How useful is the Rehearsal Scale for Children – Chinese in measuring emotional rehearsal in pre-adolescents of different ages?

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The Rehearsal Scale for Children – Chinese (RSC-C) measures the propensity to rehearse emotionally taxing experiences in children, however, the initial development of the scale has overlooked the validity of the scale for pre-adolescents of different ages whose cognitive development may differ considerably. Therefore, the aim of this study was to explore the internal validity of RSC-C for the different age groups (aged 6-7, 8-9 and 10-12) across an age range of 6 to12 years. Confirmatory factor analysis based on the original factor structure suggested that the internal validity of the RSC-C is poor and the scale was modified for the age groups concerned. Test-retest reliability for the modified scales was stronger for the younger age groups and moderate concurrent validity against the Chinese Trait Anxiety Scale for Children (CTAS-C) was established. No gender differences were found. The results highlight the importance of testing the validity of a psychometric instrument across different age ranges, given the potential for significant developmental differences. The current study also provided a new set of psychometrically sound RSC-C for the different age groups to promote greater understanding of the role of emotional rehearsal and psychological stress in physical and psychological well-being in young children.

Introduction

Emotional rehearsal is a generic type of rumination which refers to the propensity to recurrently think about emotionally taxing events that may or may not have taken place (Roger & Nesshoever ,1987). Rehearsal has been associated with psychological stress in adults where high rehearsers exhibited delayed heart rate recovery following a stress-inducing task (Roger & Jamieson, 1988) and nurses with high rehearsal tendencies demonstrated elevated salivary cortisol level before a major exam compared to low rehearsers (Roger & Najarian, 1998). To evaluate rehearsal tendencies, the Rehearsal Subscale of the Emotion Control Questionnaire (ECQ) was designed for western adults (Roger & Nesshoever ,1987). The scale was later translated and adapted for Chinese 6-12 year-old pre-adolescents (the Rehearsal Scale for Children – Chinese; RSC-C) and an association between propensity for rehearsal, negative health behavioural change, adiposity and body image was evident (Ling, Maxwell, Masters, & McManus, 2010; Ling, Masters, & McManus, 2011; Ling, Masters, Yu, & McManus, 2011; Ling, Masters, McManus, & Polman, 2013). Specifically, children with high rehearsal tendencies were more likely to become less active when they were reminded about their relatively low habitual physical activity level (Ling et al., 2011a). Moreover, while rehearsal tendencies were positively linked with adiposity, low rehearsal tendencies were associated with body size underestimation in Chinese children (Ling, Masters, Yu, & McManus, 2011; Ling, McManus, Knowles, Masters, & Polman, 2013). Authors of the above studies involving the Chinese population argued the possible role of psychological stress as a behavioural mediator and/or a physiological mediator, however, the concurrent validity of the RSC-C with psychological stress is yet unknown.

Another potential psychometric issue with the RSC-C is its validity for the different age groups within the targeted age range, despite following standard procedures to ensure its face validity, as well as internal, convergent and divergent validity in its initial validation (Ling, Maxwell, Masters, & McManus, 2010). The development of self-report psychometric instruments for children is inherently challenging due to validity issues arising from continuous emotional and cognitive growth during the relatively short span of childhood (Cremeens, Eiser, & Blades,

2006). Issues pertaining to the validity of an instrument for younger children include understanding of emotional terms, meanings of items (semantic, representational) and the construct in question, as well as the memory of one's own experiences. These issues are likely to affect the internal validity of an instrument should it be completed by children of different ages. For example, Marsh, Graven, and Debus (1991) reported an improvement in model fit associated with age for the Self-Description Questionnaire-I, which measures self-concepts in children aged 5-8 years. For this reason, it is vital that validity of psychometric instruments, especially those designed for children from a wide age range, is ascertained for the different periods within childhood (Solan et al., 2008). While some researchers have gone to extra lengths to provide different age appropriate versions of the same instrument (French, Christie, & Snowden, 1994), others have fallen short in this relatively rigorous process when children of all ages (typically around 6-12 years) are involved in the validation process. In the latter process, good validity within one age group may mask weaker validity within another. As a result, the meaningfulness of the results obtained in research adopting these instruments might be affected, leading to subsequent equivocal conclusions despite the inclusion of children from the same age group but from different age ranges.

In view of this, an aim of the current study was to explore the internal validity of the RSC-C for three age groups (6-7 years, 8-9 years and 10-12 years), and to modify the model(s) to achieve a sound internal validity where necessary. Test-retest reliability of the modified model(s) for the respective age groups was also investigated. An additional aim was to examine the concurrent validity of the RSC-C, using the Chinese Trait Anxiety Scale for Children (CTAS-C; Li & Lopez, 2004) to ensure the sensitivity of the RSC-C to psychological stress, which was found in the original Rehearsal Subscale from the ECQ (Roger & Jamieson, 1988; Roger & Najarian, 1998). As previously discussed, with psychological stress posited to be a possible mediator for the link between rehearsal and adiposity/health behavioural change in children (Ling, Masters, & McManus, 2011; Ling, Masters, Yu, & McManus, 2011), it is essential that the concurrent validity of the RSC-C, using a psychometrically sound instrument that measures trait-oriented psychological stress, is ascertained. Thus, we hypothesized that a moderate to strong correlation would

exist between the RSC-C and the CTAS-C. In addition, we aimed to test gender differences in the propensity for rehearsal due to contradictory findings presented in previous research (Ling, Maxwell, Masters, & McManus, 2010; Ling, Masters, Yu, & McManus, 2011), again based on the modified questionnaires for the age groups in question.

Method

Participants and Procedure

Parental consent was obtained from 490 participants, aged 6-12, from a local government aided primary school in Hong Kong and the RSC-C was completed at Time 1 (267 boys, 223 girls; mean age = 9.11years ± 1.66). A sub-sample of 248 children (135 boys, 113 girls; mean age = 10.28 years ± 1.15) completed the questionnaire again a year later (Time 2) together with the CTAS-C (Li & Lopez, 2004). Both questionnaires were completed in the participants' classrooms on a normal school day with the assistance of a teacher. The study protocol was approved by the Institutional Review Board for Human Ethics.

Measures

Rehearsal Scale for Children − Chinese (RSC-C). The 13-item RSC-C (Ling, Maxwell, Masters, & McManus, 2010) measures the propensity to rehearse emotionally taxing adverse experiences in 6-12 year-old Chinese children. Each item is anchored by 1 = *never* and 4 = *all the time*. An example item is 'If you lose out, would you get over it quickly?'. The RSC-C showed good internal validity and satisfactory test-retest reliability (α= .43). Its convergent and divergent validity was demonstrated against the Emotional Symptoms Subscale and the Prosocial Subscale of the Chinese version of the Strengths and Difficulties Questionnaire (SDQ) (Goodman, 1997).

Chinese Trait Anxiety Scale for Children (CTAS-C). The CTAS-C (Li & Lopez, 2004) was translated from the State-Trait Anxiety Inventory for Children, which measures the relatively stable disposition for anxiety in stressful experiences

in 7-12 year-old children (Speilberger, Edwards, Ushene, Monturoi, & Platzek, 1973). The CTAS-C consists of 20 items, each of which is rated on a 3-point Likert scale (1 = *hardly* to 3 = *often*). Example items are "I worry too much" and "I notice my heart beats fast". The CTAS-C possesses high test-retest reliability (α = .76 to .91) and internal consistency (*r* = .73 to .92) across different age and gender groups.

Analysis Strategy

For the confirmatory factor analyses (CFAs), each age group was randomly divided into two sets to allow for factor structure testing (the exploratory sample) and for cross-validation (the cross-validation sample) purpose. This procedure can help ascertain the stability of the model across the population of interest (Anderson & Gerbing, 1998). Factor structure of the RSC-C was tested for the exploratory sample of 6-12 year-olds and for each age group (6-7 years, 8-9 years and 10-12 years) at Time 1 using AMOS 5.0 software for structural equation modeling (Arbuckle, 2003). The goodness-of-fit index criteria adopted to determine the model fit included the standardized root mean square residual (SRMR; less than or equal to .08 for a good fit), the root mean square error of approximation (RMSEA; close to or less than .06 for a good fit), the Tucker-Lewis Index (TLI) and the comparative fit index (CFI; greater than or equal to .95 and .90 to reflect a good fit and an adequate fit respectively) (Hu & Bentler, 1999). Model modification, based on cross-correlation of error terms, modification indexes, factor loadings (greater than or equal to .34 was considered as acceptable) (Stevens, 2002) and model parsimony (Cheung & Rensvold, 2002; Cheng, 2007), was carried out for the factor structures that did not meet the minimum criteria. The modified models were then tested again using the cross-validation sample. Once the model fit for each age group was demonstrated to be satisfactory, all measurement weights and structural covariances were constrained to be equal to ensure that the modified model was valid for comparison for gender differences at Time 1. Invariance between the two gender groups was based on significant changes in chi-square and goodness-of-fit indexes from the constrained to unconstrained model (Byrne, 2004). With non-significant changes from the constrained to unconstrained model, gender differences in rehearsal tendencies were tested using one-way ANOVAs. Lastly, test-retest reliability was evaluated and the concurrent validity of the modified RSC-C against

the CTAS-C for each age group was determined using Pearson Product-Moment correlation analysis.

Results

RSC-C Internal Validity

Contrary to the model fit of the original RSC-C (Ling, Maxwell, Masters, & McManus, 2010), our results presented a less than satisfactory model fit for use in this exploratory sample of 6-12 year-old Chinese children (χ^2[65] = 139.50, p < .01; SRMR = .06; RMSEA = .07; CFI = .86; TLI = .83). Factor loadings of the items ranged from .04 to .67. Mean score of the scale was 28.87 ± 6.66. When each age group was tested separately, the CFAs indicated poor model fit and low factor loadings for some items (see Table 1). Therefore, we proceeded with model modification for each age group and a summary of the model fit and factor loadings for the modified model using the exploratory and cross-validation samples for each age group was provided in Table 1. Appendix I shows the English and the Chinese version of the original RSC-C and the items retained for each age group after CFAs were conducted.

Model modification of the RSC-C for age 6-7. Results of the CFA showed that the covariances of several error terms appeared to be notably larger than the others, including items 2 and 12, items 4 and 13, items 5 and 11, items 7 and 8 as well as items 10 and 11, suggesting that these items may be similar in content. Thus these items were allowed to correlate systematically and a good model fit was achieved (χ^2[60] = 67.18; p > .05; SRMR = .08; RMSEA = .04; CFI = .96; TLI = .95). Further improvement to the model fit was achieved by deleting items not meeting the factor loading criteria (items 3, 4, 9, 12 and 13) and those just meeting the criteria (items 2, 6) (χ^2[6] = 1.70; p > .05; SRMR = .02; RMSEA = .00; CFI = 1.00; TLI = 1.08). This new model was confirmed by the cross-validation sample with factor loadings of the remaining items ranging from .45 to .73 (χ^2[6] = 3.01; p > .05; SRMR = .02; RMSEA = .00; CFI = 1.00; TLI = 1.08), thus no further changes were made to the model.

Model modification of the RSC-C for age 8-9. After systematically correlating the error terms of items that showed larger covariances than those of the other items, i.e., items 2 and 8, items 4 and 11, items 8 and 9, items 3 and 12, items 7 and 10, items 1 and 8, and items 5 and 10, the model fit was improved to a satisfactory level (χ^2[58] = 68.23; p > .05; SRMR = .08; RMSEA = .05; CFI = .93; TLI = .91). Further improvement to the model fit was achieved after deleting items that failed to meet the factor loading criteria (items 3, 4, 6, 9, 12 and 13) (χ^2[10] = 4.07; p > .05; SRMR = .03; RMSEA = .00; CFI = 1.00; TLI = 1.14). Factor structure of the modified scale was confirmed with the cross-validation sample (χ^2[10] = 9.72; p > .05; SRMR = .06; RMSEA = .00; CFI = 1.00; TLI = 1.01), thus no further changes were made to the model. Factor loadings of the remaining items ranged from .43 to .86.

Model modification of the RSC-C for age 10-12. Model fit of the scale was satisfactorily improved after correlating the larger error terms systematically – for items 3 and 12, items 8 and 10, items 4 and 12, items 1 and 2, items 6 and 9, items 2 and 9, items 10 and 12, items 5 and 7, items 5 and 11, and items 1 and 6 (χ^2[55] = 58.10; p > .05; SRMR = .08; RMSEA = .03; CFI = .99; TLI = .98). Removal of items not meeting the factor loading criteria (items 3, 4, 12 and 13) and item 6 which just met the criteria further improved the model fit (χ^2[15] = 9.10; p > .05; SRMR = .04; RMSEA = .00; CFI = 1.00; TLI = 1.06). The cross-validation sample of the 10-12 year group confirmed the newly modified model (χ^2[15] = 25.87; p > .05; SRMR = .04; RMSEA = .00; CFI = 1.00; TLI = 1.10) with factor loadings ranging from .36 to .74. No further changes were made to the model.

Table 1 Mean±SD, Model fit indices and factor loading range of the RSC-C for the original model and the modified model for each age group at Time 1

	Mean±SD		χ^2	df	p	SRMR	RMSEA	CFI	TLI	Factor loadings	Final items
6-7 yrs	29.91±7.81(n=85)	Original factor structure	111.49	65	.00	.09	.09	.77	.72	-.002 -.71	---
	---	Model modification (exploratory sample)	1.70	6	.95	.02	.00	1.00	1.08	.59 - .73	---
	29.75±6.91(n=79)	Model confirmation (cross-validation sample)	3.01	6	.81	.02	.00	1.00	1.08	.45 - .73	1, 5, 7, 8, 10,11
8-9 yrs	29.47±7.44(n=70)	Original factor structure	104.91	65	.00	.10	.09	.74	.68	.14 - .74	---
	---	Model modification (exploratory sample)	4.07	10	.94	.03	.00	1.00	1.14	.46 - .70	---
	30.00±6.92(n=67)	Model confirmation (cross-validation sample)	9.72	10	.47	.06	.04	1.00	1.01	.43 - .86	1, 2, 5, 7, 8, 10,11
10-12 yrs	28.88±6.48(n=95)	Original factor structure	120.48	65	.00	.10	.10	.80	.76	.03 -.76	---

---	Model modification (exploratory sample)	9.10	15	.87	.04	.00	1.00	.1.06	.39 - .75	---
28.56±6.09(n=94)	Model confirmation (cross-validation sample)	8.16	15	.92	.04	.04	1.00	1.10	.36 - .74	1, 2, 5, 7, 8, 9, 10, 11

Note. χ^2 = chi-square; *df* = degree of freedom; SRMR = standardized root mean square; RMSEA = root mean square error of approximation; CFI = comparative fit index; TLI = Tucker-Lewis index

Test-Retest Reliability and Concurrent Validity

The revised scale for each age group demonstrated satisfactory to moderate one-year test-retest reliability (α = .63, .54 and .40 for aged 6-7, 8-9 and 10-12 respectively). In addition, Pearson's product moment correlation showed significant positive moderate correlations between the revised RSC-C scores and the CTAS-C results at Time 2 (aged 6-7 = .48, aged 8-9 = .62 and aged 10-12 = .67).

Table 2 RSC-C Mean ± SD at Time 1 (T1) and Time 2 (T2), Cronbach's α for the test-retest data as well as correlations with CTAS-C at Time 2 based on the modified models for the respective age groups

	Mean ± SD	Cronbach's α	CTAS-C
Test-retest data (6-7 year olds)	T1: 13.34 ± 4.96 (n=164)		
	T2: 13.97 ± 4.84 (n=64)	.63	.48*
Test-retest data (8-9 year olds)	T1: 16.09 ± 4.76 (n=137)		
	T2: 16.36 ± 4.51 (n=117)	.54	.62*
Test-retest data (10-12 year olds)	T1: 20.07 ± 5.19 (n=189)		
	T2: 21.07 ± 5.11 (n=67)	.40	.67*

* $p < .01$ (two-tailed)

Gender Differences

A non-significant chi-square change from the constrained to unconstrained model was found for each age group (see Table 3 for details), indicating that the scale was fit for comparison between genders for the respective age groups. No significant difference between genders was identified from the one-way ANOVAs for all age groups (for aged 6-7, ($F(1,163)$ = 1.58, p = .21; for age 8-9, ($F(1,136)$ = 1.39, p = .24; for age 10-12, ($F(1,188)$ = 32, p = .57).

Table 3 *RSC-C Mean ± SD, Model fit indices for multigroup comparisons and ANOVA results for gender differences at Time 1 based on the modified models for the respective age groups*

	Mean ± SD		χ^2	df	p	SRMR	RMSEA	CFI	TLI	ANOVA (η^2)
6-7 year olds	boys: 13.79 ± 4.83 (n=87)	Unconstrained model	5.52	12	.94	.03	.00	1.00	1.01	
	girls: 12.82 ± 5.10 (n=77)	Constrained model	8.95	17	.94	.04	.00	1.00	1.01	*p* = .21 (.01)
		Δ measurement weights	3.43	5	.63	.01	.00	.00	.00	
8-9 year olds	boys :16.56 ± 5.45 (n=70)	Unconstrained model	22.10	20	.34	.04	.03	.99	.98	
	girls : 15.60 ± 3.90 (n=67)	Constrained model	26.47	26	.48	.05	.01	1.00	1.00	*p* = .24 (.01)
		Δ measurement weights	4.37	6	.63	.01	.02	.01	.02	
10-12 year olds	boys : 17.86 ± 4.67 (n=110)	Unconstrained model	28.68	30	.54	.03	.03	1.00	1.01	
	girls : 18.25 ± 4.69 (n=79)	Constrained model	35.78	37	.53	.05	.03	1.00	1.01	*p* = .57(.001)
		Δ measurement weights	7.1	7	.43	.02	.00	.00	.00	

Note. Δ measurement weights = change in measurement weights; χ^2 = chi-square; *df* = degree of freedom; SRMR = standardized root mean square; RMSEA = root mean square error of approximation; CFI = comparative fit index; TLI = Tucker-Lewis index; η^2 = eta-squared

Discussion

For this cohort of 6-12 year-olds, the RSC-C demonstrated a less satisfactory internal validity than indicated by Ling et al (Ling, Maxwell, Masters, & McManus, 2010). Applying the original factor structure to each age group (i.e., 6-7 years, 8-9 years and 10-12 years) revealed a poor model fit. As expected, each age group presented a different factor structure after the model was modified. The numerous correlations of error terms for each age group with almost half of the corresponding items subsequently removed from the original scale in the modification process may simply reflect the duplication of meanings in the items concerned and/or a poor fit of these items to the substantive theory. For instance, item 5 (Do you ever forget people making you angry or upset, even about small things?) and item 11, (Do you keep thinking about upsetting things?) appear similar in content and their error terms were correlated in the youngest group's model. Also, items referring to more specific experiences – 'If you see/hear about an accident, would you find yourself thinking about something similar happening to you or to other people close to you?' (item 4) and 'If you have to confront someone (such as parents, teachers or classmates), would you think a lot about it beforehand?' (item 13) were both removed from the modified questionnaires, possibly because neither scenario was applicable to most children as they had not experienced or could not imagine experiencing these events and/or the associated emotions. Although the number of items deleted from the original scale may seem extensive, especially for the younger groups, we consider it acceptable as longer questionnaires might pose greater cognitive demand for the younger children, and with more than one questionnaire often included in research projects, the internal validity of the questionnaires may be sacrificed as a result of the cognitive overload. Therefore, it is particularly crucial to uphold the principle of parsimony in the validation of questionnaires for children, as presented in our current investigation, in order to only include psychometrically and theoretically sound items.

The test-retest reliability of the modified RSC-C was higher for the younger age groups, yet for the 10-12 year-olds, the result was similar to the original validation study (Ling, Maxwell, Masters, & McManus, 2010). The current findings

are perhaps not surprising as the versatility of coping mechanisms may be influenced by experiences as well as social and cognitive development (Compas, Conor-Smith, Saltzman, Thomsen, & Wadsworth, 2001). Moreover, the moderate correlations between the RSC-C and the CTAS-C suggest that propensity to rehearse may be related to psychological stress, as proposed in previous research by Ling and colleagues (Ling, Masters, & McManus, 2011; Ling, Masters, Yu, & McManus, 2011). Future research that assesses the association between propensity for rehearsal and biological markers of stress arising during natural stress-provoking experiences could provide insight into the potential self-regulatory mechanisms contributing to the development of psychopathology in childhood.

Gender differences vary between studies when different age ranges are included (Ling, Maxwell, Masters, & McManus, 2010; Ling, Masters, Yu, & McManus, 2011), potentially reflecting the original instrument's poor internal validity. Nonetheless, the current study confirmed that Chinese pre-adolescent boys and girls did not differ in the propensity for rehearsal. It is possible that gender differences do not emerge until the beginning of adolescence, when hormonal functioning becomes increasingly distinct between the sexes (Kajantie & Phillips, 2006). Future research could prospectively monitor changes in the propensity for rehearsal over the course of childhood to track when gender differences might start to emerge. Eventually, it may be possible to design intervention strategies that promote a more adaptive coping style over this critical period of growth.

Despite the rigorous approach to the validation of the RSC-C, caution is needed in the interpretation of our results. First, the sample size for both the CFA and the retest of the scale was somewhat limited, especially with the former being divided for the exploratory and cross-validation purpose. Nevertheless, we trust the credibility of our findings as the acceptance criteria for the scale validation were made stringent until parsimony was achieved. Secondly, verbal feedback from teachers of the participating school indicated that more assistance was given to the youngest age group and so the questionnaire is less self-administering in nature compared to the older children. This is almost inevitable in the completion of questionnaires for this age group, due to their relatively limited linguistic and cognitive ability (Flavell, 1999). To aid understanding and to retain attention for

younger children, attempts could be made to incorporate pictorial presentations in both the questions and the response scale. However, should a different format be adopted for younger children, it is imperative to ensure that the versions for both older and younger children measure the same construct and that they are sensitive to developmental changes.

Conclusion

The current study has confirmed the internal validity of the modified versions of the RSC-C for Chinese pre-adolescents aged 6-7, 8-9 and 10-12. Our results highlight the importance of establishing the validity of a psychometric instrument by age group, particularly when children differing in cognitive and emotional development are included. Our study has also established the concurrent validity of the RSC-C against a trait measure of anxiety suggesting a potential link between psychological stress and propensity for emotional rehearsal in children. The newly modified instruments can thus provide clinicians with further insights into the type of maladaptive coping strategies contributing to psychological stress in young children and can potentially enable early detection of the development of rehearsal tendencies so as for interventions involving more effective coping strategies to be implemented. Future research can also utilize the RSC-Cs to enhance our understanding of the role of emotional rehearsal in health behaviours and physical health in young children.

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Appendix I. *Items in the Original RSC-C in English and in Chinese (Ling et al, 2010)*

1. Do you remember unpleasant things that upset you or made you feel unhappy for a long time afterwards? [a, b, c]

    對於很久以前發生的不愉快事情，你還會記著嗎?

2. Do you get "worked up" just thinking about things that have upset you in the past? [b, c]

    想起以前不愉快的事情時，你會感到不愉快嗎?

3. Can you usually settle things quickly and be friendly again afterwards?

    你會不停地想起一些令你生氣的事情嗎?

4. If you see/hear about an accident, would you find yourself thinking about something similar happening to you or to other people close to you?

    當你知道一件意外發生後，你會想著事情發生在自己或自己親近的人身上嗎?

5. Do you ever forget people making you angry or upset, even about small things? [a, b, c]

    在一些小事情上，你會記著曾令你生氣或不愉快的人嗎?

6. Do you find it hard to get thoughts about things that have upset you out of your mind?

    你會否覺得要不去想不愉快的事情是困難的嗎

7. Do you daydream about situations where you're getting your own back at people? [a, b, c]

    你會否想像向他人報仇時的情形呢?

8. If you see something that frightens or upsets you, would the image of it stay in your mind for a long time afterwards? [a, b]

    令你害怕或不愉快的情景會否長時間地留在你的腦子裏呢?

9. Do you generally get over bad experiences and not think about it again? [c]

    你能否忘記不愉快的記憶呢?

10. Do you find yourself thinking over and over about things that have made you angry? [a, b, c]

    你會不停地想起一些令你生氣的事情嗎?