The cross-cultural generalizability of two Western intelligence tests, the Stanford-Binet and the WAIS, in a non-Western culture was examined. Samples of 976 Australian and 1003 Chinese university and high school students participated in a rating task. Items from the two tests were given to students, and were rated on the two aspects of *relevance* and *difficulty*. On relevance ratings, the underlying three-factor structure of the Chinese sample accords very well with that of the Australian, suggesting a basic common structure for the concept of intelligence across cultures. The three factors were spatial-mechanical, verbal and memory. The results also showed that both cultures consider spatial-mechanical items most important and memory items least important. The two samples differed, however, in mean difficulty scores on the three dimensions. These differences were attributed to possible cultural differences in nurturing and providing opportunities to practice the different skills. It is concluded that the concept of intelligence is comparable between Australian and Chinese cultures, and that, for both cultures, the two tests are legitimate measures of the intelligence construct.

ATTRIBUTES OF INTELLIGENT BEHAVIOR

Perceived Relevance and Difficulty by Australian and Chinese Students

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The measurement of intelligence requires representative sampling of the abilities which we take to comprise "intelligence." Unquestionably, individual differences exist in the acquisition of such skills, the facility with which they function,

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and the different environments in which they are nurtured. Hence, it is reasonable to assume that individuals reared in contrasting cultures will develop different patterns of abilities, practice different pursuits, and value different skills.

Most intelligence tests are Anglocentric (Mercer, 1979) in that they revolve around the Western concept of intelligence, which is inextricably bound to white middle class culture and values. Given that intelligence tests are samples of the intellectual requirements of a society, and that these requirements may vary among cultures, extreme caution must be exercised in employing such measures with non-Western or non-middle class groups. It is a cross-cultural axiom that all non-Western communities may demonstrate patterns of abilities which differ widely from those of Western groups, for whom the tests were originally designed. Thus, the issue of whether patterns of abilities developed in and valued by a non-Western cultural group are compatible with those of Western culture must be resolved before the tests can be validly used cross-culturally.

In studying whether different cultural groups vary in their concepts of intelligence, most researchers rely either on global measures, such as ratings of adjectives, or on inferential information. That is, the emphasis has been on delineating "Western" concepts. Bruner, Shapiro, and Tagiuri (1958), for example, asked college students to rate on a five-point scale how much they associated each of 59 adjectives with "people who are intelligent." They found that qualities of being energetic, clever, imaginative, independent, conscientious, honest, reliable and responsible were strongly associated with the concept. Other researchers have emphasized different aspects of Western concepts of intelligence. For examples, Goodnow (1976) has pointed to the value place on such characteristics as speed, originality, mental manipulation and parsimony; Connolly and Bruner (1974) regard the defining feature as the ability to generalize or to go beyond the information given.

Stepping outside "Western" samples, Wober (1972, 1974) used the Semantic Differential technique to describe Ugandan views of intelligence. Interestingly, Ugandan villagers associated intelligence with adjectives such as slow, careful and active, whereas Ugandan teachers and the elite (more Westernized) groups associated it with speed. In other words, the latter two groups regarded intelligence in much the same way as American students did (Bruner et al., 1958), while the villagers apparently favored other capacities. Recently, Gill and Keats (1980) studied the extent to which Australian and Malay university students differentially value various aspects of intellectual competence. They found that Australian students rated academic skills more highly and stressed the ability to adapt to new events. The Malays, however, valued social and practical skills more highly, along with speed and creativity.

A different approach uses factor-analytic techniques as tools to examine the underlying structural differences associated with the nature of intelligence. If the development of specific skills is shaped by different cultural environments, it is conceivable that these skills will cluster differently in various cultures. Thus, rather than ascertain a group's beliefs about intelligence with surface ratings, these investigators have examined the structure of abilities manifested by various cultural groups.

Irvine (1969a, 1969b) and Vandenberg and Hakstian (1978) in reviewing many of these studies (for example, Guthrie, 1963; Irvine, 1969a, 1969b; Vandenberg, 1959, 1967; Vernon, 1969) concluded that when Western-based tests purporting to identify abilities are administered in different cultures, the theoretical dimensions found are similar to those underlying Western data. Nevertheless, the subjects across both Western and non-Western cultures were mostly students. Consequently, the similarity in factor structure may be a function of similarities in world-wide educational objectives that encourage overlearning of certain skills.

It is significant that those studies, concerned with perceived attributes of intelligence, have to date focused on global characteristics of both abilities and personality, and provide little information on specific intellectual skills. The factor-analytic work, on the other hand, does focus on specific skills, although instead of examining the perceived importance of these abilities in a culture, the emphasis has been placed on attainment of these skills. This approach, of course, gives rise to the old argument of whether differences in structure between Western and non-Western cultures reflect differences in ability or differences in the value that the society places on that ability or both.

Perhaps more directly related to ideas about assessment and cross-cultural comparisons is the approach that asks people to rate intelligence test items for their appropriateness in assessing or defining intelligence. Tamigawa and Willis (1977, cited by Goodnow, 1980) used items from several measures of fluid and crystallized intelligence and asked both young and old subjects to rate these items for suitability in assessing the intelligence of young and old. This method is probably a more penetrating one for studying cross-cultural differences in the concept of intelligence, both because we now have a clear reference for general adjectives and because the relevance to cross-cultural testing is more direct.

Consequently, our research used the rating technique to investigate how two different cultures vary in their perceived importance of the specific intellectual abilities that are frequently represented in traditional Western intelligence tests.

The cultural comparison was based on samples of Australian and Chinese (Taiwanese) students. The Australian and Chinese cultures have much in common in their emphasis on academic success and technology. Thus, it would not be surprising to find some similarity in the data obtained from the two groups. On the other hand, one might expect some unique results that reflect the interaction between environment and the perceived importance of abilities.

METHOD

SUBJECTS

The sample comprised 976 Australian and 1003 Taiwanese students. In the Australian sample, students were drawn from the Australian National University (279 males and 371 females) and from Canberra colleges, equivalent to the Taiwanese final two years in high school (77 males and 249 females). The average years of age were 24.7 and 16.6 for the university and college students respectively. In the Chinese sample, university students (164 males and 261 females) attended the National Taiwan University, while the high school students (291 males and 287 females) were drawn from four schools in Taipei. The average years of age were 20.5 and 16.5 for the university and college students respectively. The Australian university students were an average of four years older than their counterparts in the Chinese sample. This could be attributed to a substantial number of mature age students in the former group. Thus, the samples were equated for years of education, but not age.

MATERIALS

Twenty-seven items were selected from two well-known intelligence tests, the Stanford-Binet and the Wechsler Adult Intelligence Scale. These represented a comprehensive range of items for testing persons 13 years of age or older. Table 1 shows the nature and source of items chosen.

Both English and Chinese versions were prepared. The Chinese version was cross-translated into English to ensure consistency in content. All items were presented with answers.

PROCEDURE

A questionnaire consisting of the 27 items was compiled and subjects were asked to rate each item on a seven-point scale. Each item was evaluated twice. In Part 1, items were rated in terms of their relevance to or importance in measuring intelligence. In Part 2, subjects were asked to judge the level of difficulty of the items. Subjects were not permitted to compare their answers in Part 2 with those in Part 1. The order of presentation of items in Part 2 was different from that used in Part 1.

The rating of difficulty was included as a means of checking whether or not subjects' perceptions of the importance of various intellectual skills were independent of their own level of abilities. If subjects' judgments are a function of their abilities, the data could not be regarded as reflecting cultural values so much as individual values.

RESULTS

Three forms of analysis are presented. The first analysis examined the mean ratings on relevance and on difficulty for each item. The scores ranged from one, for items of least relevance and lowest difficulty, to seven, for the most relevant and the most difficult. Second, the results of the factor analysis for each culture are presented and compared. In the third analysis, scales were formed on the basis of the factor analysis, and mean scale scores or factor means were compared within each culture and across cultures.

COMPARISON OF ITEM MEANS

Table 1 shows the mean ratings for each item on relevance and on difficulty. The results indicate that the majority of items appear relevant for both Australian and Chinese subjects. The judged difficulty level of the items tended not to be high. The overall means for the Australian and the Chinese groups were 4.12 and 4.48 on relevance and 3.47 and 3.77 on difficulty, respectively. Chinese subjects tended to give higher

TABLE 1
Mean Ratings of Individual Items on Relevance and Difficulty by Australian and Chinese Groups

Item No. and content[a]	On Relevance[b] Australian	Chinese	On Difficulty[b] Australian	Chinese
1. Ingenuity	5.15	5.29	3.07	4.17
2. Mental arithmetic	4.86	4.73	3.81	4.01
3. Picture analysis	4.85	5.61	4.44	5.23
4. Block design	4.82	5.14	3.69	4.69
5. Reasoning	4.73	5.21	2.42	3.42
6. Orientation II	4.68	5.08	3.41	3.91
7. Codes	4.66	5.38	5.24	4.75
8. Picture absurdity	4.65	5.47	3.49	4.01
9. Paper cutting	4.53	5.12	3.79	4.35
10. Enclosed box problem	4.51	3.69	2.60	3.26
11. Picture arrangement	4.43	5.34	3.36	4.36
12. Picture completion	4.31	5.10	2.35	3.40
13. Matrix completion	4.21	4.27	2.28	2.96
14. Orientation I	4.19	4.27	2.27	2.96
15. Repeating passages	4.15	4.99	4.95	4.23
16. Similarities	4.07	4.51	3.04	4.20
17. Sentence building	4.01	4.57	3.37	4.02
18. Differences	3.85	4.10	3.17	3.93
19. Proverbs	3.77	3.95	3.68	3.43
20. Reconciling opposites	3.67	3.65	2.61	3.50
21. Sentence completion	3.67	3.70	2.86	2.92
22. Opposite analogies	3.53	3.59	3.35	2.94
23. Repeating digits reversed	3.51	4.21	5.29	4.34
24. Repeating digits	3.33	3.67	4.09	2.93
25. Finding reasons	3.17	3.11	2.94	3.00
26. Information	3.02	4.26	4.19	4.03
27. Vocabulary	2.83	3.20	3.96	2.73
Overall mean	4.12	4.48	3.47	3.77

a. Items 2, 4, 9, 18, 26 and 27 are from the WAIS. Items 3, 5, 7 and 11 are from the Chinese form of the Stanford-Binet. The remaining items are from the English form of the Stanford-Binet.
b. All ratings are on a seven-point scale with the rating of seven representing the most relevant or the most difficult.

ratings overall ($t = 9.26$, $p < .01$ on relevance; and $t = 6.69$, $p < .01$ on difficulty). It is important to note that not all items were regarded as equally important. The item means ranged from 2.83 to 5.15 for the Australians and from 3.11 to 5.61 for the Chinese. Similarly, there was variability in mean judged item difficulty ranging from 2.27 to 5.29 for the Australians and from 2.73 to 5.23 for the Chinese.

The extent to which judgments of relevance are influenced by the perceived difficulty of the item was considered important. Consequently, the strength of the relationship between perceived relevance and difficulty was examined for each item using Pearson product-moment correlation coefficients. For the Chinese sample, the correlations ranged from .22 to .47 for university students, with a median of .34, and were somewhat lower for the Chinese high school students, ranging from .11 to .30, with a median of .21. For the Australian sample, however, the correlations were negligible. They ranged from .09 to .21 (median = .14) for university students and .07 to .20 for high school students (median = .07). Given that item difficulty was accounting for a relatively small proportion of the variance in the relevance scores overall, it seemed reasonable to assume that the data were a fair reflection of cultural values rather than merely individual abilities.

In order to establish whether there was agreement among the four subgroups (two levels of education × sex) within each culture, items were ranked for each subgroup in terms of relevance and difficulty. Kendall's coefficient of concordance (W) was computed to indicate the extent of agreement among these four subgroups. On relevance, the Ws were .93 and .96 for Australian and Chinese subgroups, respectively. On difficulty, the Ws were .94 and .93 for Australian and Chinese subgroups, respectively. All values were significant ($p < .01$). Thus there was high similarity among subgroups within cultures in their ratings of both the relevance and the difficulty of intelligence test items. It was therefore appropriate to pool the data from university and college students of both sexes in later analyses.

Finally, the rankings of items in terms of relevance were compared between cultures. The correlation was moderately high (the rank correlation R = .82, $p < .01$), suggesting that the two cultures showed relatively high agreement on judging the relevance of items used to measure intelligence. For example, amongst the ten most relevant items for the Australian sample, eight appeared in the top ten derived from the Chinese data. Included were items such as ingenuity, mental arithmetic, picture analysis, and so forth. The extent of agreement at the other end of the scale, among the five least relevant items, was almost as impressive. Three were common to both cultures (vocabulary, finding reasons and repeating digits). One exception to this pattern of results was the relevance ratings of Item 26 (information). On this item, a large cultural discrepancy was found, with the Australians rating it much lower than the Chinese.

FACTOR ANALYSIS

The present analysis sought answers to the question of whether perceptions of the relevance of individual items were interrelated and whether such structures was comparable across cultures.

First, the relevance ratings of the 27 items were factor analyzed utilizing Maximum Likelihood extraction techniques with both Varimax and Promax rotations (using the EFAP program by Jöreskog & Sörbom, 1976). The three-factor solution yielded a reasonable fit to the data in both cultures. Tucker reliability coefficients were .80 and .82 for the Australian and the Chinese results, respectively. The Promax solution yielded a more satisfactory simple structure with 37 of 81 loadings below .1 in absolute value for both cultures. The Varimax solution, on the other hand, yielded 24 in the Australian and 19 in the Chinese results. The Promax solution was therefore chosen as the basis for subsequent analyses.

In Table 2, the item loadings for the three factors extracted by the Promax procedure in each culture are presented. The

TABLE 2
Factor Structures of Australian and Chinese Concepts of Intelligence in Terms of Relevance Ratings of 27 Test Items

Test Item[a]	Australian Factor One	Factor Two	Factor Three	Chinese Factor One	Factor Two	Factor Three
1	.723	–[b]	–	.615	–	–
2	.421	–	–	.305	–	–
3	.538	–	–	.458	–	–
4	.559	–	–	.502	–	–
5	.742	–	–	.628	–	–
6	.645	–	–	.716	–	–
7	–	–	–	.319	–	–
8	.515	–	–	.640	–	–
9	.509	–	–	.579	–	–
10	.538	–	–	.328	–	–
11	.498	–	–	.443	–	–
12	.645	–	–	.636	–	–
13	.558	–	–	.540	–	–
14	.667	–	–	.731	–	–
15	–	–	.419	–	.365	–
16	.387	.310	–	–	.351	–
17	–	.504	–	–	.300	–
18	–	.707	–	–	.603	–
19	–	.445	–	–	.615	–
20	–	.330	–	–	.536	–
21	–	.474	–	–	.314	–
22	–	.757	–	–	.553	–
23	–	–	1.000	–	–	.980
24	–	–	.827	–	–	.598
25	–	.361	–	–	.465	–
26	–	.544	–	–	.407	–
27	–	.654	–	–	.635	–
Inter-factor correlations	$r_{12} = -.29$			$r_{12} = .45$		
	$r_{13} = -.33$			$r_{13} = .34$		
	$r_{23} = .37$			$r_{23} = .58$		

a. The item numbers refer to those appearing in Table 1.
b. Loadings less than .3 are not shown.

first factor might be interpreted as the relevance of spatial-mechanical ability (k:m) to the intelligence concept. The second factor appears to represent verbal ability (v:ed), while the third involves rote memory (m). The factor names k:m and v:ed were adopted from Vernon (1961). The interfactor correlations ranged from low (–.29) to moderate (.58).

To estimate the similarity of factor structures in the two cultures, coefficients of congruence (Gorsuch, 1974) were computed for corresponding pairs of factors. The values of the coefficient were .95 for spatial-mechanical items, .93 for verbal items and .91 for memory items. There were only a few discrepancies in salient factor loadings between the two factor structures. For example, Item 15 (repeating passages) had a loading of .42 on the memory factor in the Australian sample but this dropped to .01 in the Chinese sample and, instead, loaded on the verbal skills factor (.37). This shift suggests that the Australians perceive a high degree of rote memory in this task, while the Chinese students see it as being more semantic in nature. The consequence is that the memory factor for the Chinese is based on two tests both measuring digit span, whereas the same factor for the Australians is based on three tests measuring something other than digit span. As the results generally show high compatibility in factor structure across cultures, it was concluded that the factor structures of the perceived relevance of facets of the traditional intelligence concept, as represented by the set of 27 test items, are highly similar across cultures.

COMPARISON OF FACTOR SCALE MEANS

It is of interest to compare the ratings of relevance and difficulty of the three factors within a culture and across cultures. Figure 1 shows the mean profiles of the three factors. Only items with loadings above .30 on a particular factor were included in computing the scale means. Comparisons of scale means were made within and between cultures using appro-

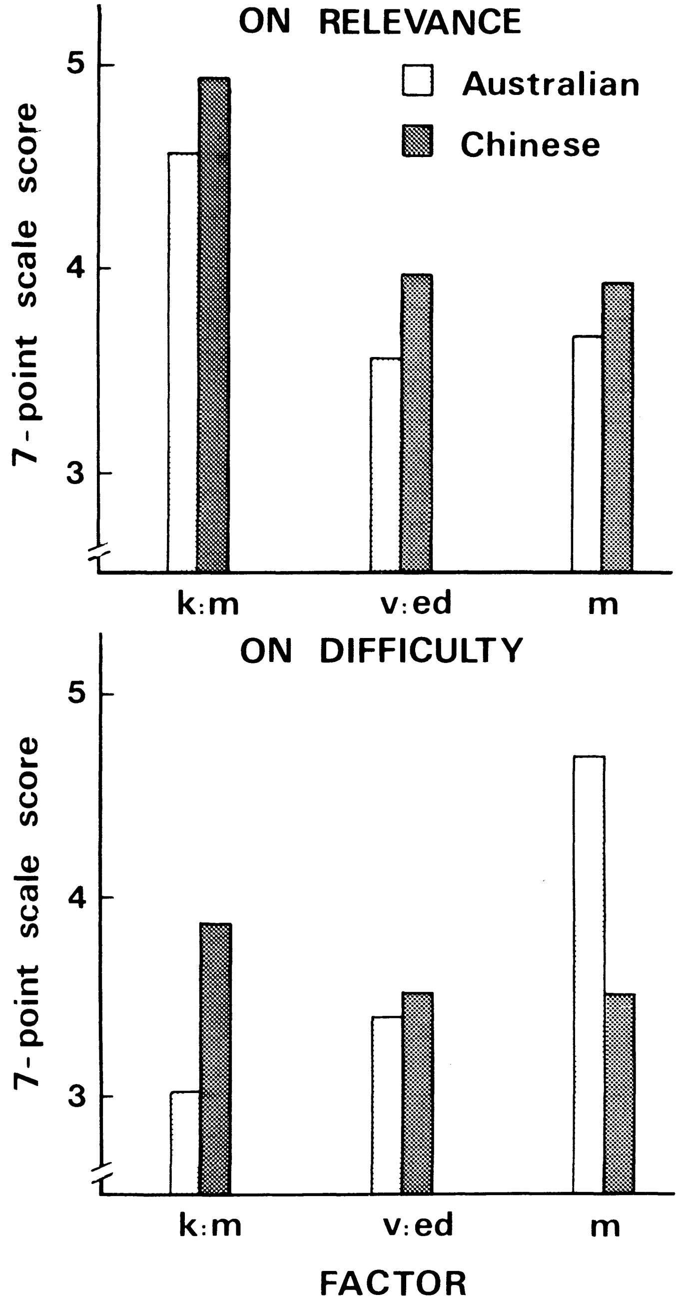

Figure 1: Mean relevance and difficulty ratings of items loading on three factors: spatial-mechanical (k:m), verbal (v:ed), and memory (m)

priate t tests. Intracultural comparisons of scale means showed that spatial-mechanical abilities were considered more relevant than either verbal or memory skills in both cultures. The t values of these comparisons ranged from 17.1 to 34.8. All were significant ($p < .01$). In neither case was a difference found in the importance attached to verbal and memory skills.

Cross-cultural comparisons showed that, although there was strong agreement between the two cultures in the rank ordering of items in terms of relevance, the Australians tended to have consistently lower mean scores than the Chinese. The between-group t values were 8.25 (spatial-mechanical), 9.13 (verbal) and 3.60 (memory), all of which were significant ($p < .01$).

DIFFICULTY RATINGS

Having concluded that difficulty of the items was not accounting for the majority of variance in relevance ratings, the judgments of difficulty were considered of interest in themselves. First, the rank orderings of items in terms of difficulty in the two cultures were correlated, the value of the rank correlation coefficient being .46 ($p < .05$). Thus it appears that the two cultures showed considerably less agreement in their judgments of difficulty than they did in judgments of relevance.

Second, upon factor analyzing the difficulty ratings in each culture, three factors emerged which corresponded closely to those identified with the relevance ratings. The coefficients of congruence were .91, .93 and .97 for spatial-mechanical, verbal and memory factors respectively. Scales were formed on the basis of the strength of factor loadings of these items, as was done with the relevance data. As shown in Figure 1, for the Australian sample, memory skills were regarded as significantly more difficult than verbal skills and spatial-mechanical ability (the t values were 39.0 and 31.6 respectively, $p < .01$ in both cases). Subjects rated the spatial-mechanical ability as least difficult. The difference between ratings of verbal and spatial-mechanical skills was also significant ($t = 11.6$, $p < .01$). Among the Chinese, a different pattern emerged: The spatial-mechanical ability was judged as the most difficult, followed by verbal and memory skills. The comparisons between spatial-mechanical versus verbal, and spatial-mechanical versus memory skills on difficulty ratings were significant ($p < .01$) with t values being 11.5 and 9.9, respectively. The difference between verbal and memory skills was not significant.

As the Australian university students were, on average, older than their Chinese counterparts, the age difference may be responsible for differences in difficulty ratings on the memory items. The hypothesis that older people believe they will perform less well in rote memory tasks because rote memory skill deteriorates with age was tested by the following procedure. The Australian university sample was divided into two groups: those less than or equal to 25 years of age ($n = 447$, median age = 20), and those over 25 ($n = 203$, median age = 32). A comparison of the mean difficulty profiles for these two groups on the spatial-mechanical, verbal and memory scales showed no significant differences. For the under-25 group, the scale means were 2.89, 3.32 and 4.71 respectively, compared with 2.98, 3.06 and 4.81 for the over-25 group. This analysis therefore suggests that the age difference does not provide a viable explanation.

DISCUSSION

When students from Australian and Chinese universities and high schools were asked to rate intelligence test items on their relevance to or importance for the intelligence construct, they showed remarkable similarity in their responses both among subgroups within each culture and between cultures.

Factor analyses of relevance ratings yielded the same three factors for each culture. It appears that for the two culture groups, perceptions of the intelligence construct can be defined in terms of three dimensions: (1) spatial-mechanical skills (k:m), (2) verbal skills (v:ed) and (3) memory ability (m). The fact that the Promax solution showed low to moderate interfactor correlations for each culture suggests that there may be a higher order general intelligence concept influencing the perceptions of the subjects. The same factor structure emerged from the difficulty ratings as from the relevance ratings in both Chinese and Australian cultures. The data may reflect the fact that students from the two cultural groups have been similarly indoctrinated into believing that intelligence is what intelligence tests measure! Alternatively, the results may suggest that the cultures value similar skills and therefore respond to the set of items in a similar manner.

When scale scores on these three factors were compared across cultures, both groups rated the items in the spatial-mechanical scale as the ones most relevant to measuring intelligence, with the verbal and memory scales being much lower in importance. However, the pattern of scale means on difficulty ratings was not as consistent across cultures as the relevance judgments. The Australians regarded items requiring rote memory as much harder and items requiring spatial-mechanical ability as much easier than did the Chinese group. Chinese students tended to rate spatial-mechanical items as the most difficult and to consider memory items as no more difficult than verbal items. This difference cannot be attributed to the average age difference between the two culture groups.

An alternative explanation for the differences in scale means on difficulty ratings might lie in the differing types of school instruction. Instruction in Chinese schools may provide sufficient practice to stimulate the development of memory skills but less in developing the spatial-mechanical abilities. In contrast, school instruction in the Australian setting tends to be less concerned with rote memory and more with the spatial-mechanical type of skills. This hypothesis, of course, assumes that as practice in a specific skill increases, the perceived difficulty of a task requiring this skill will be reduced.

It does seem plausible, however, that differences in school instruction, or more broadly, in the opportunities provided by a culture to cultivate and practice strategies relevant to the employment of these skills may account for the differences in the scale means on difficulty ratings.

It would be of interest to see if some relations could be found between actual performance and value judgments of specific skills. Although many studies have reported cross-cultural differences in performing specific skills, and others have found differences in defining the intelligence concept, the literature lacks information concerning the link between the perceptions of a cultural group regarding certain skills and their level of competence in performing these skills. Goodnow (1976) has pointed out that it is important to specify just what it is about a task that makes it easier for people of some cultures than for others; more importantly, to specify what kind of experience leads to what kind of skills. Olson (1976) argues that intelligence is "something we cultivate by operating with a technology, or something we create by inventing new technology," and that "test performance reflects those abilities as amplified by the technologies of the culture" (p. 199). Although the present study has dealt only with value judgments and perceived level of difficulty, the results do suggest that the relationship between values and skills merits further investigation.

One may speculate that in Western cultures, highly valued skills are performed with competence. Thus, the greater tendency of the Australians to work at the spatial-mechanical skills which are required by the highly technological Australian society, may well have contributed to the perceived ease of these tasks. In contrast, in the Chinese culture highly valued skills may not be associated with competence. Modern Chinese culture, although now a technological society, has evolved relatively recently from a traditional agricultural background which made great demands on memory skills. The industrialization process has been accompanied by a demand for spatial-mechanical skills, and consequently people have become increasingly aware that many new skills are needed and have to be learned. It is reasonable to expect a time lag between accepting certain new values and acquiring corresponding skills, especially when this involves the teaching of the skills in school. Meanwhile, the effect of the traditional value system lingers on, as is evident, for example, in the relevance ratings on Item 26 (information). While the ability to provide factual information was regarded by the Australians as trivial, it was still given substantial emphasis by the Chinese.

In conclusion, the results appear to support the generality of perceptions of the structure of intelligence across Australian and Chinese cultures. In spite of differing perceptions of the difficulty of items in these cultures, Chinese students do not appear to differ from Australian students in the extent to which they consider the Stanford-Binet and the Wechsler Adult Intelligence Scale as legitimate measures of the intelligence construct.

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