UNCERTAINTY AND RESPONSE STYLE IN LATENT TRAIT MODELS TO ASSESS EMOTIONAL INTELLIGENCE OF ELITE SWIMMERS

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ABSTRACT: Emotional intelligence is a key factor for success in sporting competitions, arousing great interest in the psychological assessment of athletes. When the evaluation relies on Likert-type psychometric scales, individuals could tend to respond to items regardless of their content, compromising the measurement process. In this vein, the present contribution aims to address measurement issues regarding uncertainty and response style during the assessment of emotional intelligence of elite swimmers by exploiting latent trait models. Results provide evidence in favor of models accounting for response behavior.

KEYWORDS: Elite swimmers, emotional intelligence, latent trait models, response style, uncertainty

1 Introduction

Data concerning athletes' performance and their behavior are the essential core for competitive sports. Recently, an increasing interest has been devoted to understanding the psychological behaviour of some athletes and how personality traits influence their performance. Among them, emotional intelligence (EI) stands out, affecting athletes' ability to properly perceive and manage their emotions during competitions and thus allowing them to perform at their best.

From a modeling point of view, EI can be conceived as a personal latent trait that can be measured through a set of manifest indicators, such as multi-item psychometric scales. Therefore, latent variable models represent a relevant statistical framework to detect the underlying latent trait. When categorical observed variables are considered (as for Likert-type measurement scales), item response theory (IRT) models are the main reference (Bartolucci *et al.*, 2015). In particular, the Partial Credit model (PCM) is considered for the current application among the IRT models developed for polytomous items.

Nevertheless, it should be noted that individual responses to items could be affected by factors unrelated to the measured latent trait, especially when dealing with sensitive issues. For example, some works (e.g., Tutz *et al.*, 2018) highlighted different response styles during response behavior, including a tendency to select middle or extreme categories, irrespective of item content, and random answers. Other studies (e.g., Tutz & Schauberger, 2020) focused instead on response behavior driven by different degrees of uncertainty in choosing the preferred category. It is demonstrated that ignoring such subject heterogeneity may yield biased estimates of model parameters.

Herein, latent trait models that extend the PCM to account for athletes' uncertainty and response styles when responding to Likert-type scales measuring EI are analysed. In particular, the PCM Response style (PCMRS) and the Uncertainty PCM (UPCMRS) are considered. Moreover, uncertainty and the underlying trait are linked to explanatory variables concerning age, gender, and Big Five personality traits.

2 PCM with response style and uncertainty

The PCM represents the generalization of the Rasch model in the context of ordinal data. Let $Y_{ij} \in \{0,1,2,\ldots,m\}$ be the response on a Likert scale of individual i to an item j ($j \in \{1,2,\ldots,J\}$). The probability of observing a response category r can be parametrized, according to the PCM, as:

$$P(Y_{ij} = r) = \frac{\exp\left(\sum_{l=1}^{r}(\theta_i - \delta_{jl})\right)}{\sum_{s=0}^{m}\exp\left(\sum_{l=1}^{s}(\theta_i - \delta_{jl})\right)}, \quad r = 1,\ldots,m, \tag{1}$$

where θ_i is the person parameter and δ_{jl} the item-step *difficulty* parameter.

The extended PCM with response style (PCMRS; Tutz *et al.*, 2018) modifies the item-step difficulty parameter δ_{jl} to model the tendency to extreme or middle categories. In particular, the new difficulty parameter $\tilde{\delta}_{jl}$ has the form:

$$\tilde{\delta}_{jl} = \delta_{jl} - (k - l + c)\gamma_i, \tag{2}$$

where γ_i is an additional person parameter accounting for the shifting of thresholds, $k = m/2$ denotes the middle category of the response scale, and c determines the centering of the response style. For $c = 0.5$ there is symmetry around the middle category, ensuring a local Rasch model for adjacent categories. Regarding the person parameter γ_i, positive and negative values indicate a tendency to middle or extreme categories, respectively.

In the extended version of PCM accounting for uncertainty (UPCM; Tutz & Schauberger, 2020), the new predictor $\eta_{ijr} = e^{\alpha_i}(\theta_i - \delta_{jl})$ is introduced, which contains the additional subject-specific parameter α_i. The added parameter discriminates between uncertain or non-uncertain respondents, considering e^{α_i} the *uncertainty effect*. In particular, for ordered thresholds $\delta_{jr} \leq \delta_{j,r+1}$, it follows that: (i) if $\alpha_i = 0$, the classic PCM is obtained; (ii) for decreasing values of α_i, one comes closer to a uniform distribution across categories, whatever the parameter θ_i is (random responding); (iii) for increasing α_i, the selection for categories becomes very distinct depending on the value of θ_i.

3 Elite swimmers' response behavior during EI assessment

In this contribution, a practical definition of EI validated for sports was considered, whose assessment relays on 30 items with a 7-point Likert response scale (from "strongly disagree" to "strongly agree") measuring the four dimensions of well-being, sociability, emotionality, and self-control (Petrides, 2009). In what follows, only the results for the *emotionality* subscale are presented.

The study involved $n = 205$ elite swimmers enrolled in the Italian Swimming Federation, predominantly males (61%) with a mean age of 16.8 (sd = 3.6). In addition to EI, the Big Five personality traits (Extraversion, Emotional stability, Openness, Agreeableness, and Conscientiousness) were assessed.

A simple PCM and the extended version of PCMRS and UPCM were fitted to the data. The variance of the random effect for the trait parameters in the PCM was estimated to be $\sigma^2 = 0.07$. When fitting the PCMRS and UPCM without covariates the following covariance matrices resulted:

$$\hat{\Sigma}_{PCMRS} = \begin{pmatrix} 0.06 & 0.04 \\ 0.04 & 0.16 \end{pmatrix}, \qquad \hat{\Sigma}_{UPCM} = \begin{pmatrix} 0.04 & 0.03 \\ 0.03 & 0.87 \end{pmatrix}.$$

The latter report the estimate for the variance of the trait and response style (or uncertainty) effects on the main diagonal and their covariance out of the diagonal. Figure 1 displays the estimates of the item parameters for simple PCM, extended PCMRS, and UPCM. It can be seen that for all items the estimates of item thresholds differ between the considered models, especially the extreme responses. BIC indexes (6110, 5459, and 5607 for PCM, PCMRS, and UPCM, respectively) support the selection of the model with the response style component, followed by the model accounting for individual uncertainty. Regarding the UPCM model with covariates, results reported a significant effect (p-value< 0.05) of Agreeableness on uncertainty ($\beta = 0.23$) and EI ($\beta = 0.09$), and a significant effect of Conscientiousness on uncertainty ($\beta = -0.28$).

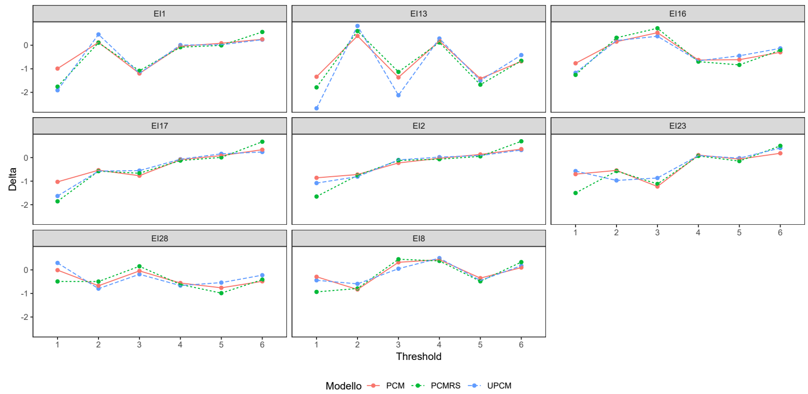

Figure 1. *Item parameter estimates for PCM, PCMRS, and UPCM.*

4 Conclusion

The study provides some evidence regarding the effect of response style and uncertainty in the assessment of the EI of swimmers. Improving the accuracy of parameter estimation by exploiting sophisticated statistical models, as those herein employed, allows for disentangling the latent trait component and the response behavior. Moreover, accounting for the effect of covariates makes it possible to identify subgroups that differ in uncertainty and the underlying trait to better promote successful factors, such as EI, in sports.

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