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ORIGINAL ARTICLE

Evaluation of the Factor Structure and Content Specificity of the Interpretation Bias Task (IBT)

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Abstract

Background Theories suggest that interpretation biases play a role in the aetiology of a range of psychopathology including depression, anxiety and psychosis. We evaluate the psychometric properties of an adapted version of an ambiguous scenario task (i.e., Interpretation Bias Task [IBT]) that assesses benign and negative interpretations in four domains: immediate bodily injury; long-term illness; social rejection; and, performance failure.

Methods The factor structure of the IBT was evaluated in a student sample (N = 237) in Study 1, and subsequently confirmed in a community sample with a wider age range (N = 1103) in Study 2. Correlations between interpretation biases and health and social anxiety symptoms were tested in both studies.

Results The four IBT domains were differentiable and each was represented by two factors (i.e., benign vs. negative). In Study 1, higher health anxiety was characterised by fewer benign interpretations for injury- and illness-related scenarios, whereas higher social anxiety was associated with more negative and fewer benign interpretations for social rejection and performance failure scenarios. Correlational results were replicated in Study 2 for social anxiety, but not health anxiety.

Conclusions The IBT is suitable for measuring interpretation biases in Asian adults. The content specificity of interpretation biases was partially supported.

Keywords Interpretation bias · Social anxiety · Health anxiety · Factor analysis · Content specificity

Introduction

Theoretical models suggest that negative interpretation bias, the tendency to interpret ambiguous information in a negative way, underlie the course and severity of a range of mental disorders including depression, anxiety, and psychosis, and can also influence the treatment of these disorders (Blanchette and Richards 2010; Everaert et al. 2017; Hirsch et al. 2016; Leonidou and Panayiotou 2018; Mobini et al. 2013; Savulich et al. 2012; Stuijfzand et al. 2018). To date, evidence of interpretation bias in relation to different types of anxiety disorders have revealed reasonably consistent results regarding the direction and intensity of these biases (Hirsch et al. 2016; Leonidou and Panayiotou 2018; Mobini et al. 2013; Schoth and Liossi 2017; Stuijfzand et al. 2018). For instance, people with health anxiety might endorse more pain-/illness-related interpretations for ambiguous health-related scenarios (Leonidou and Panayiotou 2018), whereas people with social anxiety might endorse more negative interpretations for situations related to interpersonal interaction or social evaluation, compared to non-anxious people (Hirsch et al. 2016). These negative interpretation biases can contribute to an exaggerated perception of physical/social threat, which might not only influence how people attend to threat-related information but might also encourage threat avoidance that limits the amount of additional and contradictory information that a person might encounter (Hirsch et al. 2016).

Numerous paradigms that use ambiguous words (e.g., die/dye, pain/pane, bury/berry, etc.), pictures (e.g., emotional and neutral facial expressions), or scenarios (e.g., "You have visitors round for a meal and they leave sooner than expected") as stimuli have been developed to measure

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interpretation biases, among which ambiguous scenarios have been most frequently adopted (Schoth and Liossi 2017). One of the advantages of ambiguous scenarios over word and pictorial stimuli is that they contain contextual information that approximate real-world situations and therefore may be more ecologically valid. For example, in a similarity rating task, participants are first presented with ambiguous scenarios that can be interpreted in either a negative or a benign way (Mathews and Mackintosh 2000; Schoth and Liossi 2017). In a subsequent recognition phase, participants are shown disambiguated threatening or non-threatening sentences and they need to rate the similarity of each of these sentences to the scenarios formerly presented (Mathews and Mackintosh 2000; Schoth and Liossi 2017). Higher similarity ratings for threatening sentences indicate more negative interpretation biases.

Despite the wide variety of tasks available for measuring interpretation biases, research findings regarding the content specificity of this bias are not yet conclusive. Content specificity refers to the extent to which the contents of the observed biases specifically match the psychopathology that a person experiences (Beck 1976). For example, patients with depression may endorse more negative interpretations for depression-/rumination-specific information (Hirsch et al. 2016), whereas psychosis-related paranoia may be characterised by an interpretation bias specifically for paranoid information (Savulich et al. 2015, 2017). Similar findings have been revealed in the anxiety literature, where negative interpretation biases and anxiety are associated more strongly when the contents of interpretation correspond to the subtype of anxiety (Blanchette and Richards 2010; Stuijfzand et al. 2018). However, almost all existing evidence regarding the content specificity of interpretation biases in anxiety disorders has only compared social and non-social scenarios, broadly defined, within the context of social anxiety (Blanchette and Richards 2010; Stuijfzand et al. 2018).

Paralleling the psychopathology literature, interpretation biases have also been studied in the context of physical health problems such as chronic pain. In particular, patients with chronic pain have been found to endorse more threatening interpretations for pain-/illness-related information (Schoth and Liossi 2016). This interpretation bias has also been suggested to contribute to heightened levels of pain-related fear, which may then alter pain expectations and exacerbate the intensity and interference of pain in this population (Vlaeyen and Linton 2000). One novel paradigm that emerged from this literature is the Adolescent Interpretations of Bodily Threat (AIBT) task which contains 16 vignettes that describe ambiguous situations in two different domains of daily life (i.e., eight situations related to bodily threat and eight situations related to social evaluation; Heathcote et al. 2016). Each ambiguous situation contains one benign and one negative possible consequence. Participants are asked to first imagine themselves in these situations and then (1) rate whether each consequence is likely to pop into their mind, and (2) rate their belief that each interpretation would actually happen in reality. Using this task, Heathcote et al. (2017) found that adolescent chronic pain patients endorsed fewer benign interpretations for bodily threat scenarios compared to healthy controls, but this group difference did not extend to social situations, suggesting that the AIBT task is a suitable measure of interpretation biases while also providing evidence for content specificity in their patient sample.

More recently, this task has been adapted to include a wider array of scenarios and validated by factor analyses in adolescents with and without persistent and impairing pain (Lau et al. 2020). The original bodily threat domain has been expanded to include eight scenarios describing immediate bodily injury (e.g., cut) and eight scenarios describing long-term illness (e.g., tumour). Similarly, the original social evaluation domain has been expanded to include eight scenarios describing social rejection and eight describing performance failure (Lau et al. 2020). In this expanded AIBT, an example of an immediate bodily injury scenario is: 'Someone kicks a ball and it hits you in the face. In the mirror you see your face is covered in …'. Participants are first presented with each ambiguous situation and then are offered words that resolve the situation in a negative or benign manner, for example, 'mud' or 'blood'. They are then asked to rate the likelihood that each consequence would actually happen on a 5-point scale. Higher ratings for the word 'blood' reflect a more negative interpretation while higher ratings for the word 'mud' indicate a more benign interpretation. Similarly, an example of a long-term illness situation is 'You take a pill every morning at breakfast. The pill is a …' followed by 'vitamin' and 'medicine'. An example of a social rejection situation is 'You are walking and as you approach the people in front of you, you hear them say your name. They are saying something …' followed by 'positive' and 'negative'. Finally, an example of a performance failure situation is 'Your teacher has decided to give a surprise test. You are sure that you will do …' followed by 'well' and 'badly'. In their study, Lau et al. (2020) collapsed the immediate bodily injury and long-term illness domains into one subscale and the social rejection and performance failure domains into another subscale following model-fitting of item coherence. However, contrary to the content specificity hypothesis, their results showed that adolescents with moderate-to-high pain interference endorsed a more negative and less benign interpretation bias across all domains compared to adolescents without interfering pain (Lau et al. 2020).

Despite the novelty of the original and adapted AIBT tasks, several research gaps are evident. First, this task has only been used in Western adolescent samples with and without pain problems (Heathcote et al. 2016, 2017; Lau et al. 2020) and therefore its suitability for adult samples

and for people from non-Western cultures remains unknown. Second, although a significant body of research has examined the role of interpretation biases in anxiety disorders (Blanchette and Richards 2010; Hirsch et al. 2016; Mobini et al. 2013; Stuijfzand et al. 2018), no study has yet tested the associations between responses to the AIBT task and different subtypes of anxiety symptoms, such as health and social anxiety. Although the AIBT task was originally developed for pain research, scenarios in the immediate bodily injury and long-term illness domains also appear highly relevant to health anxiety, which is characterised by the catastrophisation of bodily sensations and constant worry about having or acquiring a disease (Rachman 2012). In comparison, scenarios in social rejection and performance failure domains appear more relevant to social anxiety, which is characterised by the fear of negative social feedback and perfectionistic self-presentation (Nepon et al. 2011). Additionally, previous studies using the AIBT task revealed mixed results regarding its content specificity (Heathcote et al. 2016, 2017; Lau et al. 2020). This inconsistency highlights the need for replication in larger and more varied samples of participants.

The current article presents two studies to fill these research gaps. We adopted the expanded AIBT task from Lau et al.'s study (2020) that includes four domains of scenarios (i.e., immediate bodily injury, long-term illness, social rejection, and performance failure) and then examined its factor structure using two adult samples. Since the acronym "AIBT" stands for Adolescent Interpretations of Bodily Threat, to avoid ambiguity, and to highlight the inclusion of social scenarios within this measure, we renamed this task as the Interpretation Bias Task (IBT). Unlike previous studies, we instructed participants in the current study to rate how likely each consequence would actually happen on a scale from 1 (not at all likely) to 100 (extremely likely) since we hypothesised that individual differences in interpretation biases would be more precisely captured by measuring the perceived likelihood percentage of potential consequences rather than the 5-point Likert scales used previously (Heathcote et al. 2016, 2017; Lau et al. 2020). We expected that each domain of the IBT could be represented by two unique factors, one for benign resolutions and one for negative resolutions. We also expected that the four domains could be represented by distinct factors. In addition, to determine the content specificity of interpretation biases, the associations between responses to this task and health and social anxiety symptoms were investigated. In particular, we expected that people with elevated health anxiety symptoms might endorse more negative and fewer benign interpretations for immediate bodily injury and long-term illness scenarios, whereas people with higher social anxiety symptoms might endorse more negative and fewer benign interpretations for social rejection and performance failure scenarios.

Study 1

Methods

Participants

Study 1 was advertised through bulk emails sent to students and on noticeboards placed around the campus of the corresponding author institution. The inclusion criteria were: (1) university students, (2) Asian, and (3) able to read and understand Traditional Chinese. Interested and eligible participants completed an online questionnaire battery via a link provided in the advertisements. All participants who completed the questionnaires were entered into a lucky draw with a chance to win cash rewards. Three hundred and two participants submitted their responses to the online questionnaires. Four participants did the questionnaire two times (i.e., duplicate responses). One participant did not provide demographic information. Sixty participants did not complete the interpretation bias task. Therefore, only the remaining 237 participants (167 females, 70.5%) were included in the factor analyses. Participants' ages ranged from 17 to 40 years ($M = 19.37$, $SD = 2.40$). Ethical approval for this study was obtained from the Human Research Ethics Committee (HREC) of the corresponding author institution. All participants provided online informed consent before they started the survey.

Measures

Interpretation Bias Task The IBT consists of 32 vignettes (eight for each domain) describing ambiguous situations in four different domains of daily life (i.e., immediate bodily injury, long-term illness, social rejection, and performance failure). As the participants in the current study were university students proficient in Chinese, we performed translation and back-translation for all scenarios and resolutions in the IBT with native speakers experienced in translating English to Chinese. Participants were first presented with each ambiguous situation and were instructed to imagine themselves in the situation. They were then offered words that resolve the situation in a benign or negative manner. Participants were asked to rate how likely each resolution would actually happen on a scale from 1 to 100 (1 = not at all likely; 100 = extremely likely). As there were four domains and each domain comprised eight scenarios, with two response options for each (i.e., benign and negative), participants responded to 64 resolutions in total. Interpretation bias in each domain could be computed using a composite of two scores: (1) the mean likelihood of benign interpretations (i.e., such that a higher score reflects the belief that benign

interpretations are likely to be true); (2) the mean likelihood of negative interpretations of the ambiguous situations (i.e., such that a larger score reflects the belief that negative interpretations are likely to be true). Therefore, interpretation biases in each domain could be indexed by a benign and a negative score, which add up to eight average scores in total.

Health Anxiety The Health Anxiety Inventory (HAI) short version was used to measure participants' perceptions regarding the likelihood and feared negative consequences of becoming ill (Salkovskis et al. 2002). This measure has previously been translated into Chinese (Zhang et al. 2015). The HAI comprises 18 items regarding the frequency that respondents worry about health, each consisting of four statements that range from 0 to 3 (0 = never; 3 = always; Zhang et al. 2015). A higher total score on HAI indicates a higher level of health anxiety symptoms. In the current study, Cronbach's alpha was good (0.87) for the HAI.

Social Anxiety The Liebowitz Social Anxiety Scale (LSAS) was used to measure participants' social anxiety symptoms (Liebowitz 1987). Translation into Traditional Chinese as well as back-translation were performed for the LSAS. Participants rated the extent to which each of the 24 social situations evoke fear (0 = none, 1 = mild, 2 = moderate, 3 = severe) and the extent to which they would avoid them (0 = never, 1 = occasionally, 2 = often, 3 = severe; Liebowitz 1987). A higher total score on LSAS indicates a higher level of social anxiety symptoms. In this study, Cronbach's alpha was excellent (0.97) for the LSAS.

Procedure

After providing informed consent, participants completed the IBT. Each domain was presented to participants in a random order. Within each domain, the scenarios appeared in a fixed order across participants. Following the presentation of each ambiguous situation (i.e., a sentence with a blank), a benign resolution was shown first and participants were instructed to rate the likelihood that it would actually happen on a scale from 1 to 100. A negative resolution was then shown and participants were asked to rate the likelihood again. The two ratings were independent of each other such that they do not need to add up to 100. Participants then completed the HAI and LSAS, after which they were presented with a debriefing form.

Analytical Procedure

We first performed four confirmatory factor analyses (CFA) to examine our a priori assumption about the structure of the model. That is, the four domains are conceptually independent and each could be represented by a two-factor model (benign vs. negative). The rationale behind the distinction between benign and negative factors is that recent reviews identified both the lack of positive interpretations and the presence of negative interpretation biases in people with depression and different subtypes of anxiety (Everaert et al. 2017; Hirsch et al. 2016; Leonidou and Panayiotou 2018; Stuijfzand et al. 2018). Therefore, it is theoretically important to distinguish between benign and negative interpretation biases, and to assess these biases in different domains separately. As such, we regarded the IBT as a set of scales that assess both benign and negative interpretation biases in different domains rather than a task that provides a sum score across valences and domains. For domains where the two-factor CFAs provided good model fit, no further exploratory factor analyses (EFA) were performed. For domains where model fits were poor, EFAs were conducted for item selection.

The four CFAs were performed using the 'lavaan' package (Rosseel 2012) in R 3.5.1 (R Core Team 2018) separately for the four domains in the IBT (i.e., immediate bodily injury, long-term illness, social rejection, and performance failure), each specifying a two-factor model (benign vs. negative). We expected that there would be a stable two-factor structure (benign vs. negative) across domains. Error covariances between responses to benign and negative resolutions in each scenario were added in these CFAs. This is because each scenario in the IBT contains two resolutions, thus requiring two responses from the participants. These two responses to the same scenario may not only be influenced by the hypothesised latent construct (valence: benign vs. negative), but might also be influenced by other unspecified causes associated with the ambiguous scenario itself. Put otherwise, the residual terms of the two responses to each scenario might covary to some extent since both are associated with identical contextual information (Mueller and Hancock 2008). Therefore, it is theoretically justifiable to allow residual terms of the two resolutions in each scenario to freely covary (Mueller and Hancock 2008).

To assess model fit, we used the Comparative Fit Index (CFI; Hu and Bentler 1999), Tucker–Lewis Index (TLI; McDonald and Marsh 1990), the Root Mean Square Error of Approximation (RMSEA; Browne and Cudeck 1993), the Standardised Root Mean Square (SRMR; Mueller and Hancock 2008), and the Chi-square (Mueller and Hancock 2008). Good model fit can be inferred if (1) CFI and TLI values are close to 0.95 or greater; (2) RMSEA values are close to 0.06 or lower; and (3) SRMR values are close to 0.08 or lower (Hu and Bentler 1999). CFI and TLI values in the range of 0.90 to 0.95 may be indicative of acceptable model fit (Brown 2006).

Subsequently, EFAs were performed on domains that resulted in unsatisfactory CFA model fit. Similarly, we

Table 1 Factor loadings and reasons for exclusion of the two-factor EFA for the immediate bodily injury domain

Ambiguous immediate bodily injury scenarios	Resolutions	Factor 1 (negative)	Factor 2 (benign)	Reasons for exclusion
1. You suddenly jump out of your chair and put your hands to your face, making a loud noise. You are	Surprised	0.23	0.18	Poor loadings
	Hurt	0.27	0.10	
2. Yesterday you worked on your computer for many hours. In the end you finished your work. Today you are	Free	0.20	0.28	Poor loadings
	Sore	0.30	− 0.01	
3. Yesterday your bicycle was hit by a car. You will not be able to cycle for a while because the car broke your	Bike	0.14	**0.47**	
	Leg	0.28	0.04	
4. Someone kicks a ball and it hits you in the face. In the mirror you see your face is covered in	Mud	− 0.06	**0.48**	
	Blood	**0.62**	0.02	
5. You are hiking and try to jump over a log. Something gets caught. It is your	Trousers	0.08	**0.52**	
	Leg	**0.48**	0.22	
6. You are walking home. Suddenly there is a very loud noise. It is	Firework	0.11	0.28	
	Gunshots	**0.45**	− 0.03	
7. You are helping prepare dinner and are cutting some vegetables. The knife slips and accidentally cuts into your	Food	− 0.37	0.36	The negative resolution is most believable based on common phraseology
	Finger	**0.51**	0.04	
8. You are being driven in a car. Suddenly the car hits another car in front of you. You are	Unharmed	− 0.20	0.36	
	Injured	**0.43**	0.01	

Bold values are statistically significant for > 0.40

conducted EFAs separately for each domain, estimating two factors (benign vs. negative). Due to the unique response format of the IBT (i.e., each situation comprises two different resolutions), we set three criteria for item exclusion. In particular, we removed the whole scenario including both resolutions from the IBT if: (1) both resolutions within a scenario had factor loadings lower than 0.40, or (2) both resolutions had loadings larger than 0.40 on the same factor, or (3) any resolution had loadings larger than 0.40 on both factors (i.e., cross loading) with a gap smaller than 0.20. Besides excluding scenarios based on factor loadings, we also removed scenarios with inappropriate wordings or imprecise translation.

To examine the associations between anxiety symptoms (i.e., health anxiety symptoms and social anxiety symptoms) and benign and negative interpretations for each domain, correlation tests were conducted among responses to the HAI, LSAS, and the IBT. Specifically, we calculated the total scores of HAI and LSAS for each participant and calculated the mean likelihood of benign and negative interpretations for remaining scenarios in each of the four domains in the IBT. We also conducted partial correlations between HAI and IBT responses while controlling for LSAS scores, and between LSAS and IBT responses while controlling for HAI scores. Due to the number of correlation tests performed (2 questionnaire scores × 8 IBT scores), the alpha level was adjusted to 0.003 (0.05/16 = 0.003125) for all correlation tests (Armstrong 2014).

Results

Factor Analyses

CFAs were first performed separately for each of the four domains. The performance failure domain resulted in good model fit, CFI = 0.96, TLI = 0.94, RMSEA = 0.05, SRMR = 0.06, $\chi^2(95) = 156.55$ ($p < 0.001$), and therefore all scenarios within this domain were retained. However, the fit indices were unsatisfactory for immediate bodily injury (CFI = 0.76, TLI = 0.70, RMSEA = 0.07, SRMR = 0.08, $\chi^2(95) = 194.10$ [$p < 0.001$]), long-term illness (CFI = 0.84, TLI = 0.80, RMSEA = 0.07, SRMR = 0.08, $\chi^2(95) = 202.92$ [$p < 0.001$]), and social rejection domains (CFI = 0.83, TLI = 0.79, RMSEA = 0.09, SRMR = 0.09, $\chi^2(95) = 280.07$ [$p < 0.001$]).

The immediate bodily injury, long-term illness and social rejection scenarios were then entered into three separate EFAs. Tables 1, 2, and 3 present the factor loadings resulting from the 2-factor EFAs for each domain respectively as well as the reasons for exclusion. For the immediate bodily injury domain, two scenarios were removed due to low factor loadings and one scenario was removed as, on reflection, the negative resolution for this scenario seemed particularly believable, and the benign interpretation seemed particularly unbelievable, given the way that the sentence stem was worded ('You are helping prepare dinner and are cutting some vegetables. The knife slips and accidentally cuts into your …' where 'food' was the benign

Table 2 Factor loadings and reasons for exclusion of the two-factor EFA for the long-term illness domain

Ambiguous long-term illness scenarios	Resolutions	Factor 1 (negative)	Factor 2 (benign)	Reasons for exclusion
1. You have made an appointment to see your doctor to discuss your test results. You think the results will probably show you are	Fine	−0.01	0.25	
	Ill	**0.44**	0.03	
2. You take a pill every morning at breakfast. The pill is a	Vitamin	0.03	**0.48**	
	Medicine	**0.53**	−0.10	
3. It is 10am on a Monday and you are still in bed. You are at home because you have a	Holiday	0.00	0.32	
	Cold	**0.63**	0.12	
4. You feel weak and your stomach is making noises. You are	Hungry	−0.12	**0.66**	
	Sick	**0.62**	−0.29	
5. You are lying on the couch. Your body is heavy and your eyes are closing. You are	Tired	−0.01	**0.65**	
	Unwell	**0.63**	0.01	
6. You have a lump on your foot, which makes putting shoes on difficult. This lump is a	Blister	0.35	0.25	Both resolutions are negatively valenced
	Tumour	**0.44**	−0.15	
7. You begin to breath heavily. Your chest is quickly going up and down. You are	Exercising	−0.12	**0.54**	
	Asthmatic	**0.64**	−0.14	
8. When you wake up you notice that your eyes are swollen and it is difficult to open them. You must be	Tired	0.02	0.09	Poor loadings
	Allergic	0.33	0.13	

Bold values are statistically significant for > 0.40

Table 3 Factor loadings and reasons for exclusion of the two-factor EFA for the social rejection domain

Ambiguous social rejection scenarios	Resolutions	Factor 1 (negative)	Factor 2 (benign)	Reasons for exclusion
1. You meet someone new and get along well with them. At a birthday party the two of you talk for a long time. When you see them the next day, they smile at you and then leave quickly. You are sure that this is because they find you quite	Attractive	−0.31	0.18	Poor loadings
	Irritating	0.31	0.02	
2. You receive a notification that someone you know has put a comment on your picture on Facebook. While opening the webpage you think that it will be something	Nice	0.07	**0.62**	
	Nasty	0.03	−0.35	
3. You have been asked to give a quick announcement about an upcoming event at school/work. As you begin to make the announcement, people begin to	Clap	−0.05	**0.42**	Imprecise translation
	Giggle	0.07	−0.17	
4. Your best friend invites you to go out with their new friends. You hesitate at first but then agree to come along. At the end of the evening you think that the other people thought that you were	Lovely	−0.05	**0.83**	Both items loaded on the benign factor
	Dull	0.33	**−0.50**	
5. You are walking and as you approach the people in front of you, you hear them say your name. They are saying something	Positive	−0.15	**0.67**	
	Negative	0.39	−0.37	
6. You are having lunch with some friends. One of them invites another person who seems to know most people in the group. When they talk they do not look at you. They are	Shy	−0.06	0.15	Poor loadings
	Unkind	0.32	0.21	
7. You have just had your haircut. Another person around your age keeps looking at you. Your haircut makes you look	Hot	−0.37	**0.55**	
	Weird	**0.65**	−0.20	
8. You are with a group of people and everyone has to share a story. You are first. After you finish the other people look	Impressed	−0.39	**0.61**	
	Bored	**0.61**	−0.38	

Bold values are statistically significant for > 0.40

interpretation and 'finger' was the negative interpretation; see Table 1). For the long-term illness domain, one scenario was removed due to low factor loadings and another scenario was removed as both of its resolutions were, on reflection, negatively-valenced ('You have a lump on your foot, which makes putting shoes on difficult. This lump is a …' followed by 'blister' and 'tumour'; see Table 2). Regarding the social rejection domain, two scenarios were excluded because of low loadings, one was excluded because both resolutions within this scenario loaded on the same factor,

Table 4 Correlations and partial correlations between anxiety symptoms and interpretation biases in Study 1

	HAI	HAI (controlling for LSAS)	LSAS	LSAS (controlling for HAI)
Immediate bodily injury—benign	−0.24*	−0.24*	−0.06	0.07
Immediate bodily injury—negative	0.07	0.08	0.00	−0.05
Long-term illness—benign	−0.22*	−0.23*	−0.05	0.07
Long-term illness—negative	0.16	0.19	−0.00	−0.10
Social rejection—benign	−0.25*	−0.06	−0.42*	−0.35*
Social rejection—negative	0.19	0.02	0.35*	0.30*
Performance failure—benign	−0.26*	−0.10	−0.37*	−0.29*
Performance failure—negative	0.16	0.02	0.28*	0.23*

HAI Health Anxiety Inventory, *LSAS* Liebowitz Social Anxiety Scale

*$p < 0.003125$

and one was excluded because the Chinese translation of the negative resolution inadequately represented the meaning of the original English term ('You have been asked to give a quick announcement about an upcoming event at school/work. As you begin to make the announcement, people begin to …' followed by 'clap' and 'giggle'; see Table 3).

Correlational Analyses

Only 209 participants were included in correlation tests with the HAI, and only 211 participants were included in correlation tests with the LSAS due to random missing values for these two questionnaires. Based on the results from the factor analyses, we calculated mean likelihoods of benign and negative interpretations in each domain using only the selected scenarios (i.e., immediate bodily injury: scenarios 3–6 and 8; long-term illness: scenarios 1–5 and 7; social rejection: scenarios 2, 5, 7 and 8; performance failure: scenarios 1–8). We then performed correlation tests between these IBT scores and the total scores of HAI and LSAS. Table 4 presents the results of these correlations and partial correlations (with Bonferroni correction).[1]

Participants' health anxiety symptoms were negatively correlated with benign interpretation bias scores in all four domains, but did not correlate significantly with negative interpretation bias scores in any domain. After controlling for social anxiety symptoms, participants with higher health anxiety symptoms endorsed fewer benign interpretations for immediate bodily injury and long-term illness situations but not for social rejection or performance failure situations. Correlations between health anxiety symptoms and negative interpretation bias scores remained non-significant in all domains.

Participants' social anxiety symptoms were positively correlated with negative interpretations for ambiguous social rejection and performance failure situations and negatively correlated with benign interpretations for these two domains, but social anxiety symptoms did not correlate significantly with interpretation biases for immediate bodily injury or long-term illness scenarios. These findings persisted even after health anxiety symptoms were added as a covariate.

Discussion

Study 1 provided preliminary evidence regarding the psychometric properties of the IBT in an Asian university student sample. The performance failure domain had good model fit, whereas the immediate bodily injury, long-term illness, and social rejection domains initially retrieved unsatisfactory fits. It may be that some of the scenarios in the original task could not precisely capture interpretation biases in Asian adults or users of Traditional Chinese. We therefore performed EFAs to examine whether there were scenarios with bad loadings that should be removed from the IBT. Although the model fit of the IBT with its remaining scenarios was not confirmed within Study 1, this study nonetheless demonstrated moderate correlations between health anxiety symptoms and interpretation biases for health-related scenarios, as well as associations between social anxiety symptoms and interpretation biases for social scenarios. Interestingly, it appears that health anxiety is only characterised by the view that benign interpretations for injury-/illness-related scenarios are unlikely, whereas social anxiety is characterised by the view that benign interpretations are unlikely and negative interpretations are highly likely within social scenarios. In addition, associations between interpretation biases and anxiety symptoms were only evident when

[1] A correlation table presenting results without Bonferroni correction is available via this link: https://osf.io/dzjc7/?view_only=24e2f9ba1eeb4c668496a5b9807c4ca1.

the content of scenarios matched the anxiety subtypes, indicating that responses to the IBT may be content-specific.

Study 2

To confirm the factor structure of the IBT derived from Study 1, and to examine whether the correlational findings between anxiety symptoms and interpretation biases could be replicated, we conducted a second study in a larger community sample (not limited to university students) with a wider age range. Specifically, we collected responses from an Asian adult sample again and conducted CFAs with only the remaining scenarios in the IBT (i.e., immediate bodily injury: scenarios 3–6 and 8; long-term illness: scenarios 1–5 and 7; social rejection: scenarios 2, 5, 7 and 8; performance failure: scenarios 1–8). We also performed similar correlation tests between responses to the IBT, HAI and LSAS.

Methods

Participants

The online questionnaire battery used in Study 1 was advertised again through bulk emails and on noticeboards around the campus of the corresponding author institution. The inclusion criteria were: (1) 18–65 years of age, (2) Asian, and (3) able to read and understand Traditional Chinese. Interested and eligible participants completed an online questionnaire battery via a link provided in the advertisements. All participants who completed the questionnaires were entered into a lucky draw with a chance to win cash rewards. One thousand three hundred and sixty-six participants submitted their responses. One hundred and two participants submitted twice (i.e., duplicate responses). One hundred and fifty-four participants did not complete the IBT. Seven people participated in the first study, and thus were excluded from the second study. Therefore, only the remaining 1103 participants (757 females, 68.6%) were included in the factor analyses. The age ranged from 17 to 64 years ($M = 26.34$, $SD = 8.36$).

Measures and Procedure

Similar to Study 1, all participants completed the IBT, HAI, and LSAS. The IBT only included the selected scenarios from Study 1 (i.e., immediate bodily injury: scenarios 3–6 and 8; long-term illness: scenarios 1–5 and 7; social rejection: scenarios 2, 5, 7 and 8; performance failure: scenarios 1–8). In Study 2, Cronbach's alpha was acceptable (0.75) for the IBT, good (0.87) for the HAI and excellent (0.96) for the LSAS.

Analytical Procedure

Based on the factor structure derived from Study 1, we performed four CFAs for the four domains separately with remaining scenarios in the IBT using the new sample. Each of these four CFAs specified a 2-factor model (i.e., benign and negative). We also attempted to conduct a large CFA estimating eight factors (4 domains × 2 valences) with all remaining scenarios in the IBT in order to test whether the four domains could be explicitly distinguished. The same model fit indices and cutoff criteria were used in Study 2 as in Study 1. Finally, correlation and partial correlation tests were run between responses to the IBT, and HAI and LSAS.

Results

Factor Analyses

Four CFAs were performed with remaining scenarios in the four domains of the IBT. Results revealed satisfactory fits for immediate bodily injury(CFI = 0.91, TLI = 0.87, RMSEA = 0.06, SRMR = 0.05, $\chi^2(29) = 150.41$ [$p < 0.001$]), long-term illness (CFI = 0.91, TLI = 0.88, RMSEA = 0.07, SRMR = 0.06, $\chi^2(47) = 262.24$ [$p < 0.001$]), social rejection (CFI = 0.96, TLI = 0.93, RMSEA = 0.07, SRMR = 0.05, $\chi^2(15) = 99.95$ [$p < 0.001$]), and performance failure domains (CFI = 0.96, TLI = 0.96, RMSEA = 0.05, SRMR = 0.05, $\chi^2(95) = 333.39$ [$p < 0.001$]). Further, the 8-factor CFA including all four domains also revealed good model fit (CFI = 0.90, TLI = 0.89, RMSEA = 0.04, SRMR = 0.06, $\chi^2(938) = 2521.63$ [$p < 0.001$]).[2] These results confirmed that the four domains (i.e., immediate bodily injury, long-term illness, social rejection and performance failure) and the two valences (i.e., benign and negative) are separable in the IBT.

Correlational Analyses

Only 1099 participants were included in correlation tests with the HAI, and only 1089 participants were included in correlation tests with the LSAS due to random missing values for these two questionnaires. Table 5 presents the results of correlations and partial correlations (with Bonferroni correction) between participants' interpretation biases and health and social anxiety symptoms.[3]

Contrary to the results in Study 1, health anxiety symptoms were now positively correlated with negative

[2] The final version of the IBT (both Chinese and English) and a summary table for this 8-factor CFA are available via this link: https://osf.io/dzjc7/?view_only=24e2f9ba1eeb4c668496a5b9807c4ca1.

[3] A correlation table presenting results without Bonferroni correction is available via this link: https://osf.io/dzjc7/?view_only=24e2f9ba1eeb4c668496a5b9807c4ca1.

Table 5 Correlations and partial correlations between anxiety symptoms and interpretation biases in Study 2

	HAI	HAI (controlling for LSAS)	LSAS	LSAS (controlling for HAI)
Immediate bodily injury—benign	−0.13*	−0.11*	−0.06	−00.01
Immediate bodily injury—negative	0.26*	0.21*	0.18*	0.08
Long-term illness—benign	−0.24*	−0.21*	−0.13*	−0.04
Long-term illness—negative	0.39*	0.34*	0.21*	0.07
Social rejection—benign	−0.24*	−0.14*	−0.30*	−0.23*
Social rejection—negative	0.30*	0.18*	0.35*	0.26*
Performance failure—benign	−0.30*	−0.19*	−0.34*	−0.26*
Performance failure—negative	0.32*	0.22*	0.34*	0.24*

HAI Health Anxiety Inventory, *LSAS* Liebowitz Social Anxiety Scale

*$p < 0.003125$

interpretation bias scores and negatively correlated with benign interpretation bias scores in all four domains. These effects persisted even after controlling for social anxiety symptom levels.

Similarly, social anxiety symptoms were now significantly correlated with all IBT scores except for benign interpretation for immediate bodily injury situations. After controlling for health anxiety symptoms, however, results from Study 1 were replicated. More specifically, social anxiety symptoms were positively correlated with negative interpretations for social rejection and performance failure situations and negatively correlated with benign interpretations for these two domains, but social anxiety symptoms did not correlate significantly with interpretation bias scores for immediate bodily injury or long-term illness scenarios.

Discussion

Study 2 confirmed that the factor structure derived from Study 1 possesses satisfactory to good model fit. However, some correlations between interpretation biases and anxiety symptoms were inconsistent with that in the first study. More specifically, health anxiety symptoms were only negatively correlated with benign interpretation scores in immediate bodily injury and long-term illness domains in Study 1, whereas in Study 2 health anxiety symptoms were correlated with all IBT scores even after controlling for social anxiety symptom levels. Nevertheless, the two studies were consistent in that social anxiety symptoms were only associated with IBT scores in social rejection and performance failure domains, but not that in immediate bodily injury and long-term illness domains. The content specificity hypothesis only appears to be supported for social anxiety symptoms across studies, but not for health anxiety symptoms.

General Discussion

The current article presented two studies that evaluated the psychometric properties of the IBT, an adapted version of the AIBT task (Heathcote et al. 2016), a computerised task that measures interpretation biases of ambiguous scenarios that could happen in different domains of daily life. Results of the factorial analyses revealed a clear structure of the IBT with eight distinct factors (4 domains × 2 valences). More specifically, the four domains of the IBT (i.e., immediate bodily injury, long-term illness, social rejection and performance failure) were separable and each could be represented by a two-factor structure (i.e., benign and negative). The presence of these eight factors indicated that interpretation biases vary across domains and across valences. Results demonstrated the suitability of the IBT in assessing interpretation biases in different contexts among young Asian adults.

Regarding the correlations between health anxiety symptoms and interpretation biases, the two studies showed inconsistent results. In particular, in Study 1, we found that those with elevated health anxiety symptoms had fewer benign interpretations for immediate bodily injury and long-term illness scenarios, but these effects did not extend to negative interpretations or to other social scenarios (after controlling for social anxiety symptoms). In contrast, in Study 2, health anxiety symptoms were correlated with all IBT scores whether or not social anxiety symptoms were added as a covariate. Here we suggest two possible explanations for this inconsistency. First, Study 1 was limited to a university student sample, whereas Study 2 recruited adults who aged from 17 to 64 years. It is possible that interpretive processes and their association with anxiety symptoms vary across age cohorts (e.g., younger vs. older adults) and across different samples (e.g., university vs. community samples). Second, Study 2 had a sample size that is four times larger than that in Study 1; the overall significant correlations between health anxiety symptoms and IBT scores in Study 2 may be

a partial function of the sample size. Despite the inconsistent findings, both studies suggest that injury-/illness-related interpretation biases may be important cognitive factors in the context of health anxiety. In particular, the decreased tendency to interpret injury-/illness-related information in a benign manner might influence the way people attend to, encode and remember this information, which might then result in an overestimation of the likelihood and negative consequences of potential illnesses, as well as maladaptive behaviours such as repeatedly checking one's body for signs of illness (Leonidou and Panayiotou 2018; Rachman 2012).

Both studies found that people with higher social anxiety symptoms endorsed more negative and fewer benign interpretations for social rejection and performance failure situations, but not for immediate bodily injury and long-term illness situations (after controlling for health anxiety symptoms). These results are in line with recent reviews that confirmed the associations between social anxiety and the tendency to interpret ambiguous social information in a catastrophic fashion in both adults and adolescents (Blanchette and Richards 2010; Hirsch et al. 2016; Stuijfzand et al. 2018). These findings also add to current evidence regarding the role of interpretation biases in the maintenance and exacerbation of social anxiety. In particular, the tendency to interpret social information negatively might result in an exaggerated estimation of the negative consequences of social interactions, which might then contribute to behaviours such as avoidance of eye contact or of social interaction altogether (Heimberg et al. 2014; Nepon et al. 2011).

The findings of the current study only provided partial support for the content specificity of the IBT and interpretation biases. Put otherwise, the content specificity hypothesis only held for correlations between interpretation biases and social anxiety symptoms, but not when health anxiety symptoms were examined. It is possible that social anxiety is characterised by a negative interpretation bias for ambiguous social scenarios only, while health anxiety is characterised by an overall interpretation bias across domains. Although this contention warrants further investigation, this study is not the first that provided evidence against the content specificity of the IBT. Heathcote et al. (2016) found that adolescents with more pain issues in the past 3 months endorsed more negative and fewer benign interpretations for ambiguous scenarios across bodily threat and social domains. Lau et al. (2020) found that adolescents with moderate-to-high pain interference had a more negative and less benign interpretation bias across all four domains of the expanded AIBT task compared to those without interfering pain. It is important for future studies to test whether the domain specificity of interpretation biases varies between anxiety subtypes. It is also important to determine which aspect of interpretation biases (i.e., domain and valence) underlies the maintenance of anxiety symptoms using longitudinal designs.

One might be concerned that some resolutions in the IBT scenarios are seemingly two ends of a single dimension. For example, the scenario "You have made an appointment to see your doctor to discuss your test results. You think the results will probably show you are …" contains two resolutions, "ill" and "fine", that can be considered as two extreme cases on a single dimension. However, the two resolutions in each scenario do not necessarily have to be mutually exclusive. In both of our studies, we instructed the participants to give ratings to the benign and negative resolutions that do not need to add up to 100, which means that they could give high/low ratings to both resolutions at the same time. Heathcote et al. (2017) found that adolescents with chronic pain had fewer benign interpretations for bodily threat scenarios than healthy controls, but this difference was not evident for the negative interpretation score. Therefore, being less likely to interpret ambiguous scenarios in a benign manner might not always mean a person is more likely to interpret these scenarios negatively. This suggests that the benign and negative resolutions in each domain are independent and should not be condensed into a single dimension.

Several limitations are evident. First, both studies were based on participants' self-report of their anxiety symptoms. Although recent reviews have confirmed that illness- and social-related interpretation biases are evident in patients with clinical health and social anxiety disorders (Hirsch et al. 2016; Leonidou and Panayiotou 2018), future studies should assess the IBT in clinical populations so that the psychometric properties of this task can be further established. Relatedly, in both studies we did not assess participants' current status or history of mental disorders. Therefore, we were not able to control for the possible confounding effects of concurrent, or historical, psychiatric diagnoses. Also, we did not control for the effect of generalised anxiety symptoms in both studies. Recent reviews have confirmed that people with generalised anxiety disorder have a non-specific negative and threat-oriented interpretation bias for all sorts of ambiguous information, which may be reflective of the wide range of worry topics evident in this population (Hirsch et al. 2016; Stuijfzand et al. 2018). Participants with elevated generalised anxiety symptoms may also have high health anxiety symptoms, and may endorse more negative interpretations across all domains of the IBT. Therefore, the significant correlations between health anxiety symptoms and all IBT scores in Study 2 might be driven by generalised anxiety symptoms in our participants.

Moreover, scenarios in the original version of our task (i.e., the AIBT task) were generated based on two adolescent samples (aged 16–18 years) recruited from secondary schools in the UK (Heathcote et al. 2016). The expanded version of the AIBT task was also assessed in British adolescents aged 16–19 years (Lau et al. 2020). Therefore, it may be that the current set of IBT scenarios are more

concern-relevant to British adolescents than to Asian adults. For example, consider one scenario in the performance failure domain: "Your teacher has decided to give a surprise test. You are sure that you will do …" followed by "well" (benign) and "badly" (negative). This scenario appears more suitable for student samples than for older adults who no longer need to take courses and exams, and therefore may not accurately capture interpretation biases in non-student adults in our second sample. These items were nonetheless considered appropriate for inclusion in the IBT because most individuals can probably recall such a scenario even if they are not currently experiencing it. Also, a recent study found that Hong Kong residents were more positively biased compared to people living in the UK when tested on culturally-validated tasks measuring interpretation biases (Yiend et al. 2019). As such, future studies may need to examine age and cultural differences in participants' responses to the IBT, and determine whether inclusion of more age- or culture-specific scenarios might improve the reliability and validity of the IBT.

Finally, in our IBT we explicitly instructed participants to imagine themselves in the ambiguous scenarios, which may involve mental imagery in addition to interpretation biases. In the depression literature, theoretical models and evidence have emphasised the critical role of mental imagery in interpretation biases such that the use of mental imagery may amplify the impact of interpretation biases on depressive symptoms (Everaert et al. 2017; Holmes et al. 2009). Future studies should examine whether responses to the IBT differ between imagery perspectives (i.e., first-person vs. third-person) and vary as a function of the extent to which mental imagery is involved during the task.

Conclusion

In summary, the two studies in the current article evaluated the factor structure of the IBT. Results showed that interpretation biases can be differentiated across domains (i.e., immediate bodily injury, long-term illness, social rejection and performance failure) and between valences (i.e., benign vs. negative). The IBT is a suitable measure of interpretation biases for healthy Asian adults including those with elevated levels of health/social anxiety symptoms. Correlational analyses showed that social anxiety symptoms were associated with interpretation biases for social rejection and performance failure scenarios, but not for injury-/illness-related scenarios. However, it remains unclear whether interpretation biases in relation to health anxiety symptoms are content-specific. Future testing with clinical samples, comparisons between different populations, and considerations of mental imagery as well as other important moderating factors, is warranted.

This line of research will also serve as a foundation for future studies that modify and advance existing treatments that specifically target this cognitive mechanism. In particular, interpretation bias modification programs encouraging stronger beliefs in benign interpretations of ambiguous information have already been developed for populations with health (Antognelli et al. 2020) and social anxiety (Mobini et al. 2013). Although most bias modification studies have been conducted in Western, English-speaking samples, here the psychometric properties of the IBT have been evaluated in different languages (i.e., English and Chinese) and in different age groups (i.e., adolescents and adults). As such, the IBT may now be incorporated as a useful outcome measure in future bias modification studies to allow for more direct comparisons across study populations.

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Data Availability The data and code for this study are available via the link: https://osf.io/dzjc7/?view_only=24e2f9ba1eeb4c668496a5b9807c4ca1.

Compliance with Ethical Standards

Conflict of Interest Frederick H. F. Chan, Keisuke Takano, Jennifer Y. F. Lau, and Tom J. Barry declare that they have no conflict of interest.

Ethical Approval Ethics approval was obtained from the Human Research Ethics Committee (HREC) of the University of Hong Kong (Reference Number: EA1705032).

Animal Rights No animal studies were carried out by the authors for this article.

Informed Consent Informed consent was obtained from all individual participants included in the study.

References

Antognelli, S. L., Sharrock, M. J., & Newby, J. M. (2020). A randomised controlled trial of computerised interpretation bias modification for health anxiety. *Journal of Behavior Therapy and Experimental Psychiatry, 66*, 101518. https://doi.org/10.1016/j.jbtep.2019.101518.

Armstrong, R. A. (2014). When to use the Bonferroni correction. *Ophthalmic & Physiological Optics: The Journal of the British College of Ophthalmic Opticians (Optometrists), 34*, 502–508. https://doi.org/10.1111/opo.12131.

Beck, A. T. (1976). *Cognitive therapy and the emotional disorders*. New York: International University Press.

Blanchette, I., & Richards, A. (2010). The influence of affect on higher level cognition: A review of research on interpretation, judgement, decision making and reasoning. *Cognition and Emotion, 24*(4), 561–595.

Brown, T. A. (2006). *Confirmatory factor analysis for applied research*. New York: Guilford Press.

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 136–162). Newbury Park, CA: Sage.

Everaert, J., Podina, I. R., & Koster, E. H. W. (2017). A comprehensive meta-analysis of interpretation biases in depression. *Clinical Psychology Review, 58*, 33–48. https://doi.org/10.1016/j.cpr.2017.09.005.

Heathcote, L. C., Jacobs, K., Eccleston, C., Fox, E., & Lau, J. Y. F. (2017). Biased interpretations of ambiguous bodily threat information in adolescents with chronic pain. *Pain, 158*(3), 471–478. https://doi.org/10.1097/j.pain.0000000000000781.

Heathcote, L. C., Koopmans, M., Eccleston, C., Fox, E., Jacobs, K., Wilkinson, N., et al. (2016). Negative interpretation bias and the experience of pain in adolescents. *Journal of Pain, 17*(9), 972–981. https://doi.org/10.1016/j.jpain.2016.05.009.

Heimberg, R. G., Brozovich, F. A., & Rapee, R. M. (2014). A cognitive-behavioral model of social anxiety disorder: Update and extension. In S. G. Hofmann & P. M. DiBartolo (Eds.), *social anxiety* (3rd ed., pp. 705–728). Cambridge: Academic Press.

Hirsch, C. R., Meeten, F., Krahé, C., & Reeder, C. (2016). Resolving ambiguity in emotional disorders: The nature and role of interpretation biases. *Annual Review of Clinical Psychology, 12*, 281–305. https://doi.org/10.1146/annurev-clinpsy-021815-093436.

Holmes, E. A., Lang, T. J., & Deeprose, C. (2009). Mental imagery and emotion in treatment across disorders: Using the example of depression. *Cognitive Behaviour Therapy, 38*(S1), 21–28. https://doi.org/10.1080/16506070902980729.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*(1), 1–55. https://doi.org/10.1080/10705519909540118.

Lau, J. Y. F., Badaoui, M., Meehan, A. J., Heathcote, L. C., Barker, E. D., & Rimes, K. A. (2020). Assessing the content specificity of interpretation biases in community adolescents with persistent and interfering pain. *Pain, 161*(2), 319–327.

Leonidou, C., & Panayiotou, G. (2018). How do illness-anxious individuals process health-threatening information? A systematic review of evidence for the cognitive-behavioral model. *Journal of Psychosomatic Research, 111*(June), 100–115. https://doi.org/10.1016/j.jpsychores.2018.06.001.

Liebowitz, M. R. (1987). Social phobia. In D. F. Klein (Ed.), *Anxiety* (pp. 141–173). Basel: Karger Publishers.

Mathews, A., & Mackintosh, B. (2000). Induced emotional interpretation bias and anxiety. *Journal of Abnormal Psychology, 109*(4), 602–615. https://doi.org/10.1037/0021-843X.109.4.602.

McDonald, R. P., & Marsh, H. W. (1990). Choosing a multivariate model: Noncentrality and goodness of fit. *Psychological Bulletin, 107*, 247.

Mobini, S., Reynolds, S., & Mackintosh, B. (2013). Clinical implications of cognitive bias modification for interpretative biases in social anxiety: An integrative literature review. *Cognitive Therapy and Research, 37*, 173–182.

Mueller, R. O., & Hancock, G. R. (2008). Best practices in structural equation modeling. In J. Osborne (Ed.), *best practices in quantitative methods* (pp. 488–508). Thousand Oaks, CA: SAGE Publications Inc.

Nepon, T., Flett, G. L., Hewitt, P. L., & Molnar, D. S. (2011). Perfectionism, negative social feedback, and interpersonal rumination in depression and social anxiety. *Canadian Journal of Behavioural Science, 43*(4), 297–308.

R Core Team. (2018). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. https://www.r-project.org/

Rachman, S. (2012). Health anxiety disorders: A cognitive construal. *Behaviour Research and Therapy, 50*(7–8), 502–512.

Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software, 48*(2), 1–36.

Salkovskis, P. M., Rimes, K. A., Warwick, H. M., & Clark, D. M. (2002). The Health Anxiety Inventory: Development and validation of scales for the measurement of health anxiety and hypochondriasis. *Psychological Medicine, 32*(5), 843–853.

Savulich, G., Freeman, D., Shergill, S., & Yiend, J. (2015). Interpretation biases in paranoia. *Behavior Therapy, 46*, 110–124. https://doi.org/10.1016/j.beth.2014.08.002.

Savulich, G., Shergill, S., & Yiend, J. (2012). Biased cognition in psychosis. *Journal of Experimental Psychopathology, 3*(4), 514–536. https://doi.org/10.5127/jep.016711.

Savulich, G., Shergill, S. S., & Yiend, J. (2017). Interpretation biases in clinical paranoia. *Clinical Psychological Science, 5*(6), 985–1000. https://doi.org/10.1177/2167702617718180.

Schoth, D. E., & Liossi, C. (2016). Biased interpretation of ambiguous information in patients with chronic pain: A systematic review and meta-analysis of current studies. *Health Psychology, 35*(9), 944–956. https://doi.org/10.1037/hea0000342.

Schoth, D. E., & Liossi, C. (2017). A systematic review of experimental paradigms for exploring biased interpretation of ambiguous information with emotional and neutral associations. *Frontiers in Psychology, 8*, 171. https://doi.org/10.3389/fpsyg.2017.00171.

Stuijfzand, S., Creswell, C., Field, A. P., Pearcey, S., & Dodd, H. (2018). Research review: Is anxiety associated with negative interpretations of ambiguity in children and adolescents? A systematic review and meta-analysis. *The Journal of Child Psychology and Psychiatry, 59*(11), 1127–1142.

Vlaeyen, J. W. S., & Linton, S. J. (2000). Fear-avoidance and its consequences in chronic musculoskeletal pain: A state of the art. *Pain, 85*, 317–332.

Yiend, J., André, J., Smith, L., Chen, L. H., Toulopoulou, T., Chen, E., et al. (2019). Biased cognition in East Asian and Western cultures. *PLoS ONE, 14*(10), e0223358. https://doi.org/10.1371/journal.pone.0223358.

Zhang, Y., Liu, R., Li, G., Mao, S., & Yuan, Y. (2015). The reliability and validity of a Chinese-version Short Health Anxiety Inventory: An investigation of university students. *Neuropsychiatric Disease and Treatment, 11*, 1739–1747. https://doi.org/10.2147/NDT.S83501.