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Children's Motivation Analysis Test (CMAT): An experimental manipulation of curiosity and boredom

Gregory J. Boyle
Bond University, Gregory_Boyle@bond.edu.au

Lisa M. Richards
University of Queensland

Anthony J. Baglioni Jr.
University of Queensland

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Gregory J. Boyle

Bond University and University of Queensland

and

Lisa M. Richards, and Anthony Baglioni

University of Queensland

Abstract

The present study investigated the influence of manipulating the states of curiosity and boredom on the 10 scales of the Children's Motivation Analysis Test (CMAT). The CMAT is a multidimensional objective (T-data) instrument measuring several important dynamic motivation traits among primary school children. The CMAT was administered to 202 grade 6 and 7 children, pre- and post-exposure to either curiosity, boredom, or control (neutral) conditions. Scores on the Unintegrated Curiosity scale of the CMAT increased for the children in the Curiosity condition. For children in the Boredom condition, Unintegrated Pugnacity, Unintegrated and Integrated Narcism scores increased in response to the mildly aversive experimental manipulation. Evidently, a number of the dynamic traits measured in the CMAT are sensitive to situational stimuli as hypothesized in the dynamic calculus theory of motivation.

Cattell and his colleagues have developed three objective tests of motivation based on the dynamic calculus model (cf. Cattell & Child, 1975; Boyle, 1988; Dielman & Krug, 1977), and exploratory factor analysis of dynamic trait structure (Kline, 1979; Boyle, 1983a). In the present study, the ***Children's Motivation Analysis Test*** (CMAT) is used (IPAT, 1982). The CMAT, designed for use with 8 to 12 year olds, is a more recently developed downward extension of the School Motivation Analysis Test or SMAT (Krug, Sweney & Cattell, 1976), and of the Motivation Analysis Test or MAT (Cattell, Hom, Sweney & Radcliffe, 1964).

The CMAT is a 230-item objective (T-data) instrument which purports to measure at both the integrated (I) and unintegrated (U) levels 10 of the major dynamic trait factors (Cattell & Kline, 1977). The biologically based drives (ergs) measured include: Narcism (self-gratification), Play (enjoying games), Fear (alertness to external danger), Pugnacity (destructive, hostile impulses), Curiosity (search for novelty), and Assertiveness (self-assertion). The culturally acquired drives (sentiments) include: Home (attitudes to family home), Self-sentiment (concern with social reputation and security), Superego (conscience), and School (interest in school-curricular and extracurricular activities). In comparison with the MAT which measures five ergs and five sentiments, the CMAT gives less attention to the sentiment structure (measuring only four), believed to be acquired only gradually through social conditioning (cf. Boyle & Start, 1989b; Delhees, Cattell & Sweney, 1971).

The CMAT employs four types of validated objective test device (objective measures of motivation strength) labelled: Autism, Projection, Word

Association, and Information. Autism refers to the distortion of the cognitive field by misperception and misbelief (Krug et al., 1976). In the CMAT, inscrutable and merely operational terms rather than psychological terms are used. Thus, the Autism device is labelled "Guesses". Individuals are required to "make a guess" at the answer to a "how many" type question. Projection ("Uses") involves the individual's first reaction about what .different types of resources could be used for. This is virtually a simple preference statement test, but actually asks what anyone would find to be the natural use of certain means to ends. Thus, individuals project their values onto others (Krug et al., 1976). The word association test (Paired Words in the CMAT booklet) is self-explanatory; spontaneous associations are interpreted as in the direction of interests (Krug et al., 1976). The underlying assumption in the Information test is that a person consistently interested in an area knows more about it (Krug et al., 1976).

The CMAT provides objective (T-data) measurement wherein the relationship of items to factors is not readily discernible. This is important since, in terms of classical psychoanalytic theory, much human motivation is at the unconscious level, so that insight into one's motivational drives is unlikely to be highly accurate. This approach minimizes item transparency and resultant proneness to response distortion (faking good/bad) associated with self-report questionnaires (Boyle, 1985).

The psychometric properties of the MAT and SMAT have been investigated in many studies (Kline & Grindley, 1974; Krug, 1977; Birkett & Cattell, 1978; Kline, 1979; Boyle, 1983a,b, 1985; Cattell, 1984). These studies have reported moderate reliability and validity. Since the CMAT is a downward

extension of the MAT and SMAT, it is likely that it has similar reliability and validity characteristics.

The I components exhibit some stability, indicating they are more like traits than states, whereas the U components change in relation to experimental manipulation (Boyle & Cattell, 1988; Cattell, 1985). Cattell and Child (1975) have also provided evidence that sentiments show a higher degree of stability than ergs. Boyle and Cattell (1984) discussed these issues addressing the question of state-like and trait-like dynamic traits. These authors investigated the difference scores between pre- and post-exposure to mild and severe aversive situations. Changes in MAT dynamic trait scales were mainly on ergs, supporting the ergs as more state-like, and the sentiments as more trait-like. Changes were noted for U-Home (decreased), U-Fear (increased), U-Assertiveness (decreased), and I-Narcism (decreased), in response to aversive stimuli. These results support the work of Kline and Grindley (1974) who demonstrated greater stability for sentiments than for ergs. Krug (1977) also found a significant increase in U-Fear in response to aversive stimuli (a film portraying violence) in an investigation of fear and academic achievement in adolescents using the SMAT.

To date, three studies have used the CMAT: an investigation into norms for Australian school children (Boyle, 1989), a comparison of higher-order motivational factors across gender (Boyle & Start, 1989a) and an investigation into sex differences in the prediction of academic achievement (Boyle & Start, 1989b). While investigations into the influence of aversive situations on motivational dynamic traits exist (e.g. Boyle & Cattell, 1984), little research has been undertaken into the influence of positive stimuli on dynamic traits.

The present study investigates the influence of stimulating curiosity (via presentation of magic tricks) on the CMAT dynamic traits. Induction of a mildly aversive affective state (sitting in silence for several minutes) is also investigated, and both treatments are compared with a third (neutral) group. It is hypothesized that the U components would be more influenced by stimulation than would be the case with the I components. The biological drives/ergs are expected to alter more as a result of experimental manipulation than are sentiments.

Specifically, it is predicted that:

HI: children in the boredom condition will exhibit a significant post-exposure decrease on unintegrated assertiveness, narcism, and home. It is expected that this mildly aversive stimulus will not involve the shock aspects of the aversive stimuli outlined in previous research, and thus an increase on U-Fear in response to the stimulus treatment is not expected.

H2: children in the curiosity stimulation condition will exhibit a significant post-exposure increase on unintegrated assertiveness, narcism, home, and curiosity scores.

H3: no significant differences will be found on CMAT scale scores across measurement occasions for the control (neutral} condition.

In addition, two minor hypotheses are proposed that:

H4: test-retest reliability coefficients for the ergs will be significantly lower than those for the sentiments.

H5: test-retest reliability estimates for the two treatment groups will be significantly lower than for the control (neutral) group.

METHOD

Subjects

A sample of 238 schoolchildren from three Brisbane primary schools in grades 6 and 7 (mean age= 11.63 years) participated in the study. Children who failed to complete the CMAT on either measurement occasion or who were absent on the second date of testing were removed from the study, leaving a total of 202 students who responded to the CMAT on both measurement occasions. Ninety-six of the children were boys, while 106 were girls. With respect to treatment groups, 69, 90, and 43 students were assigned to the curiosity, boredom and control conditions, respectively. These numbers differed as a result of the need to assign class groups, rather than individuals, to treatment conditions. Although class numbers varied widely, equal numbers of grade 6 and 7 classes were assigned to each condition.

Design and procedure

An independent groups pretest-posttest control group design was employed. This design is a non-equivalent groups design (Campbell & Stanley, 1966) so that rather than the groups having pre-experimental sampling equivalence, they constituted naturally assembled collectives (in this case, classrooms). The experimental procedure required administration of the CMAT on one occasion, and re-administration following the experimental conditions on a second occasion, one month later. Thus, the MANOVA comprised a mixed design, with between groups and repeated measures effects tested simultaneously (Keppel, 1991).

The class groups were randomly assigned to one of three experimental conditions. The first experimental condition involved stimulating curiosity with the presentation of two simple magic tricks/puzzles. In the first instance, a volunteer was called for. The class was then asked the question, "How would you go about tying a knot in a piece of rope without letting go of the ends?" Suggestions were accepted. The volunteer was then given a piece of rope roughly 1m in length. It was explained that there were two ways of carrying out the task; the "cheat's" way (fold arms, pick up the ends of the rope from the table, then unfold arms), and the "magical way", which was demonstrated. The volunteer was then asked to repeat the sequence of moves. This he/she did, but the knot did not form. Finally, after much by-play, the magician helped the assistant to form the knot (magically). The assistant was sent back to his/her seat. The second trick presented also involved use of ropes. It is commonly known as the Professor's Nightmare (Pecor, 1976). Three ropes are shown to be unequal in length. Magically they are made equal, then once more they return to their unequal lengths. These tricks stimulate curiosity by encouraging children to question what they are seeing and how it is done. Magic is not normally performed in a way that encourages people to puzzle out how it was done. While a certain amount of curiosity regarding method is natural, technically, if the audience is too busy trying to seriously figure it out, the magician's performance is not considered to be of the highest quality (Fitzke, 1988).

The second condition was designed to produce "mind boredom" and required the children to wait for a period of 7 min in total silence before being allowed to commence the CMAT. The waiting period was equivalent to the time taken to demonstrate the magic tricks described above. It is recognized that this

Table 1

Test-retest reliabilities for the primary and secondary SMAT scales

	Treatment group					
	Neutral		Boredom		Curiosity	
Dynamic trait	U	I	U	I	U	I
Narcism	0.50	0.21	0.45	0.35	0.40	0.35
Pugnacity	0.74	0.47	0.54	0.72	0.58	0.58
Curiosity	0.61	0.56	0.45	0.36	0.30	0.43
Assertion	0.51	0.12	0.49	0.06	0.28	0.23
Play	0.32	0.50	0.65	0.54	0.44	0.46
Fear	0.40	0.12	0.43	0.30	0.30	0.14
Self-Sentiment	0.58	0.51	0.56	0.30	0.41	0.56
Superego	0.28	0.47	0.50	0.37	0.39	0.39
Home	0.53	0.52	0.57	0.70	0.55	0.40
School	0.60	0.55	0.68	0.16	0.41	0.32

Note. One month interval between test-retest administrations.

treatment may involve other aspects including self-control/self-discipline, so that the label "boredom" as used in this study is applied in a general sense only.

A third, neutral condition, in which nothing occurred prior to administration of the questionnaire on the second measurement occasion, served as a control. As it has been demonstrated that time of day influences psychological states such as fatigue,

depression and anxiety (levels of these variables are higher in the afternoon-Barton & Cattell, 1974), administration of the CMAT and experimental conditions was carried out only in the mornings for all groups, ensuring that all children involved in the study were alert, and able to cope more efficiently with the experimental requirements of the study. It was expected that students would be able to respond more adequately to the 230 CMAT items when alert than when tired, and likewise that children in the "boredom" groups would be able to concentrate on being silent for 7 min more easily when alert than when tired.

Results and Discussion

Test-retest reliability estimates were obtained for both primary (U and I) and secondary (total motivation) components of the CMAT, for each of the three testing conditions (Table 1). To test for differences in the test-retest reliabilities for subscales for the control group as compared with both treatment groups, Fisher's Z transformation was used (Winer, Brown, & Michels, 1991). No significant differences were found between groups or between ergs and sentiments.

Two one-way treatment (Boredom, Neutral, Curiosity) MANOVAs were performed for the first testing occasion to test if randomization procedures had produced comparable groups. Dependent measures in the first analysis were the 10 I-scores and in the second analysis the 10 U-scores. To protect against Type 1 error, the experiment-wise alpha of 0.05 was adjusted to a more conservative level of 0.025 for significant differences between groups (cf. Keppel, 1991, p. 171). No significant differences were found between treatment groups on the first testing occasion (all $p_s > 0.025$).

Separate two-way treatment (Curiosity, Boredom, Control) x Wave (Pre-, Post-Treatment) multivariate analyses of variance were performed•for the U and I scales of the CMAT, using the SPSSX Manova Program (SPSS Inc, 1991).The multiple dependent measures in these analyses were the 10 scale scores (Narcism, Pugnacity, Curiosity, Assertiveness, Play, Fear, self-Sentiment, Superego, Home and School) for the U and I components, respectively. Time (Wave) was a within Ss (repeated-measures) factor. Results of the evaluation of assumptions of normality, and homogeneity of variance were satisfactory, indicating that the MANOVAs were justified.

The multivariate treatment effect was highly significant for both the U and I scales, $F_{(l,201)} = 21{,}018.31$, $p < 0.001$; and $F_{(1,201)} = 19{,}547.41$, $p < 0.001$, respectively (cf. Huberty & Morris, 1989). This result justified examination of the individual scales of the CMAT via univariate repeated measures ANOVAs.

Three by two by two treatment (Curiosity, Boredom, Control) x Wave (Pre-, Post-Treatment) x Component (U, I) ANOVAs were performed for each of the 10 scales of the CMAT. The Component factor compared the I- and U-scores across treatment groups and measurement occasions. The main effects for the components collapsed across time and treatment group, indicating differences in mean scores between I and U factors were significant (Bonferroni corrected) for all 10 CMAT scales (except Assertiveness), as follows: Narcism, $F_{(l,l99)} = 400.56$, $p < 0.001$; Pugnacity, $F_{(l,l99)} = 390.99$, $p < 0.001$; Curiosity, $F_{(1,199)} = 396.24$, $p < 0.001$; Self-Sentiment, $F_{(1,199)} = 499.31$, $p < 0.001$; Superego, $F_{(l,199)} = 371.53$, $p < 0.001$; Home, $F_{(1,199)} = 607.18$, $p < 0.001$; School, $F_{(1,199)} = 390.99$, $p < 0.001$; Play, $F_{(1,199)} = 190.54$, $p < 0.001$; and Fear, $F_{(l,199)} = 414.78$, $p < 0.001$, indicating that the U and I components measure independent aspects of children's motivation.

As for the Wave effects collapsed across components and treatment groups, differences in mean scale scores over time were significant (Bonferroni corrected) for Narcism, $F_{(l,l99)} = 40.51$, $P < 0.001$; Superego, $F_{(l,l99)} = 9.58$, $P < 0.002$; Assertiveness, $F_{(l,l99)} = 106.88$, $P < 0.001$; and Fear, $F_{(l,199)} = 659.55$, $P < 0.001$, respectively. For the Treatment by Wave interaction collapsed across I and U components, significant effects were obtained for Narcism, $F_{(2,199)} = 12.30$, $P < 0.001$; and for Curiosity, $F_{(2,199)} = 7.80$, $P < 0.001$. In regard to the Components by Wave interaction collapsed across treatment groups, significant effects occurred for Pugnacity, $F_{(2,199)} = 17.06$, $.P < 0.001$; for Assertiveness, $F_{(2,199)} = 180.38$, $P < 0.001$; and for Fear, $F_{(2,199)} = 804.56$, $P < 0.001$, respectively. Finally, for the Treatment by Component by Wave interaction, three scales were significant as follows: Narcism, $F_{(2,199)} = 7.19$, $P < 0.001$; Pugnacity, $F_{(2,199)} = 3.76$, $P < 0.025$; and Curiosity, $F_{(2,199)} = 21.21$, $P < 0.001$. While many of the scale scores exhibited a Wave effect (altering across time), only U- and I-Narcism, U-Pugnacity, and U-Curiosity exhibited a Wave by Treatment interaction. For both U- and I-Narcism, those in the boredom group had significantly higher mean scores on the second testing occasion than those in the curiosity or in the control groups ($t_{131} = 3.36$, $P < 0.001$). The difference between pre- and post-test scores was greater for the U-Narcism scale, with mean scores on this scale increasing across time for all groups. U-Pugnacity also increased significantly across time for all groups. Those in the boredom group, however, exhibited a significantly greater increase on this scale across testing occasions ($t_{42} = -4.05$, $P < 0.001$). As predicted, for U-Curiosity, those in the curiosity groups exhibited significantly higher mean scores on the second measurement occasion than did either of the other two groups ($t_{137} = -6.06$, $P < 0.001$), in which scores on this scale dropped significantly across

occasions. Both I-Fear and I-Assertiveness exhibited very sharp decreases across testing occasions for all groups. The proposition that the U-dynamics are more state-like than the I-dynamics was not supported, as equal numbers of U- and I-motivation components altered significantly.

Scores across testing occasions for the control (neutral) group remained relatively stable. Twelve of the 20 scales did not change significantly. The significant change across testing occasions for those in this group occurred predominantly for I-Assertiveness, I-Fear, U-Narcism, and U-Pugnacity.

Children in the boredom group did not exhibit significantly higher scores on U-Fear, or decreased scores on U-Narcism, U-Assertiveness and U-Home. Although the boredom (mildly aversive) condition was not pleasant, it did not have any of the shocking or frightening aspects which characterized the strongly aversive stimuli used in other studies (e.g. road accident films, Boyle & Cattell, 1984; war films, Krug, 1977). The boredom condition may have involved aspects of self-control/self-discipline. This may to some extent explain the increased scores of U-Narcism, $t_{42} = -6.25$, $p < 0.0001$; I-Narcism, $t_{42} = -3.67$, $p < 0.001$; U-Pugnacity, $t_{42} = -4.05$, $p < 0.0001$, for this group (significant decreases occurred for I-Assertiveness, $t_{42} = 6.12$, $p < 0.0001$; I-Fear, $t_{42} = 19.49$, $p < 0.0001$; I-Self-Sentiment, $t_{42} = 2.89$, $p < 0.006$; and U-Curiosity, $t_{42} = 2.80$, $p < 0.008$). If it is accepted that sitting quietly for 7 min is not an easy task for a 12-year-old, then it is possible that actually being able to do so may enhance children's self-image (Krug, 1977). Although both unintegrated and integrated components of Narcism exhibited significant increases, the difference was much greater for U-Narcism. U-Pugnacity exhibited a significant increase in scores across measurement occasions in the boredom group. Pugnacity is a measure of hostile impulses (Cattell et al.,

1964). Clearly, the children expressed a certain amount of dissatisfaction in being required to complete a rather long questionnaire for the second time.

Children in the curiosity group exhibited a significant increase in U-Curiosity, $t_{68} = -6.16$, $p < 0.0001$, across testing occasions. It is possible that as the children in the curiosity group did not receive a resolution of their heightened state of curiosity (they were never actually told how the tricks were really done), they were not satisfied and thus did not show the expected rise in narcism. Significant decreases (Bonferroni corrected) in I-Assertiveness, $t_{68} = 10.39$, $p < 0.0001$; and I-Fear, $t_{68} = 19.55$, $p < 0.0001$ occurred. Scores on U-Assertiveness (as for most of the CMAT scales) did not change significantly across testing occasions. The experimenter interacted with the children in the curiosity group in such a way as to foster the social and relaxed atmosphere essential for the successful impact of the magic. It may be that the children regarded the experimenter like one of their teachers. This attitude may be one reason these children did not exhibit the expected increase on self-assertion. A more likely determinant of the weak repeated-measures effects, however, was that the curiosity and boredom treatments were very mild, thereby reducing the occurrence of significant changes in the dynamic trait scores across measurement occasions.

Four out of the 20 CMAT scales exhibited significant changes across measurement occasions. There were significant decreases in I-Assertiveness, $t_{89} = 2.52$, $p < 0.01$; and I-Fear, $t_{89} = 2.27$, $p < 0.0001$, while there were significant increases in U-Narcism, $t_{89} = -8.55$, $p < 0.0001$; and U-Pugnacity, $t_{89} = -2.95$, $p < 0.004$, respectively.

Very large decreases in both I-Assertiveness and I-Fear were observed. These changes may have been in part an artifact of the time of testing. The first

measurement occasion took place just before the school children were due for a semester break, and thus they were tested during a school assessment period. This may account for the high scores on the fear scale. As assertion incorporates aspects of mastery and achievement as well as self-assertion (Cattell et al., 1964) it is logical that this scale also exhibited high scores at this time. These changes occurred for the I-components of the dynamic trait rather than the U-components.

The fact that many of the CMAT scale scores (both I and U) changed over time and/or in response to an experimental manipulation, provides some support for the dynamic nature of children's motivation traits, in agreement with the findings on adults using p-technique (individuals retested over many occasions to investigate changes in motivation dynamic traits) such as those of Barton and Flocchini (1985), and Birkett and Cattell (1978). These results support the work by Kline and Grindley (1974), and Boyle and Cattell (1988), demonstrating that the ergs are more state-like than the sentiments. Virtually all of the dynamic motivation traits which exhibited change across time and/or in response to the treatment conditions were ergs. Among the sentiments, only the score for I-Self-Sentiment changed significantly (decreased) across testing occasions for the boredom group.

Test-retest reliability estimates did not differ significantly across treatment conditions. Nor were the test-retest reliability estimates for the ergs significantly different from those for the sentiments. It must be remembered however, that sentiment structures develop over time (Delhees et al., 1971; Cattell & Child, 1975). It is possible that in children of this age, the sentiment structures are still relatively unformed and thus less stable. It would be interesting to carry out

longitudinal studies in order to test this possibility, measuring children's sentiment structures over time.

In the present study, changes in dynamic trait scores were obviously attenuated due to the very "mild" nature of the experimental manipulations used to induce mild, transitory curiosity and boredom, respectively. Nevertheless, the CMAT appears to be a situationally sensitive instrument, picking up changes in dynamic motivation traitacross time and in response to experimental manipulation. The CMAT is only in its infancy, however, and much work needs to be done in confirming its factor structure, reliability and validity.

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