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Parent Perception Survey: The Analysis of Parents' Opinions on Giftedness using Partial Credit Model (PCM)

Background

Hong Kong Academy for Gifted Education (HKAGE) is a non-governmental organisation, providing research-based information and support to all gifted students aged 10-18, teachers and their parents across Hong Kong. To cater for the needs of parents, a survey on parents' opinions has been undertaken in 2015. One of the aspects concerned is about their opinions of whether a child is gifted when the child possesses a certain characteristic (such as "Be interested in number-related games and solving mathematical problems"). These characteristics fall into seven areas, namely: (i) Inter-personal, (ii) Intra-personal, (iii) Bodily-kinesthetic, (iv) Music, (v) Verbal-linguistic, (vi) Visual-Spatial, and (vii) Logical-mathematical/Uniqueness.

The related responses from 311 parents of HKAGE (**HKAGE parents**) and 111 parents of general population contacted via some social organizations (**SocOrg parents**) were collected. It should be noted that the socio-economic status (SES) of HKAGE parents is, in general, better than that of SocOrg parents.

Partial Credit Model and its Enhancements

In the following, we use Item Response Theory (IRT) modeling to analyze the responses. The IRT model employed is based on **Partial Credit Model (PCM)** with some enhancements so as to explore some group effects in a systematic manner. The basic form of PCM is stated below.

$$P_{\mathrm{k}}(\lambda) \propto \exp\{k\lambda - \sum_{j=1}^{k} \tau_{\mathrm{j}}\}$$

Conventionally, $P_k(\lambda)$ is the probability of a student with ability λ obtaining the score k on an item with minimum mark equal to 0 and maximum mark equal to m, and $\{\tau_j\}$ are the non-centralized thresholds (i.e., non-centralized threshold = centralized threshold + item difficulty). In our current setting, a parent acts as a student with ability λ. Each item has its difficulty (the average of τ_j). The above mentioned model is the standard one, the right hand side of which could be written in WINBUGS programming code as follows:

*$P_k(\lambda)$ α exp(k*lambda[i] - sum(tau[j,1:k]))*

We want to capture systematically the differences in ability across different groups, namely: (i) *HKAGE parent* vs. *SocOrg parent* and (ii) *Primary student parent* vs. *Secondary student parent*. ***Primary student parent*** is a parent whose eldest child is in primary level. Similarly, ***Secondary student parent*** is a parent whose eldest child is in secondary level. Accordingly, the model could be enhanced as follows:

$P_k(\lambda)$ α exp(k(lambda[i]+(a1[parGrp[i]]+a2[parSta[i]]+a1a2[parGrp[i],parSta[i]])) - sum(tau[j,1:k]))*

The enhancements are simply to adjust a parent's ability (lambda[i]) based on his/her groups using the following convention:

parGrp[i] = 1 if the ith parent is a *HKAGE parent*
= 2 if the ith parent is a *SocOrg parent*
parSta[i] =1 if the ith parent is a *Primary student parent*
= 2 if the ith parent is a *Secondary student parent*

For model identification, certain constraints (similar to the ones used in two-way ANOVA) have to be applied to the coefficients a1 (row effect), a2 (column effect), a1a2 (the interaction effect). The values for a1, a2 and a1a1 could then be estimated using the MCMC method under the Bayesian framework.

Estimation Results

A parent got 2 marks if he/she answers YES (which is supposed to be the correct answer), 0 mark when answering NO and 1 mark when answering UNCERTAIN. If his/her ability is higher than the item's difficulty, he/she got a higher chance of answering the item correctly; vice versa. The estimation results of the coefficients a1, a2 and a1a2 are tabulated below.

Table 1: Estimation results of the coefficients a1, a1, and a1a2

node	mean	sd	MC error	5.00%	95.00%
a1[1]	0.326	0.06966	0.006474	0.2145	0.4448
a1[2]	-0.326	0.06966	0.006474	-0.4445	-0.2141
a2[1]	0.04337	0.06397	0.006318	-0.05804	0.1525
a2[2]	-0.04337	0.06397	0.006318	-0.1524	0.05854
a1a2[1,1]	-0.1171	0.07724	0.009503	-0.2556	-0.002288
a1a2[1,2]	0.1171	0.07724	0.009503	0.0023	0.2557
a1a2[2,1]	0.1171	0.07724	0.009503	0.0023	0.2557
a1a2[2,2]	-0.1171	0.07724	0.009503	-0.2556	-0.002288

Based on the estimated coefficients in Table 1, the adjustment terms to parent ability (λ) for different groupings could be derived accordingly, which are tabulated below.

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Table 2: Adjustment terms to parents' ability according to their groupings

Source/ Level	Primary	Secondary
HKAGE	0.2523	0.3997
SocOrg	-0.1655	-0.4865

Findings

From Table 2, the followings could be observed:

(i) When a *HKAGE parent* transits from *Primary student parent* to *Secondary student parent*, his/her ability got an increase of 0.1474 (i.e., 0.3997 -0.2523). It may be due to that they could learn more as time goes by.

(ii) On the other hand, when a *SocOrg parent* transits from *Primary student parent* to *Secondary student parent*, his/her ability got a decrease of -0.3210 (i.e., -0.4865 – -0.1655). It may be due to that they are too busy for working to concern the matter of giftedness.

(iii) From (i) & (ii), it should be noted that the difference between *HKAGE* and *SocOrg parents* becomes bigger when both of them transit from *Primary* to *Secondary student parents*, changing from 0.4178 (i.e., 0.2523 – (-0.1655))) to 0.8862 (0.3997 – (-0.4865)).

According to the estimated item difficulty of each question, **the top three of difficult items** are: (i) Understands and likes oneself; has self-confidence (0.7209), (ii) Listens attentively; shows empathy and respect (0.9961), and (iii) Gets along with peers well and enjoys being with them (1.282). On the other hand, **the top three of easy items** are: (i) Asks many unexpected questions or expresses unique opinions on some topics (-0.8708), (ii) Be interested in number-related games and solving mathematical problems (-0.9701), and (iii) Asks many questions and thinks about how things work and the principles behind (-1.428). Besides, we can take average of item difficulties of the questions within the same area, which are tabulated below.

Table 3: Average of item difficulties for each area

Area	Average of Item Difficulties
Inter-personal	0.7919
Intra-personal	0.5327
Bodily-kinesthetic	0.3278
Music	0.1602

Verbal-linguistic	-0.0931
Visual-Spatial	-0.4086
Logical-mathematical/ Uniqueness	-0.9834

The average of abilities of all the parents is 0.1094. Therefore, amongst these seven areas the abilities in Logical-mathematical Uniqueness, Visual-Spatial, and Verbal-linguistic are easily accepted by parents, in general, as a kind of giftedness. On the other hand, the abilities in Music, Bodily-kinesthetic, Intrapersonal, and interpersonal are rather difficult to be accepted by parents.

According to the current theory of multiple intelligences, gifted education should possess a much wider perspective rather focusing on academic excellence alone. Such an attitude should be promoted to general population of parents in Hong Kong. With understanding and appropriate help provided from their parents, the chance of gifted students to develop their talents would be much higher.