is matched to a culture’s need for affect could be helpful in cross-cultural health campaigns. The presence of an association between NFC and early hearing intervention indicates that more effective persuasion might be possible in the Chinese geriatric population if hearing health campaign messages are framed to more specifically reflect the cognitive benefits that audiences actually value to match their low NFC. For example, early intervention could make you feel less “different” from your community (this is important for Chinese individuals). Alternatively, if a subdimension of NFC, such as NFC approach or NFC avoidance, as derived in other translations of the NFC scale [66], is found to be differentially relevant to health intentions, messages could be tailored to match that specific NFC subdimension to increase their persuasive power. We recommend research on these perspectives.

Our study has multiple limitations. First, limited demographic information was collected from the samples. Although the Chinese and American samples were comparable in terms of sex distribution ($\chi^2(1) = 1.782, p = .182$), only 55% of the age data were available in the American sample. Other demographic differences (e.g., education, SES), as well as variables associated in the literature with affective style (e.g., neurodevelopmental history, disease exposure history, social network richness, frontal EEG asymmetry, and exposure to weather...
phenomena) [67–69], might moderate our results. However, public health campaigns normally target audiences at the population level rather than the individual level, and as such, it would have been inappropriate to analyze individual differences in the current study. Our large-scale public samples were representative of the campaign target audiences who have access to the campaign messages usually spread on social media in both countries and advocated across community sites in China, so examining cross-cultural differences in NFA and NFC in those samples, as a whole, is more appropriate for our purposes. Individual differences were not controlled for or covaried, as this would require full analysis and understanding of potential moderation effects [70], which is beyond the scope of the current work. Second, as the original [22] scale scored items from 1 to 7 and the American version scored items from 1 to 5, we could not be consistent with both; our version inherited its scale from Appel’s [22] sample and was thus inconsistent with the American version in terms of scoring. We addressed this inconsistency by linearly converting responses from the American dataset to a 7-point scale, which could have distorted the NFA mean values of the American sample and biased the results. However, this conversion caused only a 0.17% change in the mean value and was unlikely to account for the 6% difference between the means on the 7-point scale. For future research reference, we reported the Chinese and American NFA norms by age and sex on both the 5- and 7-point scales (see supplementary material). The third limitation is the lack of hearing assessment and early hearing intervention intention data from the American sample. As a result, we were unable to directly compare the NFA and NFC levels of seniors with hearing loss between the two cultures. In addition, without data on how individuals in any of our samples responded to an actual public health campaign, all our considerations regarding campaigns, at this point, remain speculation; future research is necessary to confirm them.

These limitations notwithstanding, our results demonstrate a lack of affective and cognitive intrinsic motivation in Chinese individuals compared with the American public. These differences point to a potential challenge in framing effective messages for some cultures. Ideally, recognizing and understanding this challenge will inspire the consideration of novel persuasive strategies for these audiences. For example, using our example of public campaigns targeting hearing loss, instead of replicating the Western hearing healthcare campaign model, messages could target Asian values more specifically, such as by emphasizing a person’s ability to be in harmony with nature (e.g., hearing waterfalls) and society (e.g., reducing others’ communication burden and stress) rather than individual affective and cognitive goals. Another direction might be strengthening the influence of messages using newly available technology. Breves and Heber [71] reported that people low in NFA were influenced by immersive media, while people high in NFA were not, potentially because sensory-rich media experiences offer greater assistance to individuals with lower trait predispositions [72].

Conclusions
We conclude that the need for affect (NFA) construct may transcend its Western origins. Assessing NFA and NFC could inform global public health campaigns by helping frame messages consistent with audiences’ culture-dependent intrinsic motivation.

Abbreviations
NFC: Need for Cognition; NFA: Need for Affect; MANOVA: Multivariate analysis of variance; ESEM: Exploratory Structural Equation Modeling; FIML: Information Maximum Likelihood; CFI: Comparative fit index; NFI: Normed fit index; RMSEA: Root mean square error of approximation

Supplementary Information
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Additional file 1: Appendix. The Chinese version of the Need for Affect-Short Scale. The Chinese translation of the 10-item NFA scale.

Additional file 2: Supplement. Normative NFA values of the general Chinese and American public. The Chinese and American norms of Need for Affect approach and avoidance subscale scores by age and gender in 7-point and 5-point rating scales.

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Authors’ contributions
The contributions of the authors are as follows. Study concept and design: M.Z, G.J.S. Questionnaire development: M.Z, G.J.S., C.Z, C.H. Data collection and organization: B.Z, C.L.Y, R.V., K.A, J.F.W., C.C., C.H. Statistical analysis and results interpretation: M.Z, G.J.S., C.C. Study supervision: J.C, Q.W.R.C.H., and Z.J.B. Performing of the experiment and drafting of the manuscript: M.Z, B.Z, C.C., J. F. W. All authors reviewed and commented on the manuscript at all stages and approved the final manuscript.

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Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations
Ethics approval and consent to participate
The study received approval from Fudan University Huadong Hospital’s Institutional Review Board (No. 2018 K154). The community-based participants signed written consent forms, and consent was waived for the internet participants.
Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests. The audiometric assessment results were discussed with those who were identified as having hearing loss. Information about audiology clinic appointments was provided.

Author details
1 Shanghai Key Laboratory of Clinical Geriatric Medicine, Huadong Hospital, Fudan University, 221 West Yan’an Road, Shanghai, China. 2 Jilin University Community Health Service Center, Shanghai, Songjiang District, China. 3 National Clinical Research Center for Aging and Medicine, Huashan Hospital, Fudan University, Shanghai, China. 4 Department of Political Science, Temple University, Philadelphia, PA, USA. 5 Department of Psychiatry, University of Pittsburgh, Pittsburgh, PA, USA.

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