A NEW TECHNIQUE FOR INVESTIGATING THE FEELING OF KNOWING*

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Previous investigations of the feeling of knowing (FOK) have relied on absolute FOK judgements rather than on relative FOK judgments. This has resulted in a confounding of (1) the subject's metamemorial knowledge of nonrecalled items with (2) the subject's know/don't-know threshold. The new technique replaces the absolute FOK judgments with relative FOK judgments in which the subject generates (via paired comparisons) a FOK rank order of nonrecalled items in terms of the predicted likelihood of recognition. This new technique eliminates the aforementioned confounding, provides a richer data base, and yields separate estimates of FOK validity and FOK reliability.

The feeling of knowing, defined in terms of the subject's predicted recognition for nonrecalled items, is a relatively new topic in the area of memory research. It is part of a broader topic known as metamemory, which refers to the subject's monitoring of his own memory (Flavell and Wellman 1977), and metamemory is part of the still broader topic of metacognition, which refers to the subject's monitoring of his own cognitive processes (Flavell 1976). This interest in the subject's monitoring of his psychological processes is consistent with the shift from radical behaviorism to a more cognitive psychology that has occurred during the last decade or so (Segal and Lachman 1972). Hypothesized internal processes are becoming increasingly important in psychological theorizing, and, therefore, interest can be expected to turn toward various possibilities of monitoring those processes. To the degree that the self-monitoring of cognitive processes is valid, the door re-opens for researchers to employ introspection as a tool for investigating those processes. Moreover, because the amount of time that someone will

continue to search memory for a particular item is determined by his feeling of knowing for that item (Thompson 1977), the feeling of knowing is a necessary component in optimization models of memory retrieval and in general theories of memory searching.

The pioneering studies on the feeling of knowing were conducted by Hart (1965, 1967) and had three overall stages consisting of recall, feeling-of-knowing judgments, and recognition. First, his subjects attempted to recall either general information (Hart 1965) or information learned in the laboratory (Hart 1967). A recall trial consisted of giving the subject a cue (e.g., 'Which planet is the largest in our solar system?' or 'What nonsense syllable was paired with FROG in the list you just finished studying?'), and the subject attempted to recall the target item. Next, for any nonrecalled target, the subject again was given the cue and was asked to make a YES-NO feeling-of-knowing judgment concerning whether or not he believed that he would recognize the target appropriate to that cue. Finally, the subject received an N-alternative forced-choice (N-AFC) recognition test to assess the validity of his feeling-of-knowing judgments. The major finding was that recognition performance was significantly higher for nonrecalled items with YES feeling-of-knowing judgments than for nonrecalled items with NO feeling-of-knowing judgments. This finding qualitatively established the validity of the feeling of knowing. All of the subsequent research on the feeling of knowing (e.g., Blake 1973; Gruneberg and Monks 1974; Lachman et al. 1977; Thompson 1977; Wellman 1977) has employed the aforementioned technique of obtaining YES-NO feeling-of-knowing judgments, either in terms of two values such as YES and NO or in terms of more values reflecting finer degrees of YES and NO.

To use the subject as, in essence, a measuring device of his own psychological processes, it is desirable to employ sound techniques that have a relatively straightforward interpretation. Whenever a subject is asked to partition his subjective feelings about some YES-NO question (e.g., 'Do you believe that you will recognize the correct response to this item?'), the subject must tacitly make two decisions: (1) a decision of how likely a given outcome is and (2) a decision concerning the criterion (threshold) of likelihood, above which the subject will respond YES and below which the subject will respond NO. Naturally these two decisions can play off against each other, e.g., a moderately high degree of subjective likelihood coupled with a very high criterion could yield a NO response whereas a low degree of subjective likelihood coupled with

a very low criterion could yield a YES response. If the investigator's interest is in assessing the subject's subjective likelihood of recognition, he must somehow eliminate the confounding effects of the subject's placement of the YES-NO criterion. One *a posteriori* way to accomplish this might be to utilize some form of the theory of signal detection. However, difficulties can easily arise concerning critical assumptions about the nature of underlying distributions (see Swets 1973), and this may be why no previous investigator has advocated adapting the theory of signal detection to feeling-of-knowing judgments (nor are we advocating such an attempt). Instead, we propose a new technique that circumvents *a priori* the problem of where the subject might place his YES-NO criterion for feeling-of-knowing judgments. This technique begins by requesting paired-comparison feeling-of-knowing judgments in place of YES-NO feeling-of-knowing judgments. For instance, instead of requesting separate YES-NO feeling-of-knowing judgments on two items, i and j, we would ask the subject to judge whether his feeling of knowing is (1) greater for i than j or (2) greater for j than i. Thus, regardless of whether his *absolute* feeling of knowing exceeds a YES-NO criterion, he is forced to make a judgment in terms of his *relative* feeling of knowing for the two items. This bypasses the problem of the YES-NO feeling-of-knowing criterion (in a way analogous to the bypassing of the YES-NO recognition-memory criterion when YES-NO recognition tests are replaced by N-AFC recognition tests, as advocated by Shepard 1967). After such paired comparisons are made across all of the items of interest, a feeling-of-knowing rank order (which sometimes may contain ties) can be derived wherein the highest item is that item which was most often chosen over all other items and the lowest item is that item which was least often chosen over all other items. The validity of this feeling-of-knowing rank order can be assessed by comparing it with subsequent recognition performance (*e.g.*, the higher an item is in the feeling-of-knowing rank order, the higher its likelihood of being correct in the subsequent N-AFC recognition test ought to be).

In addition to assessing the *validity* of the feeling of knowing, the proposed technique also provides ways of assessing various kinds of *reliability* of the feeling of knowing (the latter are not examined in the feeling-of-knowing methodology used by Hart and previous researchers). For instance, after the paired-comparison judgments have occurred across all of the items, a subset of these paired comparisons may recur so as to allow for an assessment of the re-test reliability of the judgments

(*i.e.*, given that the feeling of knowing is initially judged to be greater for item *i* than item *j*, then the subject should again choose item *i* over item *j* on the re-test comparison if that feeling-of-knowing judgment is reliable). As Blake (1973) and others have pointed out, although Hart demonstrated that his subjects' feeling-of-knowing judgments were significant in predicting subsequent recognition (*i.e.*, significantly greater than chance), the magnitude of the effect was disappointingly small. For instance, the probability of correct recognition for items with a YES feeling-of-knowing judgment was 0.56 whereas that for items with a NO feeling-of-knowing judgment was 0.42, yielding a small but statistically significant difference. One possible reason for the smallness of this effect is that the validity of the feeling of knowing is low. Another possibility, however, is that the reliability is low. Without separate assessments of validity and reliability, the source of the smallness of the effect cannot be determined.

Now we shall illustrate the proposed technique, using typical laboratory materials and actual data obtained from an undergraduate subject. The application of this technique is straightforward to other kinds of items that also might interest the reader (*e.g.*, general-information questions).

Illustration of the Paired-Comparison Feeling-of-Knowing Technique

Method

An undergraduate *S* studied a list of 18 number-word pairs (*e.g.*, 27-FROG, 63-APPLE) at a 5-sec presentation rate. Next, a self-paced recall test occurred in which the *S*'s task was to recall the target word paired with each number cue (*e.g.*, 27?); the *S* was forced to guess whenever unsure so as to avoid the withholding of recallable responses (see Hart 1966). Then, feeling-of-knowing judgments occurred for nonrecalled items. However, rather than making a YES-NO judgment about each number cue (as in the Hart technique), the *S* made a paired-comparison judgment in which the number cues from two nonrecalled items were presented; the *S* had to choose whichever item he believed he would be more likely to recognize the response from subsequently. For instance, suppose that recall had been incorrect on both '27?' and '63'?. Then the *S* would be shown '27 * 63' and he would either choose 27 or choose 63 (depending upon whether he believed he would be more likely to recognize 27-FROG or 63-APPLE). These paired comparisons were made for all possible pairwise combinations of the number cues from nonrecalled items, *i.e.*, for *t* nonrecalled items there were $t(t-1) \div 2$ paired comparisons. The left-right order of the two number cues within each paired comparison was random. After

the paired comparisons were completed, a 3-AFC recognition test occurred for all nonrecalled items. The two distractors for a given item were randomly selected target words from two other nonrecalled items (*e.g.*, 27: APPLE, FROG, LAKE). This produced a recognition test of intermediate difficulty, thereby avoiding the possibility of ceiling effects that have been bothersome in previous feeling-of-knowing studies (Hart 1967: 689); furthermore, the focus was on cue-target *associations*, which corresponded to the information under investigation in the recall test. Following the recognition test, the *S* was dismissed.

The preceding paragraph describes the basic procedure. Additional variants are possible, and three of these were utilized. First, after all of the feeling-of-knowing paired comparisons had been completed, 10 of these paired comparisons were randomly selected (with the restriction that none of these came from the last third of the paired comparisons, thereby minimizing recency effects); these 10 paired comparisons recurred to provide an index of 're-test reliability' in terms of the percentage of decisions that remained the same from the first to second paired comparison on a given pair of items. Second, two 'bottom anchors' were added to the set of items undergoing feeling-of-knowing paired comparisons. That is, two number cues that had never been presented to the *S* during study or during recall were intermingled with the other items in the set undergoing paired comparisons — these bottom anchors were expected to be chosen by the *S* seldom if at all during the feeling-of-knowing judgments. Third, two number cues from items that were studied and were recalled correctly during the recall test were intermingled with the other paired-comparison items — these served as 'top anchors' and were expected to be chosen nearly always during the feeling-of-knowing judgments.

Results

Fig.1 shows the results from one subject. The left side of the figure shows the raw data. Eighteen of the number-word pairs were studied (no items were studied for the cue numbers 44 and 70). Recall errors occurred to the cue numbers 26, 27, 40, 55, 56, 96, and 97, so these seven items became the focus of the feeling-of-knowing judgments and subsequent recognition test. Also included in the feeling-of-knowing judgments were the cue numbers 44 and 70 (nonstudied bottom anchors) and the cue numbers 28 and 35 (correctly recalled top anchors). All 55 possible paired comparisons occurred for these eleven items (seven nonrecalled items, plus two bottom anchors, plus two top anchors). The *S*'s feeling-of-knowing choices during the paired comparisons are indicated by '>' or '<' with 'greater than' being equivalent to 'chosen over'. Also notice the 10 extra paired comparisons used to determine the re-test reliability. The total number of times that a given item was chosen over all other items in the paired comparisons (not counting the re-test reliability phase) is tallied and entered into the 'FOK choices' column; *e.g.*, item 26 was chosen 6 times, namely, over items 27, 40, 44, 55, 56, and 70. Finally, the *S*'s recognition performance on the seven nonrecalled items shows 5 correct recognitions and 2 wrong recognitions.

The recoding of these data is shown in the right side of fig.1. First the items are ranked in terms of most to least total feeling-of-knowing choices (*e.g.*, item 35 was chosen most often, namely, 10 times). This produces a *derived feeling-of-knowing*

Raw Data

Item	Recall	FOK Choices	Recognition
17 VALLEY	C	--	--
26 PARTY	W	6	C
27 MUSIC	W	4	C
28 DOLLAR	C	9	--
30 HORSE	C	--	--
32 WINTER	C	--	--
35 PAPER	C	10	--
40 TABLE	W	0	C
44 --	--	1	--
48 COTTON	C	--	--
55 CHURCH	W	3	W
56 FAMILY	W	4	W
70 --	--	3	--
76 ENEMY	C	--	--
77 HOME	C	--	--
80 DOCTOR	C	--	--
81 SCHOOL	C	--	--
95 UNCLE	C	--	--
96 FLOWER	W	8	C
97 MILE	W	7	C

C = correct   W = wrong

FOK Judgments

$26 < 28$	$70 > 44$	
$56 > 44$	$55 < 26$	
$55 > 27^{a,b}$	$97 > 55$	
$28 > 70$	$35 > 97$	
$26 < 35$	$35 > 70$	
$44 < 55$	$35 > 27$	
$26 > 27_b$	$70 < 97$	
$55 < 70$	$70 > 40$	
$28 > 96$	$96 > 26$	
$97 > 27$	$40 < 56$	
$55 > 40$	$26 > 44$	
$44 < 96$	$97 < 96$	
$28 > 27$	$40 < 44$	
$70 < 96$	$55 < 28$	
$97 > 56$	$56 < 35$	
$97 > 40$	$97 < 28$	
$35 > 96$	$35 > 44$	
$56 < 26$	$70 < 56$	
$27 > 44$	$55 < 96$	
$56 < 96_b$	$26 > 70$	
$70 < 27$	$44 < 28$	
$27 > 56^a$	-------	
$56 > 55^a$	Re-test	
$28 > 56$	-------	
$96 > 40$	$97 > 26$	
$27 < 96$	$55 > 40$	
$26 > 40$	$27 > 56$	
$40 < 35$	$26 > 27$	
$28 < 35$	$56 < 96$	
$97 > 26$	$27 > 40$	
$40 < 28$	$55 < 27$	
$97 > 44$	$97 > 56$	
$35 > 55$	$27 < 96$	
$27 > 40$	$56 > 55$	

[a] intransitivity
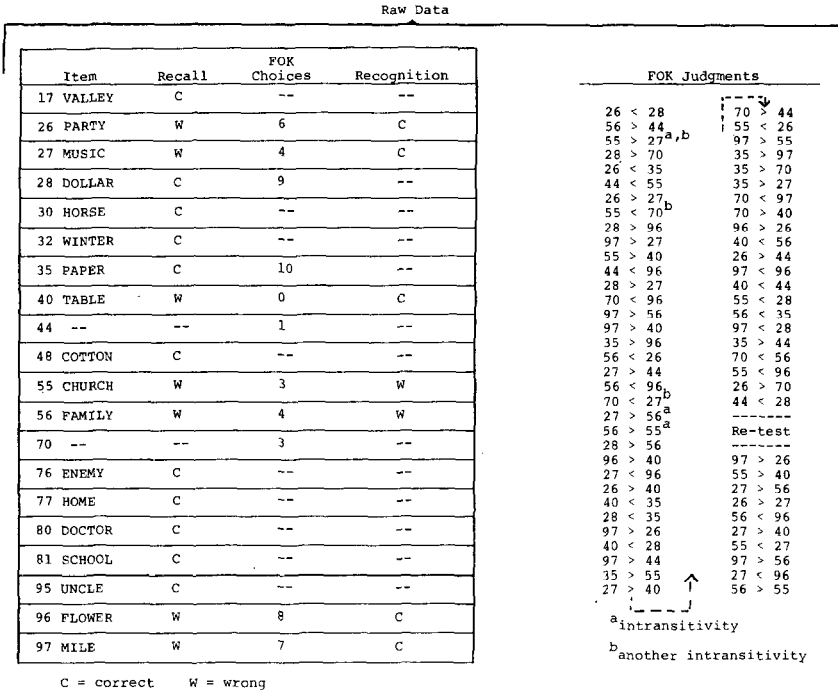
[b] another intransitivity

Fig.1. Actual protocol from one subject in the new feeling-of-knowing task.

rank order, with tied ranks being assigned to items with the same number of choices (*e.g.*, items 55 and 70 were both chosen three times). Notice that the top anchors — items 35 and 28 — were chosen the most often and ended up in the two top positions of the S's derived feeling-of-knowing rank order. The bottom anchors—items 70 and 44—were chosen very seldom and ended up near the bottom of the rank order. The location of these anchors in the rank order reflects the lower limit of the S's feeling of knowing for the set of items being examined. Notice that item 40 was chosen less often than the two bottom anchors (which never even appeared in the study list), implying that the S's feeling of knowing for that item is essentially nil. (Thus, although this paradigm focuses on the relative feeling of knowing, as described above, information about the absolute feeling of knowing occasionally can be inferred.)

Next, we examine the validity of the feeling-of-knowing judgments by seeing where in the rank order correct recognition performance occurred. If the feeling-of-knowing judgments were totally nonvalid, then the distribution of correct recognitions should be randomly distributed throughout the derived feeling-of-knowing rank order; by contrast, to the degree that the validity is high, the correct recognitions should tend to be most frequent in the upper portion of the rank order. The data presented here suggest that the feeling of knowing is somewhat valid for this

Recoded Data

Item	FOK Choices (c_i)	FOK Rank	Recog.
†35	10	11	--
†28	9	10	--
96	8	9	C
97	7	8	C
26	6	7	C
56	4	5.5	W
27	4	5.5	C
55	3	3.5	W
†70	3	3.5	--
†44	1	2	--
40	0	1	C

Re-test Reliability			
Re-tested Items	Ranks of Re-tested	Diff. btw. Ranks	Reliab.
(27, 40)	(5.5, 1)	4.5	R
(56, 96)	(5.5, 9)	3.5	R
(27, 96)	(5.5, 9)	3.5	R
(55, 40)	(3.5, 1)	2.5	R
(97, 56)	(8, 5.5)	2.5	R
(56, 55)	(5.5, 3.5)	2	R
(55, 27)	(3.5, 5.5)	2	U
(26, 27)	(7, 5.5)	1.5	R
(97, 26)	(8, 7)	1	R
(27, 56)	(5.5, 5.5)	0	R

† = top anchor

↓ = bottom anchor

Observed number of intransitivities: 2

Number of maximum possible intransitivities: 55

P(observed intransitivities): .04

P(chance intransitivities): .75

R = reliable

U = unreliable

Number of unreliabilities: 1

Largest difference between ranks of unreliable: 2

Fig. 1 (*continued*)

particular subject (*e.g.*, the Goodman-Kruskal measure of association, described in Hays 1973: 800, yielded $\gamma = +0.40$ between the derived feeling-of-knowing rank order and obtained recognition performance). All three of the uppermost items in the feeling-of-knowing rank order were correctly recognized; the only two recognition errors occurred amongst the lowermost four items (chance probability correct ≈ 0.3 in 3-AFC recognition).

Finally, consider the reliability of the feeling-of-knowing judgments. The first index of reliability comes from the *percentage of judgments that were the same on the re-tests as on the original tests*. If the feeling-of-knowing judgments were made haphazardly by chance, then we would expect approximately 50% of the re-test to yield the same judgments on the re-test as on the original test and the remaining 50% of the re-tests to yield reversed judgments on the re-test relative to the original test. As can be seen the present *S* was very reliable, with 90% of the judgments being the same on the re-test as on the original test. A second reliability measure— this is the only statistic in the present paper that makes an assumption stronger than an ordinal scale—can be obtained by noticing the *largest difference between the ranks in which a reversed re-test judgment occurred*. For only one reversed re-test judgment, this value by chance would be the median difference between the ranks; the chance value increases for more than one reversed re-test judgment. For the present *S*, there was only one reversed re-test judgment, and the corresponding dif-

ference between the ranks of the two items being re-tested is 2 (with the chance value being 2.25). If, for instance, a given difference between the ranks were 0, we would expect a reversed re-test judgment to be about as likely as a same re-test judgment because the S probably would not be able to discriminate between the feeling of knowing for each of the two items. As the difference between the ranks increases, discrimination should become increasingly easier, and the likelihood of a reversed re-test judgment should decrease. Thus, the largest difference between the ranks in which a reversed re-test judgment occurred reflects the degree of 'fineness' in the S's discrimination. As Ss make finer and finer discriminations in their feeling of knowing, there ought to be a corresponding decrease in the largest difference between the ranks for which a reversed re-test judgment occurs. (Note: the possibility of a S's producing a same re-test judgment by remembering his original judgment seems fairly remote, given such a large number of judgments and the fairly long lag between the original test and the re-test of every re-tested pair; if desired, a yoked-control S without any study trial can be given all of the paired-comparison tests to evaluate this possibility.)

The final measure—mathematically independent of all of the previous measures—concerns *the number of intransitivities in the subject's feeling-of-knowing judgments*. That is, when an S chooses item i over item j, and item j over item k, then an intransitivity occurs if he chooses item k over item i.[1] As Krantz *et al.* (1971: 74) have pointed out, an intransitivity is due to either of two factors: (1) an underlying structure that is multidimensional rather than unidimensional, coupled with a change in the basis of the decision in terms of the relative emphasis on the various dimensions, and/or (2) unreliability (*i.e.*, noise, or lack of fineness in discrimination). If the second factor can be eliminated (*e.g.*, by a high degree of reliability in the re-test data), then a substantial occurrence of intransitivities implies that the feeling of knowing is not based on a simple unidimensional scale of judged strength—such an outcome would have serious negative consequences for any theories assuming a unidimensional entity underlying the feeling of knowing. Moreover, one can easily determine the number of intransitivities in a set of paired comparisons by using the following equation (derived by Kendall 1970: 148):

$$\text{number of intransitivities} = \tfrac{1}{12} t(t-1)(2t-1) - 0.5 \sum_i c_i^2 \qquad (1)$$

where t = number of different items in the set of paired comparisons (*e.g.*, 11 in the present protocol) and c_i = number of times that item i was chosen over all other items. Intuitively, the number of intransitivities decreases as the variance of the c_i increases (reaching a Guttman scale in the limit), and the number of intransitivities is maximal when the variance of the c_i is zero (*i.e.*, a rectangular distribution of the

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[1] Various levels of intransitivities can potentially be examined (*e.g.*, intransitive 3-tuples as in $i > j > k$ but $k > i$, intransitive 4-tuples as in $i > j > k > l$ but $l > i$, and so on). However, 3-tuples seem to be the most fundamental in that every intransitive 4-tuple necessitates some intransitive 3-tuples but not *vice-versa* (Kendall 1970: 146; also see David 1963: 24). Consequently, in the present paper, the term 'intransitivity' will always be restricted to an intransitive 3-tuple.

c_i and an odd-valued t). Applying eq. 1 to the present protocol shows that there were only 2 intransitivities. Isolating the intransititivities by hand is sometimes tedious, and calculator/computer programs would be helpful (*cf.* Coombs 1964: 353ff). A search through the present S's feeling-of-knowing judgments shows that the two intransitivities were: (a) $55 > 27$ and $27 > 56$ but $55 < 56$, and (b) $55 > 27$ and $27 > 70$ but $55 < 70$. Notice that by chance, each of these intransitivities could have involved three items anywhere in the rank order; however, for both intransitivities, the involved items were quite close together in the feeling-of-knowing rank order (and, hence, the fineness of the S's discriminations may have been insufficient to discriminate these items in terms of his feeling of knowing). The observed number of intransitivities can be examined further in a number of ways. First, it can be evaluated in terms of the maximum possible number of intransitivities, which is given by the following equation (from Kendall 1970: 156):

$$\text{maximum number of intransitivities } = \tfrac{1}{24}(t^3 - t) \text{ for odd } t$$

or

$$= \tfrac{1}{24}(t^3 - 4t) \text{ for even } t \tag{2}$$

where t = number of different items in the paired comparisons. For the present $t = 11$ (which is an odd number), the maximum number of intransitivities that could have occurred is 55. Second, the observed number of intransitivities can be evaluated against the number of intransitivities expected by chance if the S's pairwise judgments were completely arbitrary. This chance value is equal to $0.25 \binom{t}{3}$ with a standard deviation of $\sqrt{0.1875 \binom{t}{3}}$ (from David 1963: 34). For the present S the chance number of intransitivities is 41.25 with a standard deviation of 5.56; the observed number of intransitivities (*i.e.*, 2) is more than seven standard deviations below the chance number, indicating that these pairwise judgments were not made arbitrarily.[2]

The above illustrates the richness of the data that accrue from the new feeling-of-knowing task. Although there are many ways to statistically analyze such data, we offer some analyses that invoke only minimal assumptions. For instance, non-parametric correlations such as the Goodman-Kruskal γ rather than the parametric point-biserial Pearson r can be used to relate the S's feeling-of-knowing rank order to his/her recognition performance so as to obtain a single measure of validity. The

[2] An exact significance test for a single subject's obtained number of intransitivities can be found in Kendall (1970: 147). More often, however, the researcher probably will prefer to examine the obtained numbers of intransitivities across a sample of subjects so as to obtain a central-tendency value with an associated confidence interval. This can be accomplished directly when the value of t is identical for all subjects. When t varies across subjects, then each subject's obtained number of intransitivities should initially be converted into the 'proportion of intransitivities out of the maximum possible' by dividing the value from eq. 1 by the value from eq. 2. For the present subject, the P (intransitivities out of the maximum possible) $= 2 \div 55 = 0.04$.

Goodman-Kruskal γ (see Hays 1973: 800−801) is ideal here because: it ranges from −1.0 to +1.0, is easily computed, has the same straightforward interpretation as Kendall τ, and, unlike Kendall τ or Spearman r_s, the absolute maximum possible value never decreases below 1.0 when the data contain ties in either or both of the rankings. When there are no ties, the obtained value of the Goodman-Kruskal γ always is identical to the value of Kendall τ. To assess the effects of an independent variable (*e.g.*, auditorily *vs.* visually presented study items) on the feeling-of-knowing validity, each S's γ could be determined and these could be evaluated across the two groups of Ss by a Mann-Whitney U test (or across more than two groups by a Kruskal-Wallis test, followed by Mann-Whitney U tests of pairwise group comparisons if the overall result of the Kruskal-Wallis test is significant). The same inferential analyses could be used for between-group comparisons on the various measures of reliability, such as the number of re-test reliabilities for each S. The descriptive statistics summarizing the central tendency of a group of Ss should be a median rather than a mean to avoid the assumption of an underlying interval scale, especially since one of the basic scales is ordinal (namely, the feeling-of-knowing rank order). A confidence interval can easily be computed around the median (Mosteller and Rourke 1973) if a measure of dispersion of the Ss' scores is desired (*e.g.*, to evaluate an exact hypothesis such as median $\gamma = 0$). Finally, across the Ss within a group, various kinds of relations can be examined by computing nonparametric correlations on the various measures of reliability or on the measures of reliability and validity. The above are only a portion of the potential analyses for the rich data base generated in the new feeling-of-knowing task, and the reader can probably discover many others that are even better suited to the particular questions that he or she is investigating.

Shorthand version

A shorthand version of the above procedures also is possible. This consists of replacing (a) the paired-comparison stage used to derive the feeling-of-knowing rank order with (b) a more direct method in which the subject himself arranges all of the nonrecalled items into a feeling-of-knowing rank order.[3] This can be accomplished by giving the subject

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[3] The present shorthand version consists of giving the subject one set of all t of the nonrecalled items and having him rank-order the t items, whereas the aforementioned paired-comparison version consists of giving the subject $\binom{t}{2} = t(t - 1) \div 2$ sets of 2 nonrecalled items per set and having him rank-order the 2 items within each set. Other versions in between this shorthand version and this paired-comparison version are possible, *e.g.*, the subject can be given $\binom{t}{3}$ sets of 3 nonrecalled items per set and he would rank-order the 3 items within each set. The relative advantages of these and other versions of the give-items-for-ranking procedure are discussed in Coombs (1964: ch. 2).

a set of cards in which each card shows a single number cue from a non-recalled item. These cards can be displayed in a circular arrangement on a table to avoid the kind of bias that might occur if they were given to the subject as a linear arrangement like in a deck of cards. Next, the subject would rank-order the cards from 'highest degree of feeling of knowing' to 'lowest degree of feeling of knowing'. Although this procedure would not yield as rich a data base as in the paired-comparison procedure (*e.g.*, no measures of intransitivity are possible), the extra simplicity and savings in subject-running time are factors that might be of concern for some investigations.

Conclusions

Regardless of which version of the new feeling-of-knowing technique is employed, both the paired-comparison version and the shorthand version have important advantages over the previous Hart version. The new feeling-of-knowing technique yields a set of criterion-free relative feeling-of-knowing judgments instead of a set of absolute feeling-of-knowing judgments that are confounded by the subject's placement of his/her decision criterion. This relative (*versus* the previous absolute) feeling-of-knowing technique yields benefits for assessing the feeling of knowing similar to those from the relative N-AFC (*versus* the absolute YES-NO) technique of assessing recognition memory described by Shepard (1967). Finally, the new feeling-of-knowing technique yields a rich data base and some unique options for assessing reliability that we hope other researchers will find useful.

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