Beliefs of students talented in academics, music, and dance concerning the he...
Tania Tremblay; Francoys Gagne
Roeper Review; Apr 2001; 23, 3; Research Library
pg. 173

Beliefs of Students Talented in Academics, Music, and Dance Concerning the Heritability of Human Abilities in These Fields

Tania Tremblay
Françoys Gagné

This study assessed the heritability beliefs of talented students concerning the heritability of human abilities, more specifically the extent to which these talented laypersons endorsed the strong environmentalist ideology promoted in the social sciences and the media. Three groups of talented students (academics, music, dance) assessed the heritability of three sets of human abilities (cognitive, musical, physical), as well as motivational characteristics, for a total of 22 items. Six formal hypotheses were formulated; four of them were confirmed. The results showed that a majority of the respondents held middle-of-the-road positions, recognizing a significant causal role for both nature and nurture. However, the very large standard deviations indicated the presence of substantial numbers of students toward both extremes of the heredity-environment continuum. Explanations for such diversity in beliefs remain elusive in the literature. Significant differences in degree of perceived heritability were observed between ability domains as well as within each of them. A series of follow-up studies are proposed.

Tania Tremblay is a doctoral student in Psychology, and **Françoys Gagné** is a professor of psychology and Contributing Editor of the *Roeper Review*. Both are at the University of Quebec at Montreal, Canada.

The beginning of the nature-nurture debate regarding the source of individual differences in human abilities can be traced back to the last decade of the nineteenth century with the publication of Francis Galton's *Hereditary Genius* (1892/1962). Since then, it has regularly made the front pages in scientific journals and the news media, most recently with strong reactions (see Devlin, Fienberg, Resnick, & Roeder, 1997, for an extensive bibliography) to Herrnstein & Murray's (1994) *The Bell Curve*. The debate has remained on the scholarly forefront during the last two decades thanks to the growth of the field of behavioral genetics. Dozens of twin and adoption studies have shown that genetic influences account for a large proportion of the variance in cognitive abilities among youth and adult populations (Plomin, DeFries, & McClearn, 1990). The significant impact of genes on human abilities is now recognized by a large majority of measurement experts in psychology and education (Snyderman & Rothman, 1987). Still, many scholars in the human sciences express strong opposition to the behavior genetics literature; they maintain a theoretical position that leans strongly toward the environmentalist end of the nature-nurture continuum (e.g., Bloom, 1985; Ericsson & Charness, 1994; Howe, Davidson, & Sloboda, 1998). Some participants in that debate (e.g., Pinker, 1997; Scarr, 1981) maintain that pure (or strict) environmentalism is the more common—and politically correct—theoretical position within the social sciences. Tooby and Cosmides (1992) even coined the expression ***Standard Social Science Model*** (SSSM) to describe it.

The divergent positions among researchers and scholars over that question demonstrate the importance of their personal beliefs, not only in their choice of subjects and independent variables when studying human behavior, but also in the way they analyze and interpret the data (Albee, 1982). Personal beliefs, however, are not a monopoly of research professionals. The exploration of laypersons' beliefs and causal attributions has grown steadily over the last two decades (Dweck, 1986; Nichols, 1989; Weiner, 1984). Different expressions have been used almost interchangeably to describe that area of study: implicit, personal, naive or lay theories, or expressions like folk psychology, preconceptions, attributions, and so forth (Calderhead, 1996; Goldman, 1993; Pajares, 1992). Many studies have shown the significant influence of personal beliefs on the decision making process (Alexander, Noyes, MacBrayer, Schwanenflugel, & Fabricus, 1998), as well as their impact on learning behavior and motivation (Dweck, 1986; Neisser, 1978). For instance, Dweck's work reveals that students who perceive intelligence as a rather stable characteristic, as compared to those holding more malleable beliefs, tend to show somewhat less perseverance when faced with obstacles and difficulties. While no direct comparison has been made between Dweck's stable/malleable dichotomy of intelligence and the nature-nurture continuum, it is hard to avoid making a parallel.

Many studies of laypersons' beliefs regarding the nature-nurture controversy can be found in the scientific literature (e.g., Gallagher, Jones, & Barakat, 1987; Himelstein, Graham, & Weiner, 1991; Taylor, 1996). A few targeted human abilities. In some cases the nature-nurture theme was a small part of a much larger survey (e.g., Alexander, 1985; Snyderman & Rothman, 1987); in others it was the core of the study (Furnham, Johnson, & Rawles, 1985; Larsen, 1975; Zeidner & Beit-Hallahmi, 1988).

In the most detailed of these studies, Furnham, *et al.* (1985) examined which of a range of demographic variables, especially voting pattern, best predicted peoples' beliefs about the heritability of specific features in human nature. They asked a diversified sample of 308 laypersons to rate 48 characteristics, factorially grouped into 6 categories (physical characteristics, illnesses, skills, personality, psychological problems, and beliefs), on a 9-point scale (1 = totally determined by heredity; 9 = totally determined by environment). The skills category included intelligence, memory, multi-lingualism, sport skills, musical ability, mathematical ability, artistic ability, and left-/right-handedness. Category scores ranged from 8 to 72; the global average was 42.1, close to the scale's midpoint of 40. Skills were judged to lean slightly more toward the heredity pole (37.8); unfortunately, no data were presented for specific skills. Zeidner & Beit-Hallahmi (1988) also obtained average heritability assessments that hovered around the midpoint

Manuscript submitted January, 2000.
Revision accepted December, 2000.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

of their percentage scale for most of their items. Past studies never looked at the size of individual differences. Our analysis of their tables of results indicates that the standard deviations were very large, indeed much larger than would be expected with normal distributions of responses.

Recently, Gagné, Blanchard, & Bégin (in press) attempted to clarify questions left unanswered by Furnham *et al.* (1985). They gathered samples of educators and students in three different occupational fields: regular school, music, and sports. As part of a very broad survey of beliefs about talent development, the three very large subsamples, a total of over 3000 participants, were asked to assess the heritability of a small set of human abilities typical of their own occupational field. The respondents used a 4-point Likert-type scale (1 = No, not at all; 2 = Yes, a little; 3 = Yes, to some degree; 4 = Yes, a lot) to answer the following question: "Here is a set of '***n***' (academic, musical, athletic) abilities. Is there anything genetic or innate about them? Do some youngsters have a greater **natural** ability to acquire one or the other? If so, to what extent?" They found that most average means hovered close to the midpoint of the scale, with very large individual differences, and significant percentages of respondents with mean scores at both extremes (1.0 and 4.0) of the scale. As a complement to the Furnham *et al.* (1985) study, Gagné *et al.* discovered significant differences **within** the set of abilities proposed; for instance, in the sports sample, strength was judged by far the most heritable of the six physical abilities presented (flexibility, coordination, endurance, reaction speed, sports intelligence). No gender differences were observed, but educators tended to hold stronger interactionist beliefs than students (athletes in sports). No other sociodemographic variables were found to explain any significant part of the large individual differences observed.

The present study extends Gagné, *et al.'s* (in press) investigation in three ways. First, it examines potential differences in viewpoint related to the respondents' field of specialization. To do that, three different sets of abilities were identified, each specific to a particular talent field: academics, music, and dance. All the participants had to judge the heritability of the three sets, two of them outside their field of expertise. Second, it uses a quantitative heritability scale instead of Gagné *et al.*'s qualitative 4-point Likert-type scale. Third, to facilitate the emergence of group differences, it appeared important to focus on individuals who had already invested much energy in the pursuit of excellence in their field, and had attained talent-level performances, as defined in Gagné's (1999) Differentiated Model of Giftedness and Talent. To facilitate comparisons with Gagné *et al.*'s results, two of their talent fields were adopted, namely academics and music, and dance was chosen instead of sports to cover talents based on physical abilities.

This study addressed the following six hypotheses.

- Average scores will be very close to the midpoint of the measurement scale; past studies show time and again close to midpoint positions between pure environmentalism and pure hereditarianism.
- As also suggested by past research, very large individual differences in personal beliefs over the nature-nurture question will be observed.
- In line with Gagné, *et al.*'s (in press) results, there will be significant differences in heritability beliefs between groups of abilities/characteristics, especially more environmentalist positions concerning motivational characteristics.
- As a corollary to the first hypothesis, and as shown by Gagné *et al.*, no significant overall differences in judgment will be observed between the three samples of subjects.
- More environmentalist positions toward those abilities relevant to one's field of talent as compared to foreign abilities will be observed. That hypothesis was suggested by the self-referenced hypothesis proposed in attribution research (Weiner, 1984) to interpret the recurring tendency of students to attribute success to internal causes (ability, effort) and failure to external ones (difficult texts, bad luck). It was similarly assumed that individuals who are actively involved in mastering the specific skills of a given field tend to perceive as less heritable, thus more amenable to change and improvement, those abilities they are trying to master. On the other hand, they would tend to accept more readily as somewhat more controlled by the genetic endowment abilities belonging to domains outside their own field of expertise.
- Finally, as a corollary to hypothesis 3, significant differences in heritability perceptions between specific abilities within each cluster will be observed.

Method

Participants

The data were collected in the Montreal area from three groups of talented students: in academics (n = 80), music (n = 82), and dance (n = 80). Most of them (83%) were girls, with ages varying from 14 to 19 (M = 16.6; SD = 1.08); no significant age and gender differences were observed between the three groups. The academically talented students were enrolled in a highly enriched college program mixing science, arts, and humanities, with very selective admission criteria. The music students came from two music schools, a senior high school (80% of them) and a college-level one. The dance students belonged to five different dance programs, two in high schools (50% or them), the others in private dance schools.

Instrument and Procedure

The questionnaire (see Appendix), written in French, comprises 22 human characteristics: cognitive abilities (n = 5), musical abilities (n = 7), physical abilities related to dance (n = 7), and motivational characteristics (n = 3). Most of the characteristics were borrowed from Gagné, *et al.* (in press); some musical abilities were chosen from the Talent Identification Instrument (TII) proposed by Baum, Owen, & Oreck (1996); some physical abilities came from Harrow's (1972) taxonomy of the psychomotor domain, as well as the above mentioned TII. The assessment scale (see Figure 1) was adapted from those of Furnham, *et al.* (1985), and Zeidner & Beit-Hallahmi (1988). Participants were asked: "To what extent does heredity influence the following abilities?" All subjects completed the questionnaire during a class period; it required 20 minutes on average.

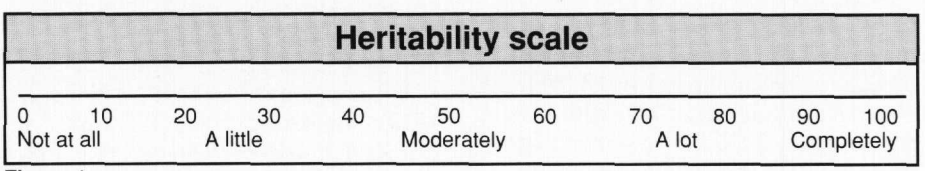

Figure 1

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Average Heritability Judgments by Ability and Group, with Domain and Total Averages

Characteristics	GROUPS Acad.	Music	Dance	All (*SD*)
Academic abilities				
Learning	53.6	46.6	52.6	51.0 (25.8)
Reasoning	49.2	48.6	55.4	51.0 (26.0)
Memory	49.8	53.1	56.4	53.1 (27.5)
Observation	48.5	50.2	52.1	50.3 (26.5)
Creativity	44.5	45.5	50.3	46.7 (27.2)
Musical abilities				
Auditory	51.3	46.5	49.9	49.3 (29.6)
Coordination	44.2	39.3	40.9	41.5 (28.9)
Rhythm	38.4	41.8	47.3	42.5 (29.9)
Auditory memory	48.4	42.1	47.6	46.0 (28.8)
Fingering memory	42.4	39.2	41.0	40.9 (28.5)
Creativity	48.3	43.6	42.6	44.8 (29.2)
Interpretation	46.6	42.8	43.0	44.0 (30.5)
Dance abilities				
Strength	49.8	45.9	45.6	47.1 (27.3)
Flexibility	49.3	43.8	52.1	48.4 (28.9)
Agility	49.6	44.8	42.9	45.7 (26.9)
Coordination	41.7	45.6	42.8	43.3 (26.5)
Rhythm	43.6	44.0	51.4	46.3 (29.4)
Creativity	43.5	40.7	42.6	42.3 (28.8)
Interpretation	44.9	38.2	45.8	42.9 (29.0)
Motivation				
Concentration	39.6	44.6	53.1	45.8 (28.9)
Interest	48.9	48.5	61.4	52.9 (31.1)
Persistence	50.6	48.1	63.8	54.1 (30.8)
	Domain averages			
Academic	49.1	48.8	53.4	50.4 (21.3)
Musical	44.3	43.6	44.6	44.2 (23.0)
Dance	46.1	43.3	46.2	45.2 (21.9)
Motivation	46.4	47.1	59.5	50.9 (25.9)
Heritability Score (H)	46.4	45.8	50.9	47.7 (18.8)

Note. $N = 242$. Acad. = academically talented students ($n = 82$); Music = musically talented students ($n = 80$); Dance = students talented in dance ($n = 80$).

Table 1

Results

Table 1 presents the average heritability judgments (the higher the value, the more heritable the ability) for each characteristic in each of the three groups, and for the total sample. Domain scores were computed, as well as a total heritability (H) score; they appear at the bottom of Table 1. Homogeneity was checked; Cronbach α coefficients were all above .85 (.94 in the case of the H scores), except for the motivational characteristics (two values of .76) where the scores were based on three items only. The H scores range between 4 and 91, and 40% of them between 40 and 60. To verify the first hypothesis, namely that average judgments would be close to the scale's midpoint, *z*-tests were performed; neither the domain averages nor the H score were found to differ significantly from that midpoint. But the averages do not tell the whole story; if these judgments were normally distributed and covered the whole range, the expected *SD* would be around 16 or 17. The very large observed *SD* values—some of them almost twice as large as expected in normal distributions—for all characteristics at the total sample level indicate very large individual differences as predicted by the second hypothesis. Even the domain averages, which are influenced by regression to the mean effects, are subject to these large individual differences in belief; their *SD*s were almost as large as those for individual abilities.

Three other hypotheses were examined with a 3 x 4 (Group by Domain) ANOVA, the last factor a repeated measure; the results are presented in Table 2. Hypothesis 3 stated that there would be differences in perceived heritability between the four sets of characteristics, especially a judgment of lesser heritability for motivational characteristics. The very significant domain effect confirms the presence of such differences, but not the specific one expected; Tukey post hoc comparisons show that academic and motivational characteristics are judged by all groups to be more heritable than the two sets of artistic abilities (see Table 1). As suggested by past studies, hypothesis 4 predicted that all three groups would show similar averages over all abilities. The non-significant group effect confirms that hypothesis. Hypothesis 5 predicted that each group would react differently to their own field's specific abilities, judging them less heritable than those of other fields; the significant G by D interaction in Table 2 indicates group differences in the ranking of domains in terms of their perceived heritability, but not the expected effect. As can be seen at the bottom of Table 1, the small effect $\eta^2 = .03$) is due to higher heritability judgments for motivational characteristics from the dance students.

The last hypothesis predicted significant differences between abilities belonging to the same cluster. To verify that hypothesis, four repeated-measures ANOVAs were computed, one for each cluster of abilities. A significant ability/characteristic effect was observed in each case. Within the cognitive ability cluster (F (4, 956) = 4,07, $p \leq 0{,}01$, $\eta^2 =$ .02), Tukey post hoc comparisons confirmed a significant difference between the two extreme means, memory/recall (53.1) and creativity (46.7). Within the musical ability cluster (F (6, 1434) = 5,37, $p \leq 0{,}01$, $\eta^2 = .02$), two subgroups emerged, with auditory ability judged more heritable than coordination, rhythm, and fingering memory. In the case of dance abilities (F (6, 1434) = 3,64, $p \leq 0{,}01$, $\eta^2 = .015$), flexibility was judged more heritable than coordination, interpretation and creativity. Finally, the motivational cluster results (F (2, 239) =

Repeated Measures ANOVA for the Heritability Judgments of the Four Domains

Source	*df*	*F*	η^2
	Between subjects		
Groups (G)	2	1.82	
S within-group error	239	(1396.79)	
	Within subjects		
Domains (D)	3	12.59****	.05
G by D	6	3.59**	.03
D x *S* within-group error	717	(237.14)	

Note. Values enclosed in parentheses represent mean square errors. Only minimally substantial interactions ($\eta^2 \geq .01$) are shown.
**$p < .01$ **** $p < .0001$

Table 2

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

13,43, $p \leq 0{,}01$, $\eta^2 = .05$) revealed that concentration was judged less heritable than the two others. Significant group by ability interaction effects were observed in the case of the musical and dance clusters (see Table 1); but the small explanatory power of these effects ($\eta^2 < .03$) did not warrant a closer analysis.

Discussion

Four of the six hypotheses were confirmed. The position of the overall mean close to the scale's midpoint (H.1), as well as the absence of group differences on the heritability score (H.4), are perfectly in line with past studies. These talented adolescents behave just as the adult samples queried in different countries. Such stability across various samples anchors the ecological validity of the middle-of-the-road position observed in every study of nature-nurture beliefs. Most laypersons shun extreme positions, and give credence to both genetic and environmental explanations of individual differences in behavioral characteristics. But, this last statement must be somewhat qualified in view of the large variability of individual H scores (H.2). No other study, except Gagné, *et al.* (in press), ever underscored that large variance, a phenomenon that modifies the interpretation of the observed averages. Indeed, no less than 44% of these talented youths obtained H scores either ≥ 65 or ≤ 35 (18% and 26% respectively). These percentages indicate that an important minority of them lean strongly toward one of the two poles, some even showing very strong environmentalism (7% with H scores ≤ 20) or very strong hereditarianism (4% with H scores ≥ 80). Considering that most of these talented youngsters have probably never been systematically exposed to the literature on the nature-nurture debate, it is quite surprising that so many of them hold rather strong beliefs in either direction. Moreover, considering the clear bias shown by the media in favor of the more politically correct Standard Social Science Model (Tooby & Cosmides, 1992), it is no less surprising that there is no clear leaning toward the environmental pole.

The lack of group differences in H scores (H.4), as well as the lack of any statistically significant age or gender effects, underline the recurring difficulty in explaining the source of such large variation in beliefs. Past research has been unable to account for much more than approximately 5-8% of the variance, even when a large variety of sociodemographic variables were introduced (e.g., age, gender, occupation, political affiliation). And significant results are rarely consistent. For instance, Furnham *et al.* (1985) found a small gender effect that was replicated neither by Nilsson and Ekehammer (1989), nor by Gagné, *et al.* (in press). Similarly, Gagné, *et al.* found a significant-albeit modest-role effect (educators vs students), but in only two of their three large samples.

By contrast, ability comparisons (H.3 and H.6) produced more significant effects. Unfortunately, the unique design of the present study limits comparisons with past research. The strongest global effect was the higher perceived heritability of academic abilities and motivational characteristics, as opposed to music and dance skills. In the case of cognitive abilities, the higher H mean could be due to their clear association with IQ, no doubt the psychological construct around which the nature-nurture debate has raged most. Students would thus be showing some awareness of the growing evidence in favor of a significant heritable component for these abilities. It is also possible that music and dance abilities were associated with specific training programs leading to clearly identifiable expertise. It might, in these students' mind, make these abilities more amenable to environmental influence.

The results are much more ambiguous in the case of motivation, since their higher perceived heritability directly contradicts Gagné, *et al.*'s (in press) results. In that large survey, the same three motivational characteristics, presented along with the same set of five academic abilities, were judged to be the least heritable by large samples of both French Quebec and American educators and students. When the two groups of abilities were contrasted, that contrast accounted for 80% of the total variance between the eight characteristics, a very strong effect. One hypothesis can be tentatively advanced to explain this contradictory result. Notice that the higher mean for motivation is in large part attributable to the dance sample (the significant group by domain interaction in the repeated measures ANOVA). Why would the dance students be more hereditarian than the two other groups in their assessment of motivation? One thing distinguishes them from the two other groups: they rarely practice alone. Thus, their group training might make them more aware of the large individual differences with regard to that behavior domain, and the limited openness to change exhibited by these behaviors. Still, when the dance group is set aside, the motivation means do not become higher than the academic ones. There is still an unexplained discrepancy between the two studies over that particular set of beliefs.

At a more microscopic level, namely within domains, significant heritability differences were observed between abilities Again, many of them contradicted Gagné, *et al.*'s (in press) results. In the academic domain, the only significant difference concerns the two extreme means, memory (53.1) and creativity (46.7). By contrast, Gagné, *et al.*'s large sample selected learning ability and creativity as the two **most** heritable cognitive abilities. These authors pointed out that they were not surprised by the high perceived heritability of creativity, arguing that they had often heard art teachers assert with conviction that drawing techniques were much easier to teach than the production of creative art work. Why does this sample judge creativity differently? It was not possible to identify a satisfying counter hypothesis. In the case of the physical abilities, comparisons are less appropriate since there were dance students in this study, as opposed to athletes, trainers, and phys.ed. educators and students in the other. Still, it is interesting to note that the ability singled out as the most heritable here, namely flexibility, received the **lowest** heritability score in the Gagné, *et al.* study. By contrast, strength, judged much more heritable by people in sports than the five other physical abilities proposed, is rated just above average by these three groups of students. It appears that the demands of different talent fields significantly influence the respondents' beliefs.

Finally, the hypothesis (H.5) concerning the tendency of students to perceive as relatively less heritable their domain's abilities, was not confirmed. That unexpected result might be due to the strict selection process in operation in the three talent fields. The students become aware that their presence in the program cannot be explained by effort alone, but that there were other factors in play to bring the excellent performances that allowed them to be picked for their respective talent development program. This might help maintain their

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

awareness of the large individual differences in natural abilities, and of their high relative standing with respect to these abilities when comparing themselves to average peers. That assumption is our best effort to explain in hindsight results that were not predicted. The fragility of that hypothesis made us painfully aware that hindsight might not always be 20/20 vision!

Conclusion

The present study has shown, like its predecessors, that most laypersons do not endorse the strict environmentalism commonly observed in the social sciences and the media. Instead, a majority believe that individual differences in human abilities cannot be adequately understood without introducing a genetic component as well. The talented students in this study behave just like members of the general population; the large majority of them agree that human abilities have a moderate genetic underpinning. Because of its unique design, this study has also revealed that human characteristics are not perceived as equally heritable. Moreover, comparisons with Gagné, *et al.*'s (in press) earlier survey point at many significant contradictions. Finally, this study has shown how easy it is to measure heritability beliefs reliably and validly with a minimum number of items.

The generalizability of the results is limited by unavoidable particularities of the design, for instance the fact that 85% of the participants were girls and that the three samples were not drawn through random sampling. These limits suggest the necessity for complementary studies on that question. These future studies could address the following questions: Is it possible to create a stable and consistent hierarchy of abilities in terms of their perceived heritability? How do heritability beliefs associate with other belief systems? Are there any social and personal characteristics that can account for a significant percentage (> 10%) of the very large variance in heritability beliefs? How do individuals who lean strongly toward either the environmental or hereditary poles of the continuum explain their particular leaning? To what extent can these beliefs be modified by factual information about genetic and environmental influences on human behavior? It is hoped that this exploratory study will spark more interest for this very provocative question.

REFERENCES

Albee, G. W. (1982). The politics of nature and nurture. *American Journal of Community Psychology, 10*(1), 4-30.

Alexander, P. A. (1985). Gifted and nongifted students' perception of intelligence. *Gifted Child Quarterly, 29*, 137-142.

Alexander, J. M., Noyes, C. R., MacBrayer, E. K., Schwanenflugel, P. J., & Fabricus, W. V. (1998). Concepts of mental activities and verbs in children of high and average verbal intelligence. *Gifted Child Quarterly, 42*, 16-27.

Baum, S. M. Owen, S. V., & Oreck, B. A. (1996). Talent beyond words: Identification of potential talent in dance and music in elementary students. *Gifted Child Quarterly, 40*, 93-101.

Bloom, B. S. (1985). *Developing talent in young people*. New York: Ballantine Books.

Calderhead, J. (1996). Teachers: Beliefs and knowledge. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology* (pp. 709-725). New York: Macmillan.

Devlin, B., Fienberg, S. E., Resnick, D. P., & Roeder, K. (Eds.). (1997). *Intelligence, genes, & success: Scientists respond to The Bell Curve*. New York: Springer-Verlag.

Dweck, C. S. (1986). Motivational processes affecting learning. *American Psychologist, 41*, 1040-1048.

Ericsson, K. A., & Charness, N. (1994). Expert performance: Its structure and acquisition. *American Psychologist, 49*, 725-747.

Furnham, A., Johnson, C., & Rawles, R. (1985). The determinants of beliefs in human nature. *Personality and Individual Differences, 6*, 675-684.

Gagné, F. (1999). Is there any light at the end of the tunnel? *Journal for the Education of the Gifted, 22*, 191-234.

Gagné, F, Blanchard, D., & Bégin, J. (in press). Beliefs about the heritability of natural abilities observed in general education, in music, and in sports. In N. Colangelo & S. Assouline (Eds.), *Talent Development: Proceedings from the 1998 Henry B. and Jocelyn Wallace National Research Symposium on Talent Development*. Dayton, OH: Ohio Psychology Press.

Gallagher, B. J., Jones, B. J., & Barakat, L. P. (1987). The attitudes of psychiatrists toward etiological theories of schizophrenia: 1975-1986. *Journal of Clinical Psychology, 43*, 438-443.

Galton, F. (1892/1962). *Hereditary genius: An inquiry into its laws and consequences*. New York: Meridian Books.

Goldman, A. I. (1993). The psychology of folk psychology. *Behavioral and Brain Sciences, 16*, 15-28.

Harrow, A. J. (1972). *A taxonomy of the psychomotor domain*. New York: Mackay.

Herrnstein, R. J., & Murray, C. (1994). *The bell curve: Intelligence and class structure in American life*. New York: Free Press.

Himelstein, S., Graham, S., & Weiner, B. (1991). An attributional analysis of maternal beliefs about the importance of child-rearing practices. *Child Development, 62*, 301-310.

Howe, M. J. A., Davidson, J. W., & Sloboda, J. A. (1998). Innate talents: Reality or myth? *Behavioral and Brain Sciences, 21*, 399-442.

Larsen, K. S. (1975). Attitudes toward Black-White integration as a function of beliefs about nature versus nurture. *Psychological Reports, 36*, 310.

Neisser, U. (1978). The concept of intelligence. Intelligence, 3, 217-227.

Nicholls, J. G. (1989). *The competitive ethos and democratic education*. Cambridge, MA: Harvard University Press.

Nilsson, I., & Ekehammer, B. (1989). Social attitudes and beliefs in heredity: A replication and extension. I363-365.

Pajares, M. F. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research, 62*, 307-332.

Pinker, S. (1997). *How the mind works*. New York: W. W. Norton.

Plomin, R., DeFries, J. C., & McClearn, G. E. (1990). *Behavioral genetics: A primer* (2nd ed.). New York: Freeman.

Scarr, S. (1981). *Race, social class, and individual differences in IQ*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Snyderman M., & Rothman, S. (1987). Survey of expert opinion on intelligence and aptitude testing. *American Psychologist, 42*, 137-144.

Taylor, M. G. (1996). The development of children's beliefs about social and biological aspects of gender differences. *Child Development, 67*, 1555-1571.

Tooby, J., & Cosmides, L. (1992). The psychological foundations of culture. In J. M. Barkow, L. Cosmides, & J. Tooby (Eds.), *The adapted mind: Evolutionary psychology and the generation of culture* (pp. 19-136). New York: Oxford University Press.

Weiner, B. (1984). Principles for a theory of student motivation and their application within an attributional framework. In R. Ames & C. Ames (Eds.), *Research on motivation in education* (Vol. 1). Orlando, FL: Academic Press.

Zeidner, M., & Beit-Hallahmi, B. (1988). Israeli students' perspectives concerning determinants of intelligence. *The Journal of Social Psychology, 128*, 517-523.

APPENDIX

Part A: Academic Abilities

1. Learning ability: ability and speed in learning new facts, in grasping new ideas and principles. **2. Reasoning:** ability to argue logically, to analyze, and to synthesize. **Memory / recall:** ability to memorize information rapidly, and to access that knowledge. **4. Sense of observation:** ability to perceive subtle details rapidly. **5. Creativity:** originality and imagination when solving academic problems.

Part B: Musical Abilities

6. Auditory ability: ability to recognize and discriminate sounds. **7. Coordination:** ability to move hands on the instrument, and to synchronize both hands. **8. Rhythm:** ability to reproduce beats, duration of sounds, pauses, and tempo of a melody. **9. Auditory memory:** ability to memorize a melody quickly. **10. Fingering memory:** ability to memorize fingering. **11. Creativity:** ability to improvise or compose melodies. **12. Interpretation:** ability to play a musical piece with feeling.

Part C: Physical Abilities (Dance)

13. Strength: ability to do a short term muscular effort. **14. Flexibility:** suppleness of muscles and joints. **15. Agility:** ability to move with fluidity and precision. **16. Coordination:** ability to synchronize movements of different parts of the body. **17. Rhythm:** ability to synchronize movements with music. **18. Movement creativity:** ability to improvise or choreograph in an imaginative manner. **19. Movement expression:** ability to introduce feelings through movement.

Part D: Motivational Characteristics

20. Concentration: ability to resist distractors, to remain focused on a task for long periods. **21. Interest:** intellectual curiosity, thirst for knowledge. **22. Persistence:** to show determination and tenacity, especially when the goal is not easily reached.

Note. Translated from French especially for this publication.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.