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ABSTRACT

Conditional letter sound correspondences (LSC) in which the pronunciation of a letter is determined by its graphemic environment were studied. Conditional LSC patterns selected for investigation were the c, g, and vowel-in-final-e patterns. The study had two aims: (1) to gather normative data for LSC generalizations and (2) to examine, for each pattern, the relation of appropriate choice of pronunciation to school achievement and IQ. A 69-item list of synthetic words was constructed and presented to a total of 561 subjects from grades 2, 4, 6, and 8 and undergraduates. IQ and achievement test scores from school-administered tests were recorded. Grade point average was used as an achievement-score measure for undergraduates. Both correct and plausible responses were analyzed. Treatment of data was by analysis of variance. Results indicated that better students showed greater mastery of all three conditional patterns tested. Mastery of the conditional patterns increased through grade 8. This is in contrast to the acquisition pattern for simple LSC generalizations. References and tables are included. (WB)

USE OF SIMPLE AND CONDITIONAL LETTER-SOUND CORRESPONDENCES IN CHILDREN'S PRONUNCIATIONS OF SYNTHETIC WORDS[1]

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Introduction

Regular letter-sound correspondences (LSCs) in English include not only simple one-letter, one-sound relations, but also conditional correspondences in which the pronunciation of a letter is determined by its graphemic environment; the full regularity of English orthography is not revealed unless the second type of correspondence is taken into account (Venezky, 1967).

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The conditional LSC patterns of concern in this study are three: the c, g, and vowel in final e patterns. The letter c has two major pronunciations, /k/ and /s/; when followed by the single vowel letters, a, o, and u, however, c is always pronounced /k/ (e.g., cake, coke, cute). When followed by the single vowel letters e, i, or y, c corresponds to /s/ (e.g., cell, city, cyst). Thus the appropriate pronunciation of c is conditional upon the following vowel letter in English. A similar pattern determines the correspondence of g to /g/ or /ǰ/, as in gate, got, gun versus gem, gin, and gym; more high frequency exceptions exist to this pattern than the c pattern.

Each single vowel letter--a, e, i, o, u and y-- has two major pronunciations, usually called the long and short pronunciations, in monosyllabic words or the stressed portion of polysyllabic words. When followed by a simple consonant unit[4] and another vowel spelling, including final, silent e, the vowel is usually given its long pronunciation; otherwise, the short pronunciation occurs.[5] Examples of the long and short pronunciations, respectively, are rate, mete, site,

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[3]Letters will be underlined to indicate their graphemic occurrence; IPA symbols in slashes will be used to indicate pronunciation.

[4]A simple consonant unit is a consonant letter or digraph corresponding to a single pronounced consonant--e.g., th but not x. The rule is expressed here in terms of phonemic environment, then; if we express the rule in terms of graphemic environment, it proves incorrect for x and fails to include digraphs (e.g., bathe) in its scope.

[5]A few exceptions to the vowel rule exist (e.g., love, lose, have), but they are infrequent.

pope, cube, gyre; rate, met, sit, pop, cub, and gyp. Observe that final -e simply serves as a marker of vowel pronunciation; it is not itself pronounced.

In contrast to the conditional correspondences cited, many letters have invariant or nearly invariant pronunciations; e.g., d, f, j, l, q, v, and z. Others, like p and t, are invariant in initial or final positions, unless occurring in a digraph sequence; these will be classed as simple correspondences for the purpose of this paper.

The LSC generalizations presented were drawn from data on patterns of pronunciation in the 20,000 most common English words; whether readers make use of these generalizations is an empirical question. In a previous study we reported on use of the predictable c and long vowel patterns by third grade, sixth grade, high school, and adult Ss; older Ss and better readers were more likely to give the appropriate long vowel and pronounce c as /s/ before e, i, or y (Calfee, Venezky, and Chapman, 1969). In the study to be reported here, a more complete sample of synthetic words testing c, g and long and short vowel patterns was constructed. Relatively invariant correspondences (e.g., f, l, p, t) were also included in the test words. Pronunciation data on these words were obtained from second, fourth, sixth, and eighth graders, as well as adults; preliminary analyses are reported in this paper.

The study had two aims: a) to gather normative data on LSC generalizations, for the patterns examined; b) to examine, for each

pattern, the relation of appropriate choice of pronunciation to school achievement and IQ.

It was predicted that mastery of invariant, or simple, LSCs would precede mastery of conditional LSCs. It was further predicted that better achievers would show greater mastery of LSC patterns, at least in the early school years. This prediction arose from our previous finding that better readers showed greater mastery of selected LSC patterns; we hypothesized that school achievement measures, too, should show a relation to LSC use, although reading ability is only one of many contributors of variance to achievement scores.

METHOD

Stimulus Materials.--A 69-item list of synthetic words (nonsense words following English spelling patterns) was constructed; the words are listed in Table 1. Three major LSC patterns were of interest: c, g, and the vowel letter in the final -e, pattern. Synthetic words constructed to test the c pattern included instances of initial c before the single vowel letters a, e, i, o, u, y, followed by a consonant cluster (CC) or consonant -e (Ce); medial c followed by the six single vowel letters; and final c preceded by the six single vowel letters.

Synthetic words were constructed to test the g pattern in a similar fashion, except that y was omitted from the single vowel letter contexts. The vowel letters a, e, i, o, u were each tested twice in C-Ce contexts and the identical C-C contexts without e (the

letter e was inadvertently tested in only one C-C context). The four miscellaneous CVC items were included to examine the effect of preceding w on pronunciation of a and shifts in pronunciation of o as a function of similarity to existing words (phone, gone).

Procedures.--Two random orders of the 69-item list, preceded by five practice items (chung, foll, goot, lech, veeg), were prepared. The words were presented individually to Ss in one of three forms: slides made of the single items lettered in sans-serif capitals; 5" x 8" cards on which the item was typed, centered, in sans-serif 14 point capitals; or cards typed in 14 point lower case.

A Kodak Carousel slide projector was used to present the slides at low intensity on a wall or screen in the test room; minimum inter-item interval was 5 sec. Cards were bound in notebooks; the E turned the page as S pronounced each item. Slide presentation was used in Marshall school and Sherman sixth grade; all succeeding data were gathered through card presentation, which permitted faster testing and eliminated the background noise of the Carousel on the tape.

Ss were told that the words had been made up and were asked to pronounce them as if they were real English words. Responses were recorded on a Uher 5000 tape recorder at 3 3/4 i.p.s. with a Shure lavaliere microphone. Assignment to list order and upper or lower case (for cards) was random.

Subjects.--Participating in the study were 561 Ss attending second, fourth, or sixth grade in Nakoma, Sherman or Marshall elementary schools, eighth grade at Marshall, and undergraduates

at the University of Wisconsin. Nakoma and Sherman elementary schools, in Madison, Wisconsin, draw students from upper-middle class and middle class SES strata respectively. Marshall, located in Marshall, Wisconsin, draws from a heterogeneous rural and semi-rural population. All children in a grade were tested; protocols were dropped for those who did not have achievement test data.

I.Q. and achievement test scores from school-administered tests were recorded for each S; since these tests differed according to school and grade, quartile splits on a summary achievement measure were computed separately for each school-grade group. Ss were assigned, post-hoc, to one of the four quartile groups defined for their school and grade. The achievement tests and summary scores used in establishing quartile splits are presented in Table 2, along with means for each school-grade group. The I.Q. tests available and means for each school-grade group are also presented. Grade-point average was used as an achievement score measure for adult undergraduates.

In Table 3 is presented the distribution of Ss by school, grade, sex, and achievement quartile. Assigned to achievement quartile 1 (the lowest) were 113 Ss; to 2, 145; to 3, 138; to 4 (the highest), 165. Of the Ss, 281 were male; 280, female.

Transcription Procedures.--Each S's responses were transcribed phonemically in IPA (the International Phonetic Alphabet) by one of five students with previous training in transcription. Tapes were played over Ampex 140 Stereophonic headphones on an Ampex 1100 recorder. Every tenth S on tape was independently transcribed

by a second listener and disagreements noted; a third checker resolved by these checks were acceptably low (.5 - 2% phoneme disagreement) with one exception, a non-native English speaker who showed a tendency to raise mid-vowels in all environments (e.g., /ɛ/ was recorded as /æ/); all transcriptions by this listener were redone and every tenth data set checked as before.

Coding Procedures.--Each response was matched with its stimulus word and the phoneme corresponding to each letter was coded. For instance, if the stimulus word was cobe and the response /korb/, /k/ was coded for c, /o/ for o, /r/ as an insertion, /b/ for b, and silence for e. Consonant phonemes were matched only with consonant letters, and vowel phonemes with vowel letters. In the few cases where two consonant phonemes corresponded to a single consonant letter, the phoneme most similar in articulation to the expected pronunciation was matched and the other coded as an insertion. Deletion was indicated by coding silence for the letter. In the case of clear order reversals (e.g., /klaɪm/ for cylm), phonemes were matched with the appropriate letter (e.g., /aɪ/ with y) and a reversal code attached. A special code was used in the case of no response, or an aberrant response (e.g., "peanut butter"), to an item.

Coding was checked in two ways. For every 25 card images coded, two successive lines were chosen at random and independently coded by a second coder; the lines were then checked for disagreement. (Disagreements were noted about once for every 25 lines checked.) Once the data was punched, a clean-up program checked for inappropriate format; too few, too many or repeated stimulus words

incorrect number of letter matches for an item; and consonant-vowel mismatches with letters. All errors were corrected.

Categorization of Pronunciations.-- Six major and 3 minor categories were defined for purpose of data analysis. Each letter in each test word was assigned to one of the patterns and a correct and plausible pronunciation of the letter defined.

Major categories were the c (25 instances), g (23 instances), and vowel in final -e pattern (short or long; 47 instances); final -e itself (26 instances); invariant consonants (107 instances); and other vowels (29 instances). The last category did not include 3 instances of vowel letters occurring before r, one of the 3 minor patterns; post-vocalic r (3 instances) and a single occurrence of -se constituted the other minor patterns.

Correct responses for the letters c and g were defined as the pronunciations appropriate to the vowel letter context; the alternate common pronunciation of the letter was defined as plausible (see Table 4).

For single vowel letters in the final -e pattern, the correct and plausible responses selected appear in Table 5. In the -Ce context, the long pronunciation of the vowel was judged correct, and the short pronunciation plausible; in -C contexts, the short pronunciation became correct and the long pronunciation plausible. Either /u/ (as in tune) or palatalized /ju/ (as in cube) was treated as a long pronunciation of u.

The "other vowel" category (see Table 6) was not a true LSC pattern; rather, it was used to record the most frequent pronuncia-

tions expected for vowel letters appearing in bisyllabic items or in monosyllabic words before consonant clusters. The correct and plausible pronunciations defined for these vowel letters were largely arbitrary, although the short vowel was usually defined as the correct pronunciation before a consonant cluster.

No plausible responses were defined for the invariant category; correct responses are indicated in Table 7. This category, too, constituted a convenient fiction in part; 3 instances (ng, nk, ng) are actually context-specific and other letters are invariant only in certain positions or in the absence of particular graphemic context which creates a minor conditional pattern (e.g., contrast b initially with -mb finally; t with th). In the test words constructed, context creating a minor pattern was avoided.

For occurrences of final -e, the correct response was silence (no pronunciation of the letter); the plausible alternative defined was /i/. In the 3 words corb, gurk and carg, the correct and plausible pronunciations arbitrarily defined for the vowel were, respectively, /o/, /ɔ/ for o; /ɝ/, /o/ for u; and /a/, /ɛ/ for carg. The expected pronunciation of r in corb and carg was /r/, /ɔ/ constituting the plausible alternative; /ɝ/ was defined as correct for r in gurk, /r/ as plausible.

The s before e is unpredictably pronounced as /s/ or /z/ in English (dose, rose); /s/ was arbitrarily selected as correct and /z/ as plausible.

RESULTS

Per cent correct and per cent plausible responses were computed for each S for each of the six major pattern categories, hereafter abbreviated as c, g; L for vowel in final -e pattern; e for final -e; I for invariant; and V for other vowels.

Analysis of Correct Scores.--For per cent correct scores, an 11 x 2 x 4 x 6 unequal-n univariate Anova with repeated measures on the last factor was conducted: school-grade groups x sex x achievement quartile x pattern category. The following significant between-group effects were found, setting $\alpha = .01$: school-grade ($F(10,473) = 42.57$, $p < .01$); sex ($F(1,473) = 10.33$, $p < .01$); achievement quartile ($F(3,473) = 98.25$, $p < .01$); and school-grade x quartile ($F(30,473) = 3.15$, $p < .01$). Means for school-grade groups and the school-grade x quartile interaction are presented in Tables 8 and 9. Since per cent correct was summed across categories for this portion of the analysis, the reported means can vary between 0 and 600.

Tukey's HSD test with a harmonic mean estimation of n and $\alpha = .05$ was used to examine differences in school-grade means. Within a school, all adjacent grade comparisons were significant ($p < .05$) except S4-S6 and M6-M8; in these two cases the trend was in the expected direction. Comparing schools within each grade, Nakoma performance was significantly better ($p < .05$) than Sherman or Marshall in 4th and 6th grades.

The same post-hoc HSD test applied to the school-grade by quartile interaction showed the lowest and highest quartiles to differ significantly ($p < .05$) in 2nd and 4th grades for all schools and 8th grade in Marshall. Grade differences within school and quartile were non-significant by this test. It should be noted, however, that no reversal of trend occurs for grades within schools or quartiles within school-grade (UW is an exception): the summed per cent correct scores increases (or remains the same) from lower to higher quartiles and from lower to higher grades. A re-analysis of the data permitting a more powerful test of grade and quartile effects is planned.

The summed per cent correct scores for males was 420; for females, 440. By achievement quartile from lowest to highest, mean summed scores were 390, 410, 440 and 470; each adjacent pair is significantly different ($p < .01$) by Tukey's HSD test, using the harmonic mean for n.

The Geisser-Greenhouse correction to degrees of freedom was applied in testing the pattern category effect and its interactions. The main effect of pattern category was significant ($F(1,473) = 1846.15$, $p < .01$) as well as its interactions with school-grade ($F(10,473 = 9.88$, $p < .01$) and quartile ($F(3,473) = 16.45$, $p < .01$).

The mean per cent correct (maximum 100%) for each of the 6 categories is displayed in Figure 1. The per cent correct by quartile is displayed for c, g in Figure 2; for L, V in Figure 3; and for E, I in Figure 4. Figures 5-10 represent the per cent of

correct responses by school-grade groups for the patterns c, g, L, V, e and I respectively.

Scheffe hypotheses test procedures were used to test the pattern category effect; all pair-wise comparisons except c-g were significant at $p < .001$. The F values, for 1 and 473 dfs, were as follows: c - L, 68.53; c - V, 2169.93; c - e, 2266.07; g - L, 78.77; g - V, 2763.96; g - e, 2240.55; L - V, 1528.43; L - e, 2371.03; V - e, 8293.13; c - I, 61.57; g - I, 100.70; L - I, 278.87; V - I, 7793.64; e - I, 2396.68.

Plausible responses. Per cent plausible responses are also represented in Figures 1-10 for pattern category, pattern category by quartile, and pattern category by school grade. A second analysis of variance was applied to ss summed scores of per cent correct and per cent plausible for each category, in order to determine whether differences between conditional and invariant categories disappeared when both pronunciations in the conditional pattern were accepted as correct. The design was 11 x 2 x 4 x 6, as before; pattern category was again a significant source of variance ($F(1,473) = 1469.15$, $p < .01$, Geisser-Greenhouse correction applied). The mean per cent correct plus plausible scores were 91 for c, 92 for g, 81 for L, 67 for V, 98 for e, and 93 for I, compared with mean per cent correct scores of 68, 68, 65, 43, 93 and 92 respectively. All pair-wise comparisons of the correct plus plausible scores by Scheffe hypothesis test procedures were significant at $p < .001$. For practical purposes, of course, the c, g and I categories appear equivalent when plausible responses to the first two are counted as correct.

Conditional c and g patterns.--The relative lack of difference between c and g patterns may arise from the fact that proportionally

fewer instances were used in testing g before e, i than c before e, i. In Table 10, per cent correct responses to the c pattern are separated by expected correct pronunciation (/k/ or /s/) and tabulated for the bottom and top quartile of each shool-grade group. Table 11 presents the same information for the g pattern for expected /g/ and /j/ pronunciations.

Correlations of Achievement, IQ, and Pronunciation Scores.--For each school-grade group except UW, correlations between achievement and IQ measures were computed for Ss having both scores (see Table 2 for information on measures, n's, means and standard deviations). These correlations are reported in Table 12. In Tables 13-18, the correlation between achievement measures and correct responses for each school-grade group except UW are reported for c, g, L, V, e and I patterns respectively; Tables 19-24 present the correlations between IQ measures and correct responses. Tables 25-29 present correlations of achievement measures and per cent plausible responses, for the c, g, L, V, and e patterns respectively.

Achievement and IQ measures were highly correlated (approximately .80-.90) for all grades except the second, in which correlations were lower (.20-.60). Although the correlation between general achievement and IQ may be lower in younger grades, the present data also stem from the fact that the Sherman test selected in second grade was a reading test, rather than a more general achievement indicator. The correlations between test measures and per cent correct scores follow the same patterns for IQ and achievement in higher grades. In second grade, where the two test measures share less variance, it is interesting to note that correlation of correct pronunciation with achievement is always greater than the correlation with IQ (indeed, the latter correlations are often insignificant in second grade).

While the correlations of correct response with achievement reveal a substantial positive relation for all patterns except e (most Ss were performing near ceiling on this pattern), per cent of plausible responses given is unrelated or negatively related to achievement. The V pattern is the only one showing significant positive correlations between plausible responses and achievement; this would be expected, since the definition of correct response was in large part arbitrary.

DISCUSSION

Conditional Patterns.--In a previous study of children's pronunciations of synthetic words (Calfee, Venezky, & Chapman, 1969), we found that mastery of conditional LSC patterns (long vowels in -Ce context; c before e, i) could be incomplete even at college level; 75% was the highest correct response rate for any grade group. Our present data parallel the 1969 findings, although correct response rates in older grades are higher; this appears attributable to the inclusion of c before a, o, u in the c pattern and short vowels in the final -e pattern.

In the 1969 study, use of the pronunciation defined as correct was always greater for better third and sixth grade readers than poorer readers in the same grade; mastery also increased with grade. Better readers in third grade gave half as many "wild" responses (neither correct nor plausible) as poorer readers. In the data presented here, achievement test scores rather than reading scores were used to differentiate Ss (Sherman second grade is an exception), but this index too is significantly related to conditional LSC mastery.

The better students in a school and grade show greater mastery of all three conditional patterns tested (c, g, L) and give a quarter to a third fewer wild responses. Mastery of the conditional patterns increases through eighth grade, long after the end of formal reading and phonics instruction.

The c and g patterns show no overall significant difference in per cent of correct responses, although more high frequency exceptions exist for the g pattern. From the breakdown of correct responses by expected pronunciation, it is clear that g before e, i is less often pronounced correctly than c in the same environment; there were fewer instances of this context for g than c, however. The g pattern gives evidence of a bias to pronounce g as /g/; a response bias is less evident in the c data, where pronunciation of c before a, o, u is better but not completely mastered and use of the /s/ pronunciation occurs correctly with some frequency. If children begin to learn conditional LSCs on their own by using an invariant pronunciation for the letter, rather than recognizing that both pronunciations are possible and giving both (though sometimes incorrectly), then the first strategy appears modified toward the latter by second grade, particularly for better students.

Other patterns.--In contrast to the acquisition pattern for conditional LSCs, even the poorest second grade achievers show substantial mastery of the simple LSC generalizations defined in this study (I category); correct response rates range from 66 to 83% for the lowest quartiles in second grade. Correct responses to final

-e are similarly high. Quartile differences, and to some extent grade differences, exist for these patterns, although somewhat attentuated by the ceiling effect; the striking fact, though, is the high level of mastery. It would appear that very young readers can learn LSCs invariant for a particular word position quite readily (witness the high correct response rate for final -e, which is pronounced in other positions).

LSC generalizations should prove most useful to the reader in the beginning years of reading instruction; for the young child with limited reading vocabulary, knowledge of LSC generalizations permits far more extensive and independent reading. The child is learning to translate the written material into that form of language from which he already derives meaning; ability to derive the approximate pronunciation of the spelled word is clearly facilitory of, if not necessary for, early reading. LSC knowledge can release first to third grade youngsters from the lockstep imposed, ironically enough, by the scientific selection of a limited textbook vocabulary. That limited vocabulary, however, may not be selected to exemplify the regularities of English orthography; indeed, insofar as high frequency of usage is a criterion of selection, the induction of LSC generalizations will be harder, since most exceptions are high frequency.

The relation found between mastery of LSCs and school achievement in younger readers is not surprising, if such knowledge is the hallmark of the better reader. The observed correlation may arise because the induction of LSC generalizations is a cognitive or

intellectual operation; or because (better) reading skill facilitates general learning and test-taking. It is the latter relation that would seem to account for our data, since correlation of LSC mastery with IQ was low in second graders at the same time that correlation with achievement was high.

The conditional LSCs admittedly present a more complex learning problem to the child than simple one-letter-one-sound correspondences, but it is surprising to find that significant grade differences exist as late as sixth and eighth grades for the conditional correspondences. The skilled reader at these grade levels must ordinarily be able to process written information far more quickly than letter-sound translation would permit. Why should conditional LSC mastery continue to be related to school achievement and grade beyond the early years of reading instruction? One explanation, of course, is that intelligence is the basic underlying variable; those children less endowed learn the correspondences later. This was not the explanation which best fitted data for younger children. Another possibility is that the conditional patterns are less likely to be taught explicitly or used as criteria for vocabulary selection; it may be the case that extensive reading is necessary to the induction of these patterns when they are not formally presented. Should this be true, we would expect findings similar to our data: slow acquisition time, since a much larger reading vocabulary would be required for the formulation of conditional patterns; and positive correlation between LSC mastery and achievement, since the amount of reading

and information taken in should affect both.

What implications do our findings have for reading instruction? The teacher can use a similar LSC test to assess her students' knowledge of patterns and compare them to Madison children, of course; but the data do not speak directly to how LSC generalizations should be taught. The data do indicate that presentation of simple LSC generalizations in first grade is not premature; young readers are achieving substantial mastery of these patterns even with current teaching techniques and texts. We are currently working on the problem of how best to present simple LSCs, beginning with investigations of stimulus differentiation and response availability.

If simple LSCs can be successfully taught in first grade, should conditional LSCs also be presented relatively early? Early presentation would yield the most direct benefit to the child, if our argument is correct that LSC generalizations primarily benefit the young rather than the relatively skilled reader. When both correct and plausible pronunciations are accepted as correct, our data indicate substantial learning in the younger grades; teaching efforts should be directed to the introduction of the less popular pronunciation and discrimination of the appropriate conditioning context.

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Table 1

SYNTHETIC WORD LIST, GROUPED BY MAJOR PATTERNS

Initial c	Initial g
cade	gade
carg	gand
cefe	geme
cemp	geft
cipe	gite
cilf	gink
cobe	gope
corb	golb
cuse	gube
cung	gurk
cyfe	
cylm	

Medial C	Medial G
mecal	hugan
roce	noge
hacen	ponge
recilt	agime
nacom	nigom
licul	legute
necy	

Final C	Final G
dac	dag
mec	feg
jic	lig
woc	pog
nuc	sug
zyc	

Vowel in Final -e Pattern

Long Vowel	Short Vowel
dape	dap
nade	nad
kete	ket
lebe	---
bime	bim
kipe	kip
jode	jod
wome	wom
fube	fub
vune	vun

Misc.

wam
wab
fon
gon

Table 2

Background Achievement and IQ Data, for Ss with Both Scores
(S = Sherman, N = Nakoma, M = Marshall, UW = University of Wisconsin)

School	Grade	Test	Quartile Breaks for Achievement[a] 1st-2nd	2nd-3rd	3rd-4th	n	n[b]	Mean	SD
S	2	Gates-MacGinitie Reading Tests, Primary B, Composite Score (%ile rank); Fall, 2nd Grade	27	50	73	64	61	53.3	28.7
		Lorge-Thorndike Intelligence Tests, Primary Battery (%ile rank); Fall, 2nd Grade					61	59.7	24.1
	4	Iowa Tests of Basic Skills, Composite Score (%ile rank); Fall, 4th Grade	19	57	75	74	74	50.5	28.8
		Lorge-Thorndike Intelligence Tests, Level 3 Verbal Battery (IQ); Fall, 4th Grade					74	103.7	15.2
	6	Iowa Tests of Basic Skills, Composite Score (%ile rank); Fall, 6th Grade	1º	38	53	70	70	40.6	25.4
		Lorge-Thorndike Intelligence Tests, Level 3 Verbal Battery (IQ); Fall, 6th Grade					70	100.2	13.3
N	2	Metropolitan Readiness Test (%ile rank); Spring, K	61	79	89	36	36	75.8	18.2
		Lorge-Thorndike Intelligence Tests, Primary Battery (%ile rank); Fall, 2nd Grade					36	62.0	23.8
	4	Iowa Tests of Basic Skills, Composite Score (%ile rank); Fall, 4th Grade	45	78	91	59	59	68.7	28.9
		Lorge-Thorndike Intelligence Tests, Level 3 Verbal Battery (IQ); Fall, 4th Grade					59	114.3	16.9
	6	Iowa Tests of Basic Skills, Composite Score (%ile rank); Winter, 6th Grade	56	74	94	55	55	71.5	25.1
		Lorge-Thorndike Intelligence Tests, Level 3 Verbal Battery (IQ); Fall, 6th Grade					55	115.5	12.5
M	2	Stanford Primary I, Composite Score (Grade-Level); Spring, 1st Grade	1.7	2.1	2.5	47	43	2.23	.52
		Otis Quick-Scoring Mental Ability Test (IQ); Fall, 1st Grade					43	112.1	12.7

[a] Ss with scores below the break were assigned to the lower quartile; those with scores equal to the break score or better were assigned to the higher quartile.

[b] These n's and means are for Ss having both achievement and IQ data. The original n's for quartile breaks and an analysis of school-grade effects are those reported in the previous column.

Table 2 (continued)

School	Grade	Test	Quartile Breaks for Achievement[a] 1st-2nd	2nd-3rd	3rd-4th	n	n[b]	Mean	SD
M	4	Stanford Primary II, Composite Score (Grade-Level); Spring, 3rd Grade	3.4	4.3	4.9	48	46	4.28	1.01
		Kuhlmann-Anderson Test (IQ); Spring, 3rd Grade					46	112.1	12.6
	6	Stanford Intermediare II, Composite Score (Grade-Level); Spring, 5th Grade	4.4	5.2	6.2	40	39	5.74	1.61
		Kuhlmann-Anderson Test (IQ); Spring, 5th Grade					39	112.0	18.2
	8	Stanford Advanced, Composite Score (Grade-Level); Spring, 7th Grade	6.1	7.2	9.0	47	46	7.72	1.75
		Henmon-Nelson Test of Mental Ability (IQ); Fall, 7th Grade					46	106.6	14.1
UW	-	Grade Point Average (out of a possible 4.0)	2.35	2.55	3.10	21		2.6	

[a]Ss with scores below the break were assigned to the lower quartile; those with scores equal to the break score or better were assigned to the higher quartile

[b]These n's and means are for Ss having both achievement and IQ data. The original n's for quartile breaks and an analysis of school-grade effects are those reported in the previous column.

Table 3

DISTRIBUTION OF Ss BY SCHOOL, GRADE, SEX

AND ACHIEVEMENT QUARTILE

		Sherman		Nakoma		Marshall		UW	
Grade	Quartile	M	F	M	F	M	F	M	F
2	1	8	6	2	6	3	3		
	2	9	5	3	5	10	5		
	3	9	8	2	8	5	7		
	4	9	10	4	6	5	9		
	TOTAL	35	29	11	25	23	24		
4	1	9	5	9	4	6	3		
	2	18	4	9	6	7	6		
	3	10	7	7	5	6	5		
	4	10	11	7	12	4	11		
	TOTAL	47	27	32	27	23	25		
6	1	10	5	5	7	4	3		
	2	10	9	4	8	5	3		
	3	5	10	8	8	5	7		
	4	8	13	4	11	9	4		
	TOTAL	33	37	21	34	23	17		
8	1					5	4		
	2					7	6		
	3					8	4		
	4					7	6		
	TOTAL					27	20		
College	1							2	4
	2							2	4
	3							1	3
	4							1	4
	TOTAL							6	15

Table 4

CORRECT AND PLAUSIBLE RESPONSES DEFINED FOR C AND G PATTERN INSTANCES IN LIST

Pattern	Letter and Context	Correct	Plausible	No. Instances
C pattern				25
Initial	c before a, o, u	/k/	/s/	6
	c before e, i, y	/s/	/k/	6
Medial	c before a, o, u	/k/	/s/	3
	c before e, i, y	/s/	/k/	4
Final	c	/k/	/s/	6
G pattern				23
Initial	g before a, o, u	/g/	/ǰ/	7[a]
	g before e, i	/ǰ/	/g/	4
Medial	g before a, o, u	/g/	/ǰ/	3
	g before e, i	/ǰ/	/g/	3
Final	g	/g/	/ǰ/	6[b]

[a] gon, in addition to Table 1 entries.

[b] carg, in addition to Table 1 entries.

Table 5

CORRECT AND PLAUSIBLE RESPONSES DEFINED FOR

47 SINGLE VOWEL LETTERS IN FINAL -E PATTERN[a]

Context	Letter	Correct	Plausible	No. Instances
Long				25
before Ce	a	/e/	/æ/	4
	e	/i/	/ɛ/	4
	i	/aɪ/	/ɪ/	5
	o	/o/	/a/	6
	u	/u/ or /ju/	/ə/	5
	y	/aɪ/	/ɪ/	1
Short				22
before final C	a	/æ/	/e/	4
	e	/ɛ/	/i/	3
	i	/ɪ/	/aɪ/	4
	o	/a/	/o/	6
	u	/ə/	/u/ or /ju/	4
	y	/ɪ/	/aɪ/	1

[a]Includes all CVC and CVCe words on list. The pattern is more generally expressed by requiring that the second consonant letter be a simple consonant unit (i.e., realized by a single consonant phoneme); this was true of the single consonant letters used in the list.

Table 6

CORRECT AND PLAUSIBLE RESPONSES DEFINED FOR

OTHER SINGLE VOWEL LETTERS IN LIST[a]

Context	Letter	Correct	Plausible	No. Instances
Monosyllabic				10
After w	a	/a/	/æ/	2
Before final consonant cluster	a	/æ/	/e/	1
	e	/ɛ/	/i/	2
	i	/ɪ/	/aɪ/	2
	o	/o/	/a/	1
	u	/ə/	/u/ or /ju/	1
	y	/ɪ/	/aɪ/	1
Bisyllabic				
First vowel				11
	agime	/ə/	/e/	1
	hacen	/e/	/æ/	1
	nacom	/e/	/ə/	1
	legute	/ɛ/	/e/	1
	mecal	/e/	/ɛ/	1
	necy	/i/	/ɛ/	1
	recilt	/i/	/ɛ/	1
	licul	/aɪ/	/ɪ/	1
	nigom	/aɪ/	/ɪ/	1
	ponge	/a/	/o/	1
	hugan	/u/ or /ju/	/ə/	1
Second vowel				8
	hugan	/e/	/æ/	1
	mecal	/ə/	/æ/	1
	hacen	/ɛ/	/i/	1
	recilt	/ɪ/	/aɪ/	1
	nacom	/o/	/a/	1
	nigom	/ə/	/o/	1
	licul	/ə/	/u/ or /ju/	1
	necy	/i/	/aɪ/	1

[a]Vowel letters preceding r and those occurring in -C or -Ce environments are categorized separately.

Table 7

CONSONANT LETTERS CLASSED AS INVARIANT IN LIST, BY POSITION[a]

Initial		Medial		Final	
Letter	No. Instances	Letter	No. Instances	Letter	No. Instances
b	2	b	4	b	4
d	4	d	4	d	3
f	4	f	3	f	1
h	2	l	4	g*	1
j /ǰ/	3	m	5	k	2
k	4	n /ŋ/ (before g, k)	2	l	2
l	4	n	3	m	6
m	2	p	3	n	5
n	7	t	3	p	4
p	2		31	t	3
r	2				31
s	1				
v	2			*(Ø in ng)	
w	5				
z	1				
	45				

[a]No plausible responses were defined for this set. The correct pronunciation defined was that for which the letter stands in IPA (e.g., for b, /b/), unless otherwise noted.

Table 8

MEANS FOR SCHOOL-GRALE GROUPS
(Per Cent Correct Summed Across 6 Pattern Categories)

School Code	Grade 2nd	4th	6th	8th	College
S	370	430	450		
N	390	460	490		
M	370	410	440	450	
UW					480

Table 9

MEANS FOR SCHOOL-GRADE BY QUARTILE INTERACTION
(Per Cent Correct Summed Across 6 Pattern Categories)

School Code	Quartile	Grade 2nd	4th	6th	8th	College
S	1	320	370	440		
	2	340	410	440		
	3	380	450	450		
	4	420	480	480		
N	1	310	380	460		
	2	350	480	480		
	3	410	480	500		
	4	460	480	500		
M	1	300	360	410	410	
	2	320	370	380	450	
	3	470	430	450	450	
	4	440	460	470	490	
UW	1					470
	2					480
	3					470
	4					490

Table 10
Percent Correct Responses to c
before a, o, u and c before e, i, y
For Bottom and Top Quartile
of Each School-Grade Group

		S			N			M		
		2	4	6	2	4	6	2	4	6
Correct: /k/	Q1[a]	62	66	78	53	76	89	49	64	67
	Q4	86	91	92	89	95	99	81	86	93
/s/	Q1	26	25	59	24	33	55	30	27	54
	Q4	31	62	68	49	52	80	39	61	58

[a]Q1 is bottom quartile; Q4, top

Table 11
Percent Correct Responses to g
before a, o, u and g before e, i
For Bottom and Top Quartile
of Each School-Grade Group

		S			N			M		
		2	4	6	2	4	6	2	4	6
Correct: /g/	Q1[a]	71	68	85	62	74	87	70	84	85
	Q4	91	91	94	94	95	96	75	89	93
/ʒ/	Q1	4	31	33	7	20	38	5	14	18
	Q4	22	42	33	39	35	30	49	31	29

[a]Q1 is bottom quartile; Q4, top

Table 12

IQ--Achievement Measure Correlations

SCHOOL	GRADE 2	4	6	8
S	.22	.85**	.78**	
N	.52**	.83**	.81**	
M	.61**	.83**	.90**	.81**

* p < .05, 2-tailed
** p < .01, 2-tailed

Table 13

Correlations of Achievement and Per Cent Correct Responses to c Pattern

SCHOOL	GRADE 2	4	6	8
S	.57**	.66**	.40**	
N	.58**	.57**	.46**	
M	.52**	.52**	.43**	.51**

* p< .05, 2-tailed
** p< .01, 2-tailed

Table 14

Correlations of Achievement and Per Cent Correct Responses to g Pattern

SCHOOL	GRADE 2	4	6	8
S	.62**	.56**	.34**	
N	.59**	.64**	.29**	
M	.40**	.35*	.50**	.36*

* p <.05, 2-tailed
** p <.01, 2-tailed

Table 15

Correlations of Achievement and Per Cent Correct Responses to L Pattern

SCHOOL	GRADE 2	4	6	8
S	.57**	.63**	.41**	
N	.52**	.62**	.62**	
M	.72**	.80**	.70**	.67**

* p< .05, 2-tailed
** p< .01, 2-tailed

Table 16

Correlations of Achievement and Per Cent Correct Responses to V Pattern

SCHOOL	GRADE 2	4	6	8
S	.44**	.53**	.32**	
N	.44**	.47**	.25	
M	.67**	.47**	.35*	.24

* p <.05, 2-tailed
** p <.01, 2-tailed

Table 17

Correlations of Achievement and Per Cent Correct Responses to e Pattern

SCHOOL	GRADE 2	4	6	8
S	.28*	.30*	.18	
N	.40*	.17	.06	
M	.43**	.09	.09	.13

* p <.05, 2-tailed
** p <.01, 2-tailed

Table 18

Correlations of Achievement and Per Cent Correct Responses to I Pattern

SCHOOL	GRADE 2	4	6	8
S	.54**	.48**	.46**	
N	.62**	.59**	.32*	
M	.58**	.53**	.57**	.44**

* p< .05, 2-tailed
** p< .01, 2-tailed

Table 19

Correlations of IQ and Per Cent Correct Responses to c Pattern

SCHOOL	GRADE 2	4	6	8
S	.25*	.68**	.40**	
N	.26	.41**	.50**	
M	.31*	.48**	.52**	.58**

* p < .05, 2-tailed
** p < .01, 2-tailed

Table 20

Correlations of IQ and Per Cent Correct Responses to g Pattern

SCHOOL	GRADE 2	4	6	8
S	.24	.51**	.30*	
N	.46**	.46**	.18	
M	.19	.28	.46**	.36*

* p < .05, 2-tailed
** p < .01, 2-tailed

Table 21

Correlations of IQ and Per Cent Correct Responses to L Pattern

SCHOOL	GRADE 2	4	6	8
S	.07	.69**	.43**	
N	.37*	.54**	.45**	
M	.54**	.75**	.66**	.69**

* p < .05, 2-tailed
** p < .01, 2-tailed

Table 22

Correlations of IQ and Per Cent Correct Responses to V Pattern

SCHOOL	GRADE 2	4	6	8
S	.15	.59**	.31*	
N	.24	.36**	.24	
M	.51**	.42**	.27	.32*

* p < .05, 2-tailed
** p < .01, 2-tailed

Tabel 23

Correlations of IQ and Per Cent Correct Responses to e Pattern

SCHOOL	GRADE 2	4	6	8
S	.11	.24*	.18	
N	.21	.01	.01	
M	.16	.31*	.06	.08

* p < .05, 2-tailed
** p < .01, 2-tailed

Table 24

Correlations of IQ and Per Cent Correct Responses to I Pattern

SCHOOL	GRADE 2	4	6	8
S	.20	.50**	.44**	
N	.45**	.36**	.30*	
M	.29	.46**	.54**	.59**

* p < .05, 2-tailed
** p < .01, 2-tailed

Table 25

Correlations of Achievement and Per Cent Plausible Responses to c Pattern

SCHOOL	GRADE 2	4	6	8
S	-.01	-.37**	-.29*	
N	.01	-.38**	-.41**	
M	-.04	-.35*	-.11	-.40**

* p < .05, 2-tailed
** p < .01, 2-tailed

Table 26

Correlations of Achievement and Per Cent Plausible Responses to g Pattern

SCHOOL	GRADE 2	4	6	8
S	-.18	-.35**	-.21	
N	-.20	-.30*	-.05	
M	.06	.09	-.06	-.23

* p < .05, 2-tailed
** p < .01, 2-tailed

Table 27

Correlations of Achievement and Per Cent Plausible Responses to L Pattern

SCHOOL	GRADE 2	4	6	8
S	-.22	-.49**	-.30*	
N	.06	-.42**	-.50**	
M	-.31*	-.58**	-.50**	-.60**

* p < .05, 2-tailed
** p < .01, 2-tailed

Table 28

Correlations of Achievement and Per Cent Plausible Responses to L Pattern

SCHOOL	GRADE 2	4	6	8
S	.30*	.06	-.06	
N	.47	.13	-.14	
M	.39*	.21	.02	.12

* p < .05, 2-tailed
** p < .01, 2-tailed

Table 29

Correlations of Achievement and Per Cent Plausible Responses to e Pattern

SCHOOL	GRADE 2	4	6	8
S	-.19	-.26*	-.11	
N	-.26	-.03	-.04	
M	-.34*	.03	-.03	-.10

* p < .05, 2-tailed
** p < .01, 2-tailed

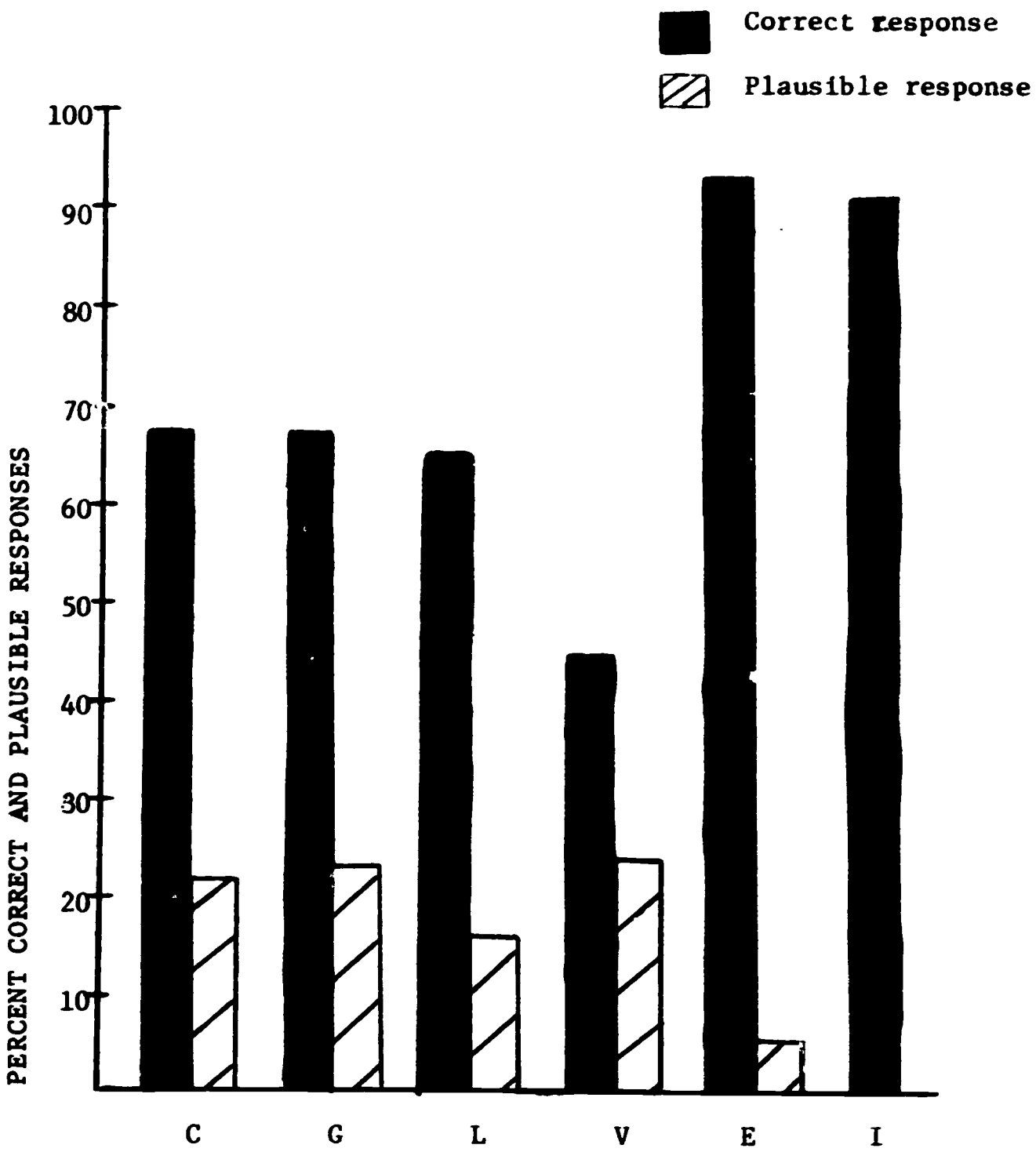

Figure 1. Correct and Plausible Responses to Six Pattern Categories

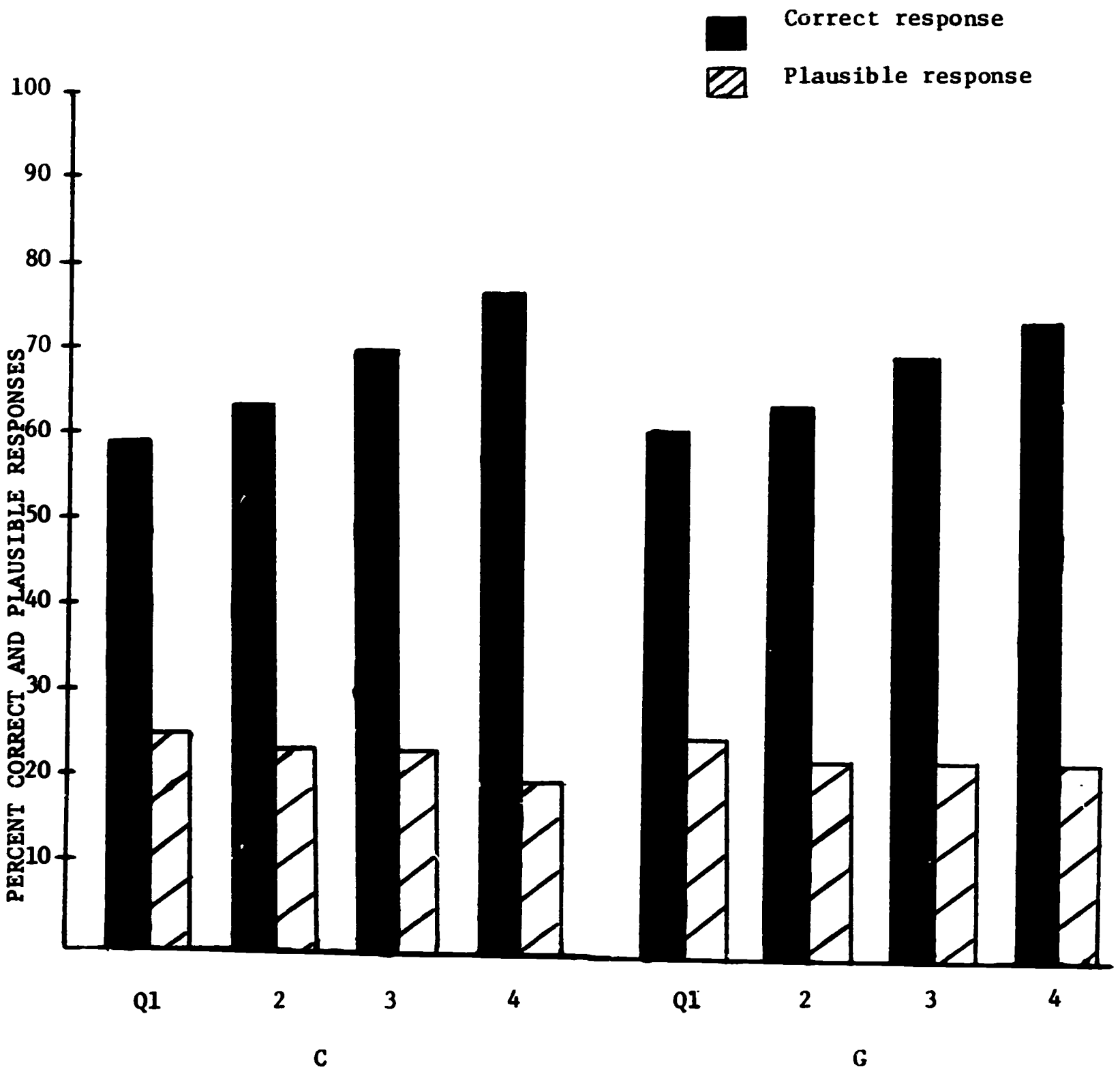

Figure 2. Correct and Plausible Responses to c and g Categories by Achievement Quartile

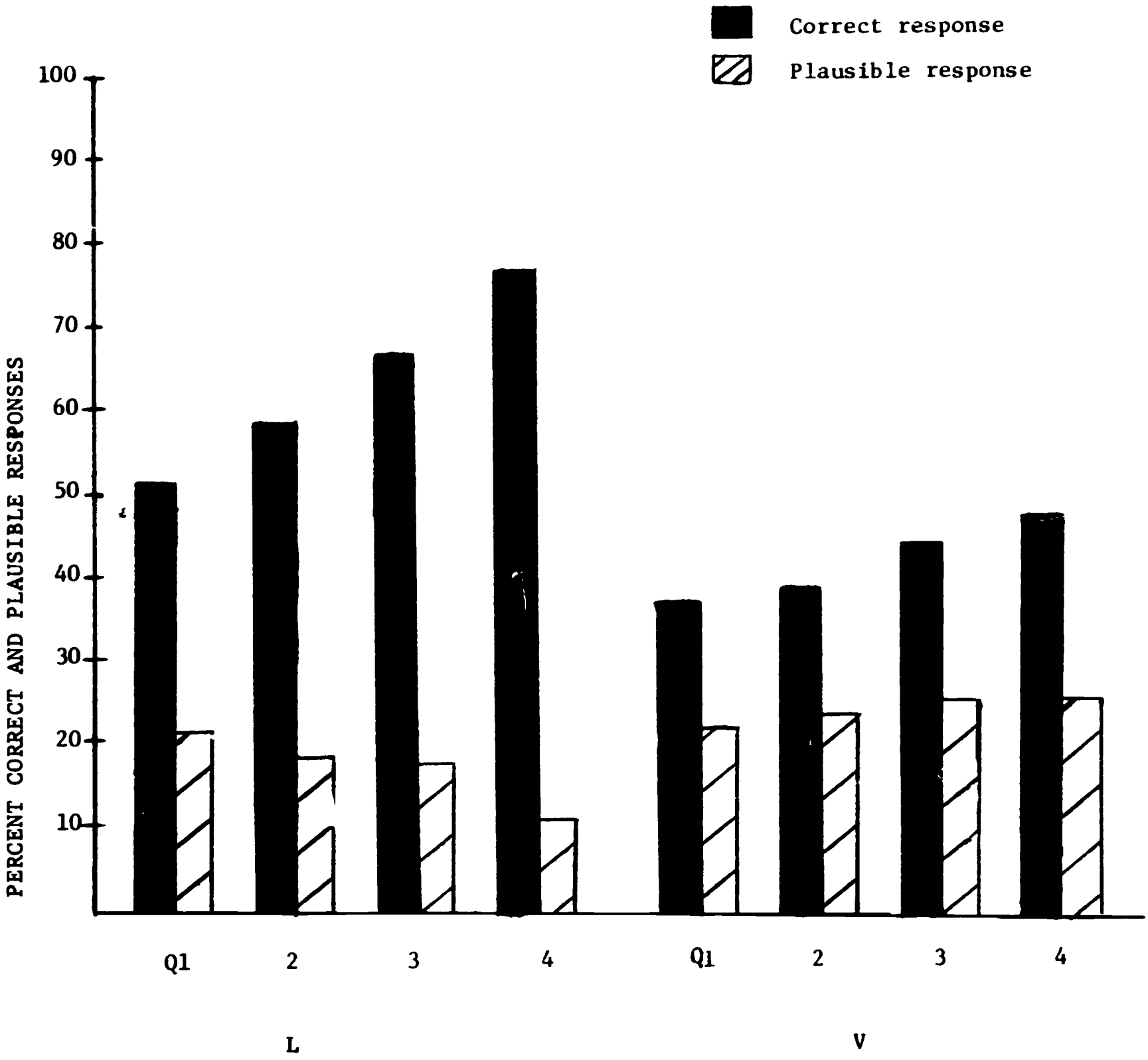

Figure 3. Correct and Plausible Responses to L and V Categories by Achievement Quartile

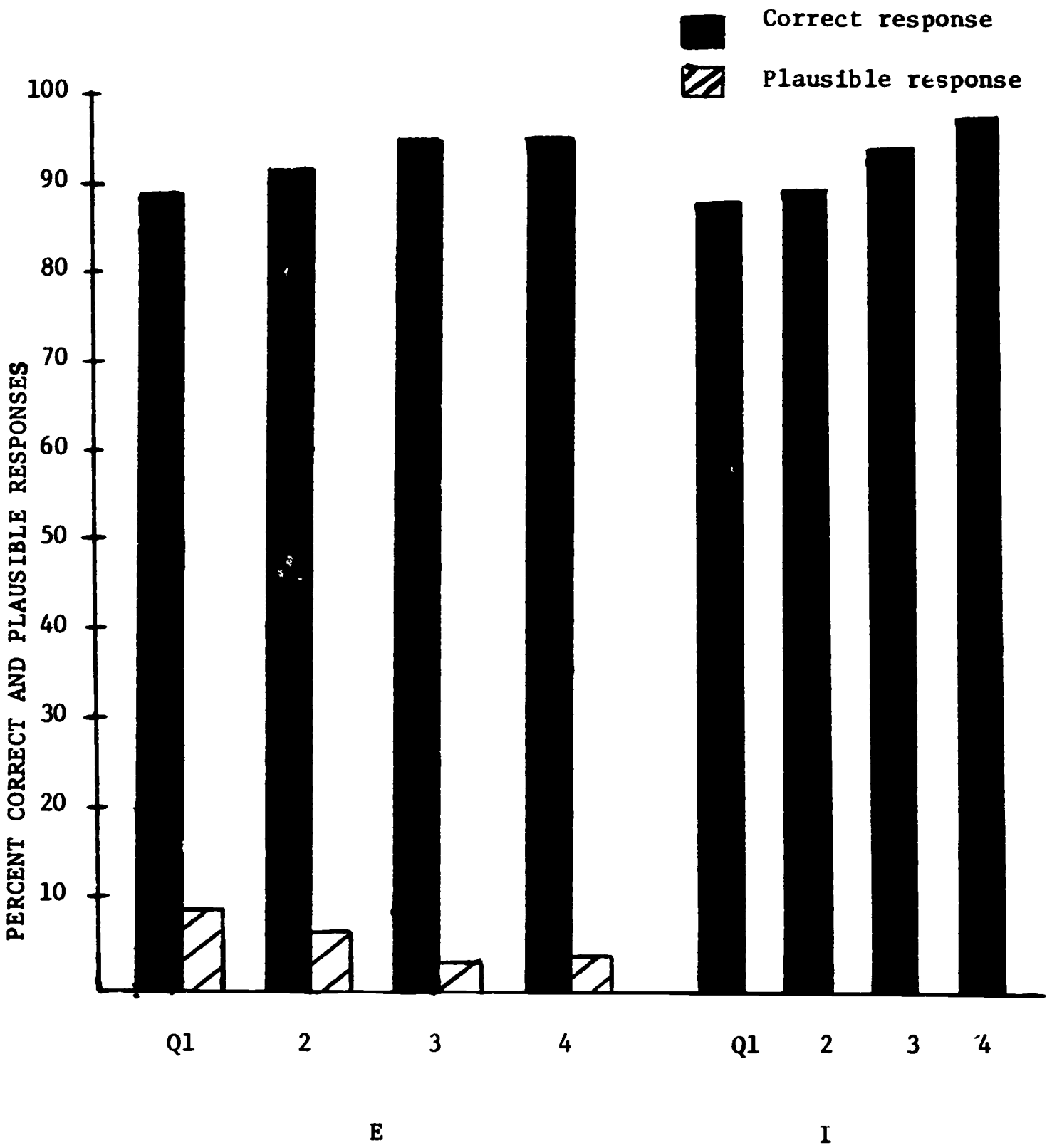

Figure 4. Correct Responses to e and I Categories and Plausible Responses to e, by Achievement Quartile

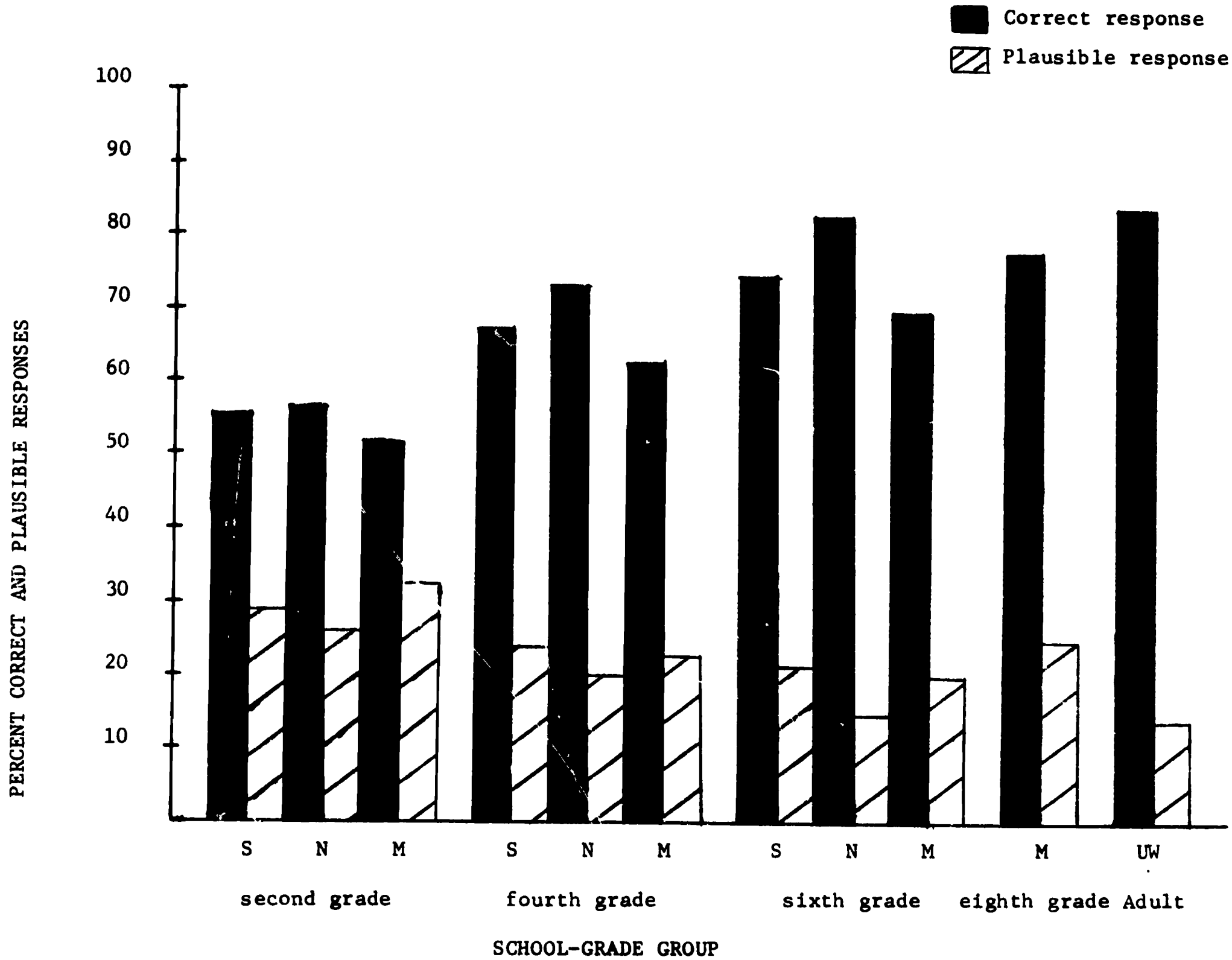

Figure 5. Correct and Plausible Responses for c Category by School-Grade Group

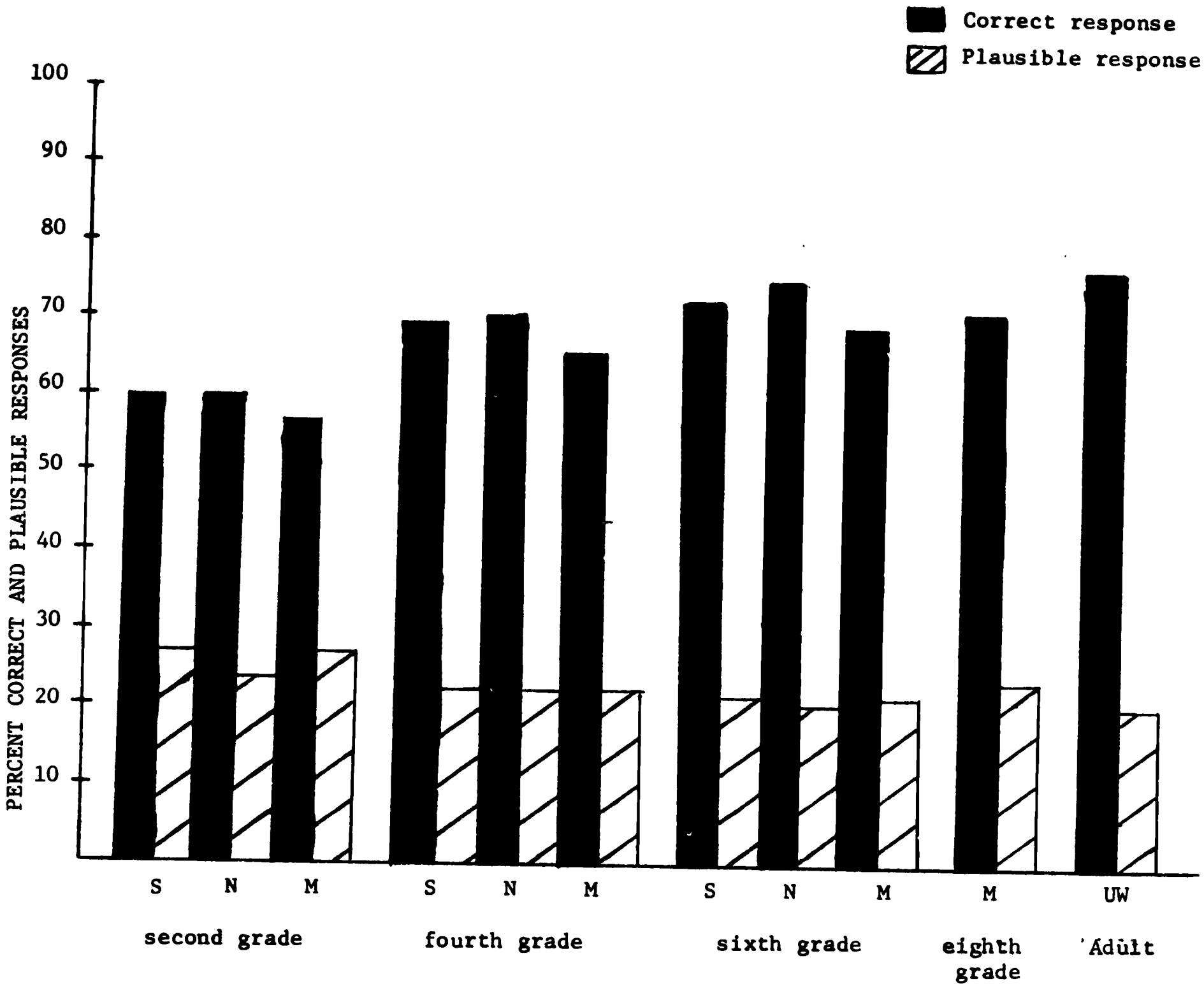

Figure 6. Correct and Plausible Responses for g Category by School-Grade Group

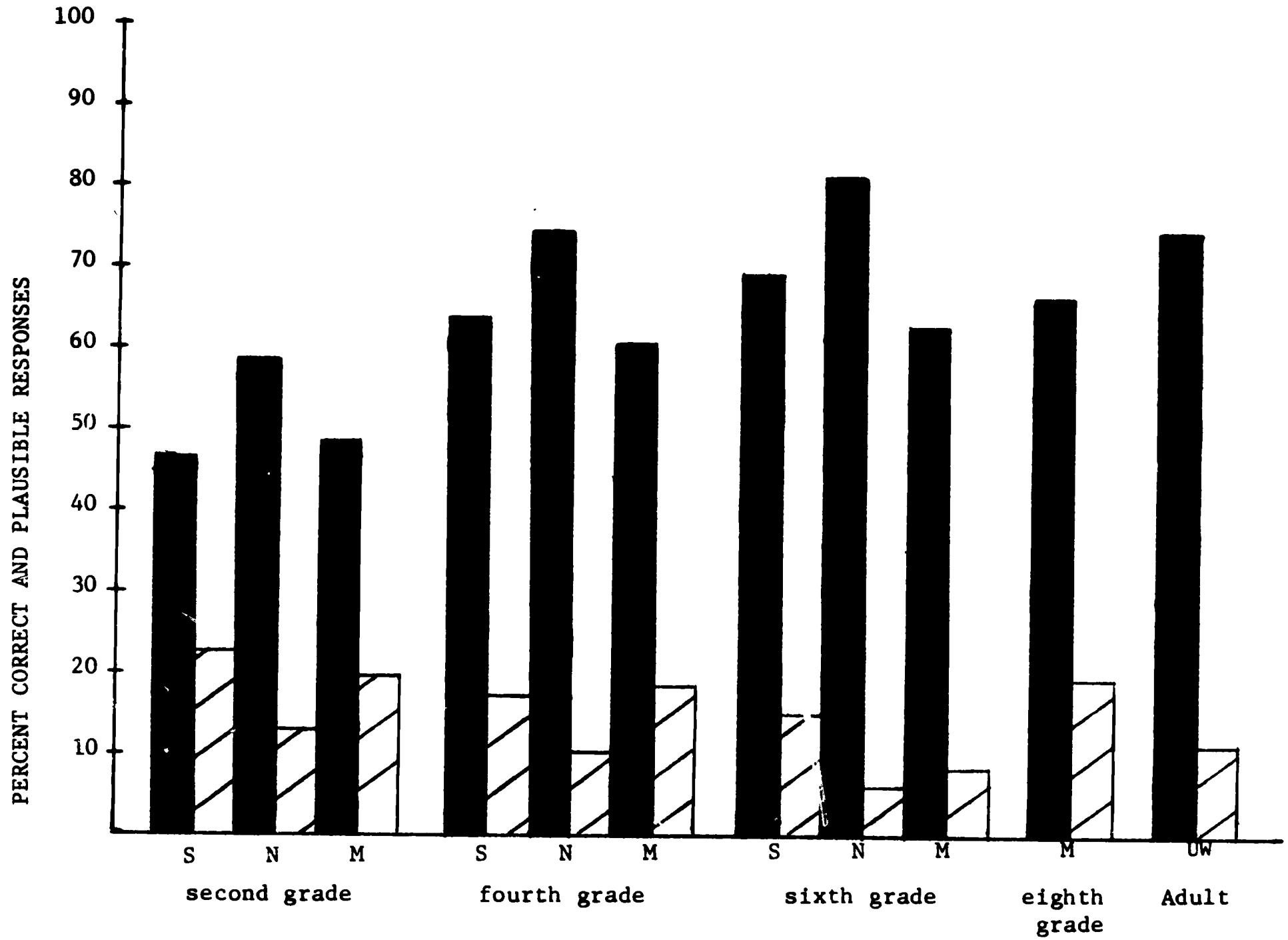

Figure 7. Correct and Plausible Responses for L Category by School-Grade Group

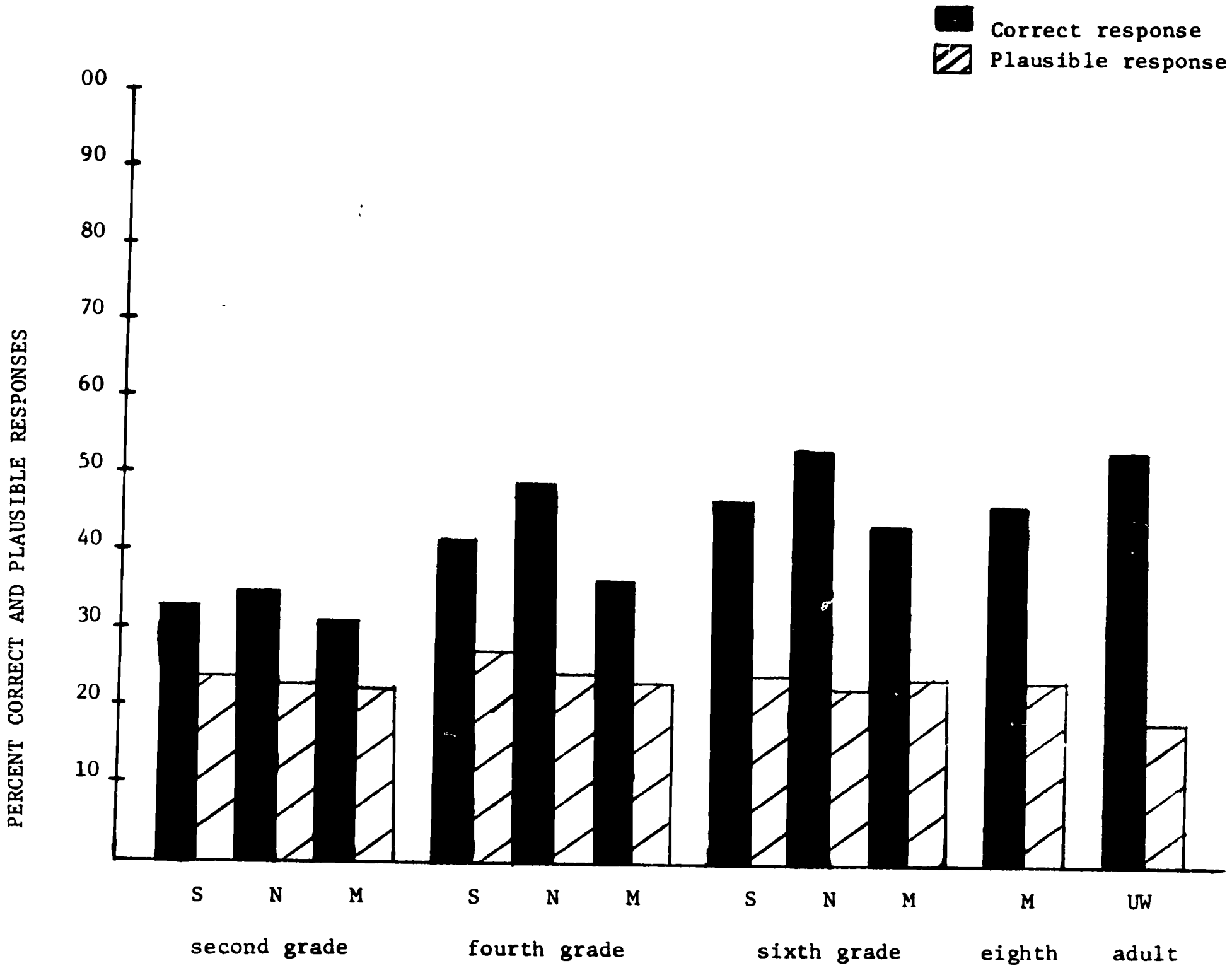

Figure 8. Correct and Plausible Responses for V Category by School-Grade Group

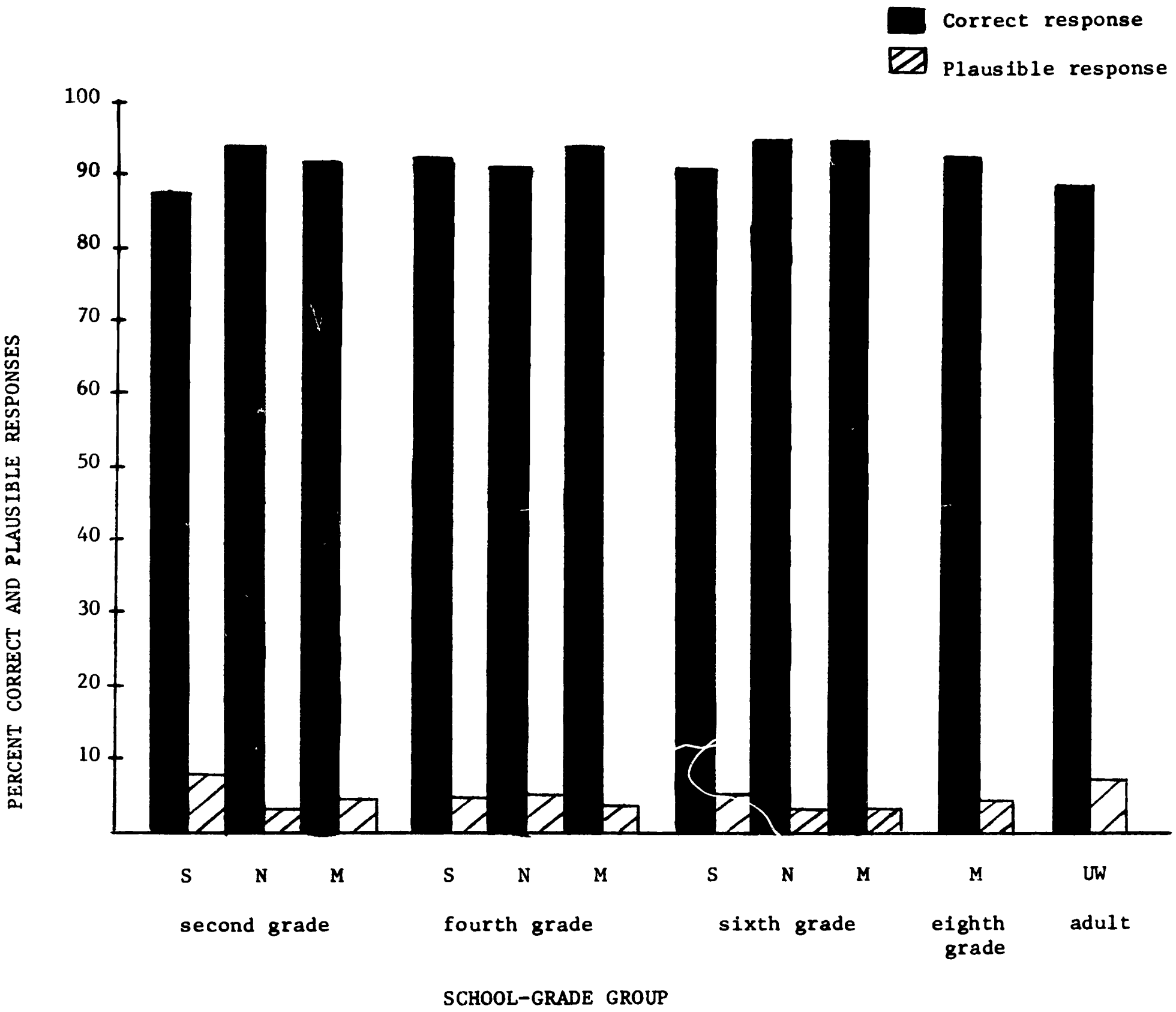

Figure 9. Correct and Plausible Responses for e Category by School-Grade Group

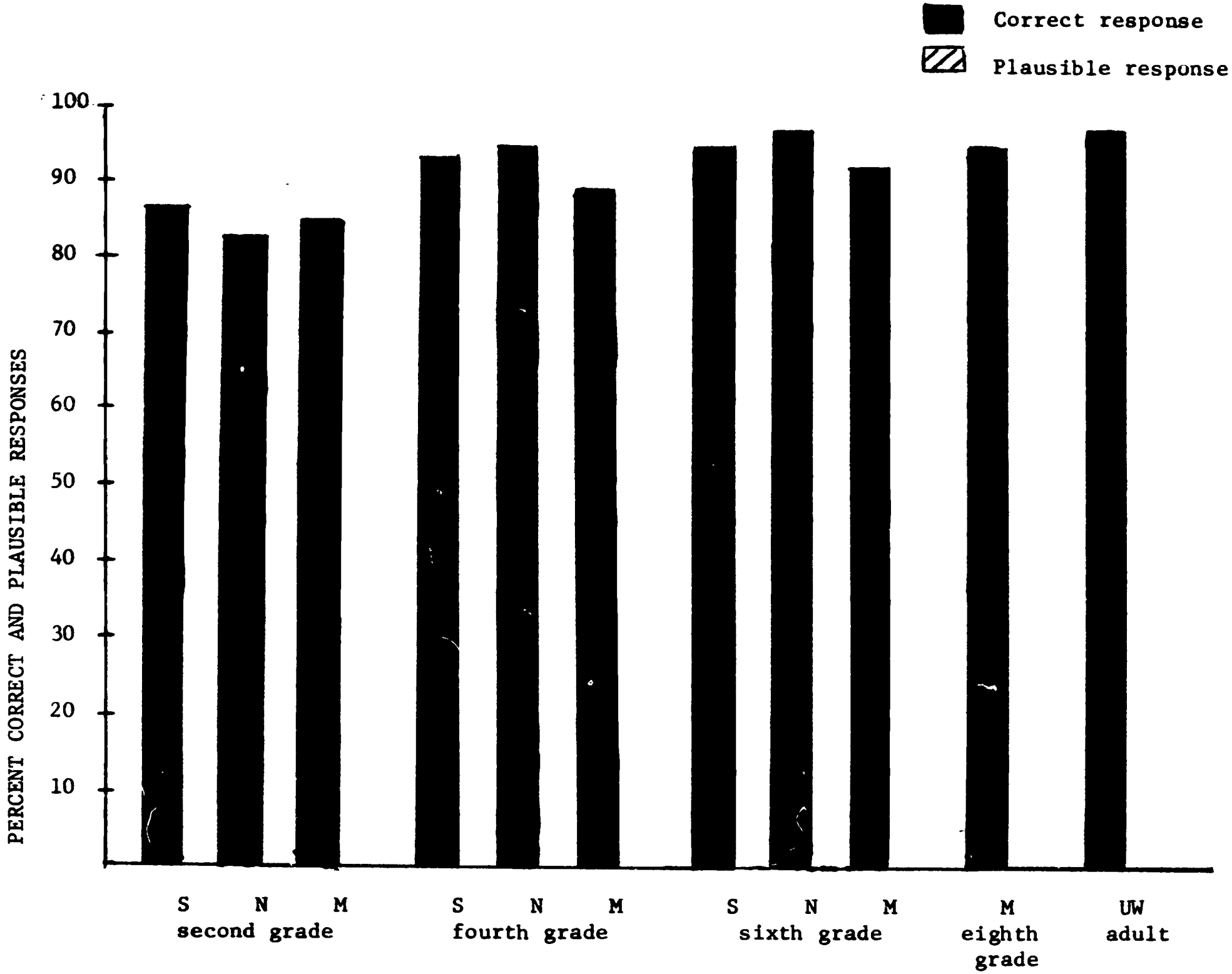

Figure 10. Correct Responses for I Category by School-Grade Group