Primacy and assimilation in the attribution process: The stable entity proposition[1]

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Consider the ubiquitous case of an entity—a person, an automobile, a tribe, a movie—that reveals its characteristics through a sequence of more or less informative glimpses. The serial unveiling of entity manifestations is an almost inevitable feature of the process of "getting to know" a person or thing. Impressions are formed in stages, typically from an expanding information base that supports and enriches our initial judgment.

What happens when a person is exposed to a sequence of information with changing implications? Answers to this question are extremely important in the development of attribution theories, but in spite of the methodological convenience of being able to present experimentally the same information in different orders, it has proved difficult to achieve reliable order effects or to provide a meaningful conceptual context for those that have occurred.

Order effects have been studied in a variety of information settings, with a variety of dependent measures including recall, evaluation, attribution, and attitude change. Targets of judgment have ranged from lifted weights, within the traditional psychophysical paradigm, to the evaluation of persons in impression formation settings. A review of different order effect paradigms appears in a recent paper by Jones and Goethals (1971).

Order effects in impression formation have been assessed primarily by a paradigm in which lists of traits are presented whose value on some dimension changes monotonically from trait to trait (as in the classic Asch, 1946 study). Frequently the dimension is evaluative and the list of traits allegedly describing a particular person becomes increasingly positive or negative in value. By and large, but by no means inevitably, the subjects' impressions in

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such studies reflect a primacy effect. That is, the positive-negative list creates a more favorable impression than the negative-positive list The values of the constituent traits are not simply averaged, the later traits are apparently discounted, distorted in meaning, or ignored.

There are many difficulties with attempting to relate the results of such studies to naturalistic impression formation. The judgment context is artificial, the judgments have no particular consequences for the subjects, it is generally not clear how the traits were derived or why they appear in the particular order they do, and subjects are often asked to make successive judgments of different persons represented by different trait lists. In general, it is not at all clear whether the subjects are able to put themselves in the role of judging another person, or whether the results might more properly be classified under the heading of semantic integration.

A more neglected but more naturalistic context for studying order effects is that in which subjects observe a stimulus person behaving through some time period and then attempt to make an integrative appraisal of an underlying disposition. The implications of order must be faced when the person's early and later actions imply different dispositions and there is no obvious situational change to account for the changes in behavior. Jones, Rock, Shaver, Goethals, and Ward (1968) conducted such an experiment to investigate the attribution of ability to persons with improving versus declining performance levels. The stimulus person attempted to solve difficult progressions and analogies and either solved more of the early items or more of the later ones, always with the same total number of successes.

Although pains were taken to assure the subjects that the items were equally difficult, and that the stimulus person was highly motivated throughout, a resulting primacy effect was observed in several related studies. Primacy was reflected in a number of measures: (1) the descending performer was seen as more intelligent than the ascending performer; (2) the descending performer was predicted to do better on a second series of items taken from the same general pool; and finally (3) the descending person was remembered as having solved more problems in the initial series.

Although primacy effects are more the rule than the exception in first impression studies, the ability attribution results were unexpected and do not lend themselves to ready explanations It was especially surprising, perhaps, that the ascending stimulus person, who just ended up doing very well on one series of items, was expected to do poorly in a second series allegedly taken from the same item pool. The general results held up whether or not the subject himself also solved problems and could view himself in a competitive relation with the stimulus person. This seems to rule out obvious explanations in terms of social comparison—such as attributing unusual intelligence to the initially successful performer in order to maintain one's own self-esteem.

Jones et al. tentatively concluded that such robust primacy data obtained because ability tends to be a very stable personal disposition. Its manifestations may come and go, but ability itself changes slowly. To make this point more clearly, one would obviously expect different results if mastery of the task involved a large learning or adaptation component The person who ends up having learned something would obviously be expected to do better on subsequent tests of the same performance than one who has apparently forgotten what he once knew. Not surprisingly, then, Jones and Welsh (1971) found a recency effect when subjects attributed ability to performers in a game requiring the development of strategies through trial and error. In the case of the Jones, Rock, et al. problem-solving experiment, however, the items were presented as measures of intelligence, and it is normally assumed that intelligence does not improve as a direct effect of practice.

Because of the assumed stability of intellectual ability, perceivers may commit themselves to inferences about level of intelligence on the basis of slender early evidence, forming durable attributions that are resistant to change. Such immutable inferences about the talents of others would not be made in cases where these talents are quickly learned and unlearned or where any manifestation of performance would be an obviously unreliable indicator of underlying capacity.

We may extend this line of speculation to draw the more general implication that primacy is enhanced when a stable entity is being judged because features of more recent information are *assimilated* to features of earlier information. To refine this implication into a respectable proposition, several conditions must be specified. *If* the entity whose manifestations are being judged is expected to be stable, and *if* valid information revealed by the manifestations is expected to be randomly distributed over time, *then* there will be a tendency to assimilate—i.e., to distort the information conveyed by later manifestations to conform to the specific expectancy created by the early manifestations. Assimilation is a sufficient condition for primacy, given a series of manifestations whose attributional implications change over time. Whether assimilation occurs through perceptual distortion or memory distortion would be very difficult to establish. Presumably, the greater the attributional ambiguity of the manifestation (as, perhaps, in the typical adjective trait list study) the greater the likelihood of perceptual assimilation. Asch (1946) proposed that the meaning of traits appearing late in the list is changed to become more consistent with early-appearing traits. This shift-in-meaning hypothesis is a special case of immediate cognitive assimilation to an expectancy. In the examples with which the present paper is concerned, it is much more likely that assimilation occurs in retrospect—the subject misremembers entity manifestations in a way that exaggerates the importance or the number of those appearing early in the series.

In order to attribute primacy to assimilation one further condition must be fulfilled. There must be some assurance that subjects initially attend to the later manifestations as closely as they attend to the earlier ones. Primacy effects can occur for the trivial reason that subjects lose interest in their monitoring task and simply do not as faithfully register those manifestations occurring late in the series. This may commonly occur in the natural environment but is not of particular theoretical interest.

Let us be concrete and see how these stipulations apply to the ability attribution study described above. We have argued that ability is a stable attribute and therefore a suitable candidate for assimilation and primacy, but these processes depend additionally on the development of an expectancy that late manifestations will replicate early ones. In the Jones, et al. ability study subjects were assured that the problems were randomly selected and of equal difficulty level—thus satisfying the condition of expected equal distribution of successes and failures Nonetheless, the assimilation concept would still not be needed if there were evidence that subjects simply failed to attend to the later manifestations. But all observations and reports suggest that the performance monitoring task was considered challenging and engrossing by the subjects. Furthermore, in some experimental conditions, the subjects were compelled to attend throughout because they were assigned the task of estimating the probability of success on the next trial. There is good evidence that they performed this estimation task carefully, paying close attention to the cumulative proportions of successes and failures.

Thus the ability attribution results are consistent with an assimilation hypothesis and the conditions of the study fulfill the criteria specified for the generalized stable entity proposition. This assumes, however, that ability is a "stable entity" and implies that manifestations of a less stable entity would not lend themselves to assimilation and primacy Is it generally true that the judgment of stable entities results in assimilation whereas the judgment of changeable or unstable entities does not? The present experiments were designed to answer this question The experiments also sought to determine whether assimilation and primacy are unique to the person perception realm or operate more generally whenever a stable entity manifests itself The strategy we attempted to adopt was to move far from the content domain of personal ability while getting a firmer grip on the variable of entity stability. By changing all but the conceptually crucial conditions we hoped that the general proposition suggested by the ability studies could be put to a reasonable test.

Experiment I

The first experiment was designed to preserve the patterns of ascending and descending "entity manifestations" of the previous ability studies while shifting the context to that of an auditory discrimination task. The study was presented as a simulation of the problem of interpreting acoustical radar signals from aircraft approaching a major urban airport. In groups of three to six, 94 female subjects were asked to distinguish between jet and non-jet signals on a series of 30 trials The signals were pure tone beeps that were either higher or lower in pitch than a steady inter-trial tone High tones were designated as jets, low tones as non-jets, and subjects were asked to record which kind of craft was approaching the runway on each trial There were 15 high beep and 15 low beep trials so distributed as to replicate exactly the successes and failures of the descending and ascending patterns of the ability studies [3] Approximately half of the subjects were exposed to each stimulus order Within each of these conditions, approximately half of the subjects were asked to estimate the probability on each trial that the next signal would be a jet.

After moving on to a more complex auditory discrimination task, subjects were finally asked to recall how many jets there had been in the first series of signals. Their recall estimates served as the main measure of the effects of order. Results showed that more jets were recalled in the descending than the ascending order ($p < .01$) In other words, there was a clear primacy effect. The results were roughly the same whether subjects made serial probability estimates or not

The relevance of this result for our main proposition is not clear, however, for the probability estimation data from this study differed strikingly from those collected in the ability studies. In brief, it appears as if subjects did not form dispositional expectancies about the "jetness" of the airport they were monitoring. The formation of a dispositional expectancy would have been reflected in a tendency to raise probability estimates of jet signals after a jet trial and to lower the estimate after a non-jet trial. Probability estimation in the ability studies followed this pattern closely Instead, subjects in the present study responded as if they expected a rough alternation of jet and non-jet signals a "gambler's fallacy" strategy.

The observed primacy effect apparently resulted less from assimilation to expectancy than from the tendency of subjects to

3 In the ascending conditions, jets appeared on trials 1, 6, 10, 11, 14, 17, 18, 19, 23, 24, 25, 27, 28, 29, 30 In the descending condition trials 1, 2, 3, 4, 6, 7, 8, 12, 13, 14, 17, 20, 21, 25, 30.

become increasingly inattentive during the monitoring task. The task was extremely simple and many of the subjects appeared to become bored and restless. The results of the jet study do not bear conclusively on our major proposition, then, because the conditions of involvement and sustained attention were not met. In addition, many subjects were not oriented toward making dispositional attributions about the airport on the basis of the data at hand. The second experiment was planned to provide a more fitting analogue for the ability studies.

Experiment II

It is the very nature of intelligence testing that some do well and some do poorly. Subjects in the ability studies should, therefore, have been clearly oriented toward making dispositional inferences on the basis of the performance data observed. As the jet study shows, this is not an inevitable orientation in processing sequences of information reflecting or characterizing an entity. Building on the experience of the jet study, a second experiment was designed so that (a) the attention of subjects could be maintained throughout the monitoring task, (b) the possibility of widely varying entity dispositions could be made salient, and (c) the expectation that entity manifestations would be randomly distributed could be emphasized in the procedure.

To accomplish these objectives our decision was to trade on the average subject's natural interest in playing cards. The experiment required subjects to display serially the cards of a well shuffled deck and to predict whether the next card was likely to be an ace or not an ace. Subsequently they were asked to recall the number of aces in the deck. The structure of the experiment was very similar to that of both the ability and the jet studies.

Method

Subjects. The subjects were 28 female undergraduates enrolled in introductory psychology. They volunteered for an experiment on "information processing" and reported individually to the experimental room.

Procedure. The experimenter explained that the study was designed to find out how people use information, and particularly how people use their past experience to anticipate future events. The experimenter went on to say that for the first task subjects would work with two specially constructed decks of cards. One, a red-backed deck, contained 30 cards, of which anywhere from 3 to 27 were aces and the rest face cards The other deck, blue-backed, contained 3 to 27 deuces and the rest 3's, 4's, or 5's. The experimenter explained that there were several red and several blue decks and made it clear that the subject would choose to work with one of each without, of course, being given any information concerning the number of aces or deuces in the chosen decks.

The subject was then shown several 30-card red and blue decks and asked to select one of each He was then asked to shuffle each of the two chosen decks carefully and to place them side by side. Having done this, the subject's attention was diverted while two stacked decks were substituted for the shuffled ones. The experimenter then asked the subject to turn one card of each deck over at a time and to record whether the card from the red deck was an ace or a non-ace, and whether the card from the blue deck was a deuce or a non-deuce. Before turning the next card in the red deck, he was told on each trial to estimate the probability that it would be an ace, using number 1 to 10. This procedure continued for 30 trials. The distribution of cards in the blue deck was not emphasized, the inclusion of this deck was designed to simulate the inclusion of a second performer in the ability studies.

The patterns of aces were identical to the now familiar ascending and descending patterns used in the ability and the jet studies (see footnote 3). There were always 15 aces in the red deck and there were always 10 deuces in the blue deck. The deuces were randomly dispersed across the trials in the same pattern as the distribution of successes for the second performer in the ability studies.

This probability estimation task was followed by a similar task of predicting whether the next checker drawn from a cannister of checkers would be red or black. No data were derived from this task, which served as an interpolated distractor preceding the major dependent variable measures These consisted of: (1) answers to the simple question, how many aces were there in the deck you worked with? and (2) attempted reconstructions by the subjects of the actual pattern of aces and non-aces. Summarizing the number of aces in the reconstructed pattern provided a second measure of recalled "aceyness."

Results

In appraising the results of this experiment we are essentially interested in the answers to two questions: (1) Is there a primacy effect in the recall of the number of aces in the deck of 30 cards? (2) Is there evidence that this effect reflects assimilation to expectancy rather than a simple failure to attend to those cards occurring toward the end of the series? In other words, does the general pattern of data appear to fit the data pattern observed in the ability experiments?

Turning first to the question of differences between conditions in the recall of number of aces, the data again indicate a primacy effect. When answers to the direct question "How many aces were there in the deck you turned over" are averaged, there is only a slight and nonsignificant trend favoring more aces recalled in the descending condition. However, as Table 1 shows, there was an interesting counter bias of recency in the recall of deuces. When a score is derived to indicate the discrepancy between the number of aces and deuces recalled, there is a significant difference between the descending and ascending conditions. Subjects in the descending condition remembered that there were more aces-relative-to-deuces than subjects in the ascending condition.

We would be reluctant to emphasize this finding of *relative* primacy except that a second measure of recall provides unequivocal support for a primacy effect As noted above, subjects were asked to recall the sequence in which aces appeared by placing or omitting a checkmark in each of 30 different scale positions. The total number of checks (for aces) could then be summed to provide a second index of recalled "aceyness" As the final column of Table 1 shows, this index yields a highly significant primacy effect. The elevation of significance level is at least in part due to the reduction of variance that occurs when subjects try to recall on an item-by-item basis.

What evidence is there that this reliable primacy effect is the result of an assimilation to the expectancy established by early trials in the sequence? At a minimum the assimilation hypothesis requires evidence that an expectancy was established plus further evidence that the memory distortion contributing to the primacy effect was mostly localized in the later trials of the sequence. Since it is highly unlikely that subjects could distort whether or not a card was an ace, the hypothesis refers to assimilation in memory rather than in perception.

Table 1. Recall of aces and deuces by condition.

	Number recalled			
	Initial estimate			Sum across items
	Aces	Deuces	Aces-deuces	Aces
Condition				
Ascending	15 86	12 14	3 72	14 14
Descending	17 00	10 21	6 79	16 42
Diff[a]	+1 14	−1 93	+3 07	+2 28
p_{diff}	n.s	n.s.	05	01

[a]Positive differences indicate primacy, negative differences recency

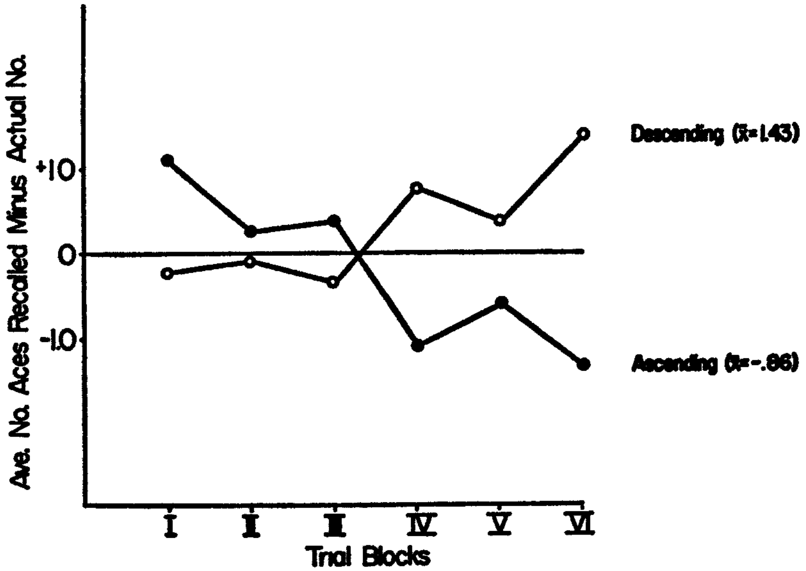

Figure 1. Direction and magnitude of recall errors by blocks of five trials. Experiment II

The evidence for memory distortion is clearly consistent with the assimilation hypothesis. As Figure 1 shows, there was very little memory distortion in the descending condition until late in the sequence. When subjects try to reconstruct the sequence of aces, they recall more aces over the last ten cards than was actually the case. As the hypothesis would also predict, subjects in the ascending condition recall fewer aces over the later trials. However, the memory results in the ascending condition were slightly more equivocal because of the apparent over-recall of aces during the first block of five trials. Close inspection shows that this is primarily a function of the fact that ten of the fourteen subjects in this condition thought the second ace appeared on trial five rather than trial six. With this exception, then, the recall data support the notion that an expectancy is formed during the early trials and that later events are seen as less disconfirming than they in fact were. An index of the tendency toward greater recall distortion on the second versus the first half of the deck was highly significant across both conditions ($t = 3.94$, $p < .001$).

In the preceding jet study, that we have only briefly described, it was observed that subjects became inattentive and bored as the trials wore on. This at least raised the possibility that the primacy effect observed in that study merely reflected a kind of "tuning out" requiring no invocation of the assimilation concept. In the present card study there was no evidence the subjects became bored with the tedium of their assignment. The task of turning over 30 pairs of cards went rather quickly and the subjects appeared to be quite involved in making their predictions for each succeeding trial. The probability estimates themselves showed fairly good sensitivity to the objective dispositional probabilities —the ratio of cumulated aces to the total number of cards turned over—except that subjects in the descending condition distorted their estimates rather systematically toward the end of the deck (see Figure 2). What happened, in effect, is that subjects in the descending condition took several trials to develop the hypothesis that they were dealing with an acey deck, and then did not adjust this hypothesis sufficiently to accommodate the subsequent decline in the frequency of aces. This finding, restricted to the descending series, is consistent with the "conservatism effect" observed by Edwards and Phillips (1964), Phillips and Edwards (1966), and Peterson and DuCharme (1967). In each of these studies, subjects in a subjective probability inference task lagged in discarding an initially confirmed hypothesis when objective events began to favor an alternative hypothesis.

These results raise some question about the value of probability

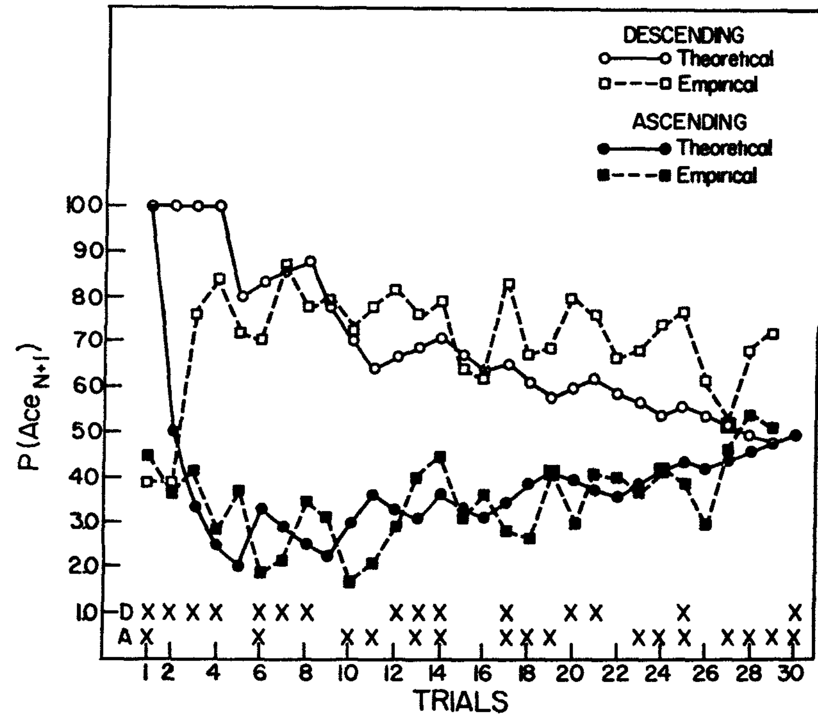

Figure 2 Judgments of probability of an ace on the next trial (on a 10 point scale). Theoretical and empirical functions Experiment II

estimation data for discounting the "tuning out" hypothesis. It is unlikely but possible that some subjects simply went through the motions of paying attention as they turned over the later cards in the deck. A detailed study of the probability estimation data in the present study shows that subjects were more accurate in tracking the objective probability of aces than subjects in the jet-study were in tracking jets. In neither study, however, did the accuracy level on the last 10 trials approach that of the ability studies. While we cannot entirely rule out the hypothesis of simple "tuning out," it seems more appropriate to apply the assimilation hypothesis to the present pattern of data and to acknowledge the possibility that assimilation effects begin with the probability estimation task itself.

Having demonstrated that the memory of particular ascending and descending patterns of events is distorted in the direction of primacy in three unrelated content domains, we now must return to a condition of the basic assimilation hypothesis that has thus far been taken for granted. the stability of the entity whose manifestations are being monitored The assimilation hypothesis, as stated in the introduction to this paper, seems logically to require the assumption that late manifestations will replicate early ones, or that no systematic changes are likely to occur in the entity over time. We have thus far tried to insure in each experiment that assumptions of entity stability would prevail. In the card study just completed, for example, there was no apparent way in which the number of aces in a deck could change once the deck had been selected, and the shuffling procedure made it highly unlikely that the distribution of aces within the deck would be seriously biased.

In order to show that entity stability is an important determinant of assimilation, it is obviously necessary to demonstrate that assimilation does not occur when the sequential manifestations of a potentially changing unstable entity are being monitored. The final experiment was designed to test this implication of the assimilation hypothesis

Experiment III

The final experiment was designed to confront subjects again with an ascending or descending series of aces, but to vary the extent to which the series reflected a single stable entity. If pressures toward assimilation arise from the basic condition that each event in a series reflects the same underlying entity, then assimilation should not occur if steps are taken to prevent the subjects from making such an assumption. In the area of person perception, and in the physical world as well, some dispositions are undoubtedly considered to be more stable than others When a perceiver assumes that he is monitoring the manifestations of a potentially changing disposition, he should not be seduced into assimilating later manifestations to an expectancy established by earlier events.

It is difficult to think of clear-cut cases in which the properties of an entity change over manageable periods of time. If the ability studies had been so conducted that practice and the possibility for improvement were highly salient aspects of the task, "performance capacity" might be considered a changeable entity. The example would still be confused, however, by the complication that smarter people learn faster and probably are believed to retain better that which they have learned. It is easier to think of cases in which surface events are manifestations of one of two underlying attributes. A sequence of changing events may thus reflect the increasing prominence of one attribute over another. The functional properties of this case appear equivalent to those of a single attribute that changes qualitatively over time. The more manageable two-atttribute paradigm was adopted in the present case.

The procedure again involved subjects in the task of revealing cards in a prearranged deck, although this time there was no second deck of randomly distributed deuces. The single deck which each subject viewed was in some conditions made up of two sub-decks differentiated by color and in others consisted of a single-colored deck. Identical distributions of aces appeared in both of the variations, thus affording a basic comparison between decks reflecting one versus two attributes. Different sub-decks and thus different colored backs predominated at each end of the sequence of cards, and a gradual transition between these two attributes occurred. Since the number of aces became more or less frequent and the predominance of one color over another also shifted systematically, the result was a correlation between the color of the card's back and whether it was an ace. It should have been possible for the attentive subject to note, then, that red cards, for example, were more likely to be aces than blue cards.

The basic comparison of this final experiment was to be between recall of the number of aces in this combined deck and recall of the number of aces in a single large deck in which the aces were identically distributed. These recall instructions thus required subjects in all conditions to treat the total series of cards as the "entity" being judged.

If primacy obtained in the single deck but not in the double deck, it might be argued that something about the further property of working with two decks created so much confusion that primacy effects were supplanted by chaos. Therefore, a second control condition was included in which blue and red cards were randomly distributed throughout the deck with which the subject worked. In this deck, then, there was little or no correlation between the color of the card and the probability that it was an ace.

The design of the experiment was thus a 3 × 2 factorial with ascending and descending distributions of aces occurring in a deck of one color or in combined decks of two colors whose backs were or were not correlated with the card values of the faces

METHOD

Procedure Subjects (69 males and females) were again drawn from the introductory course to participate individually in an experiment described as an information processing game. As in the preceding study, subjects chose from a number of card decks, shuffled the cards themselves, and turned them to reveal their face values one by one After the initial card was turned over, subjects were asked to estimate the probability that the next card would be an ace by recording a number from 1 (highly improbable) to 10 (highly probable). Successive estimates were made after each card was turned. After each of 40 cards had been revealed in this way, the subject then engaged in an interpolated prediction task which consisted of guessing whether the next marble drawn from a can would be red or green Finally, subjects were asked to recall the number of aces there had been in the series they had displayed, and as a more detailed memory check they were asked to recall the distribution of aces within the series.

In the *single-color* conditions, 21 decks were arrayed before the subject, each having 40 cards Each allegedly contained anywhere from 0 to 40 aces, and subjects were informed that the total number of aces in all of the decks combined was equal to the total number of non-aces The experimenter emphasized the wide range of possible aces per deck in order to draw the subject's attention to "aceyness" as a disposition that varied markedly across decks and to make all proportions of aces appear equally plausible at the outset. As noted above, each subject made a free choice of one of these 21 decks, shuffled the deck to his satisfaction, and then proceeded with the information processing (probability estimation) task by turning over the cards one by one. As in the preceding study, a stacked deck was secretly substituted in which half the cards were aces. The aces (20 in each condition) either predominated at the beginning (descending series) or at the end (ascending series) of the deck.

In the *double-color* conditions, each project was shown two arrays of 21 decks containing 20 cards apiece One array was red-backed, the other was blue-backed Subjects were again assured that the number of aces in each deck varied widely, this time from 0 to 20, and that any proportion would be just as likely as any other. Subjects were instructed to select freely one of the red decks and one of the blue decks, to shuffle each thoroughly, and finally to combine them with one last shuffle into a single deck of 40 cards

Once again, prior to the probability estimation task, a stacked deck was secretly substituted. In the high correlation (*double-correlated*) condition the backs of the prearranged decks were unevenly distributed so that more cards of one color appeared toward the end. Thus, given the basic ascending or descending distributions of aces, there was a necessary relationship between color of back and probability of ace The color of a card provided a strong clue, in other words, concerning its likelihood of being an ace In the low correlation (*double-random*) condition, the card colors were more evenly distributed. In all conditions, to facilitate discrimination, cards with blue backs were from the black suits and cards with red backs were from the red suits

The various sequences of aces and card colors are shown in Figure 3.

Results

Once again, there are two basic recall measures: the subject's answer to a direct question concerning the number of aces in

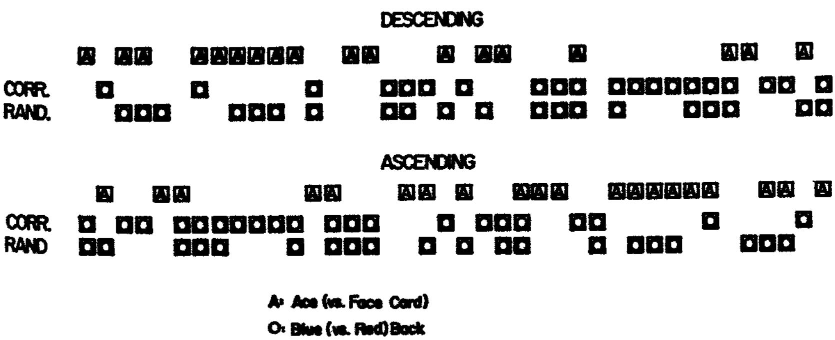

Figure 3. Feedback patterns employed in the 40 trials of Experiment III, indicating whether the card was an ace and whether the card back was blue or red.

the deck and a measure derived from totalling the aces recorded by the subject as he attempted to reproduce their actual distribution. The mean number of aces by conditions for each of these measures is presented in Table 2. Here it is apparent that regardless of the measure used there is a primacy effect in both the single-color and double-random conditions, but no primacy effect in the double-correlated condition. The results give clear support to the hypothesis. This support is somewhat stronger when the initial estimate is used than when the derived summary score is used. Nevertheless, in both cases the critical interaction is statistically reliable (see Table 3). Also, in both cases the double-correlated condition shows significantly less primacy than the single-color condition. The difference between double-random and

Table 2. Mean number of aces recalled by condition.

	Single-color	Double-random	Double-correlated
Direct initial estimate			
Descending	23.7	23.0	19.7
Ascending	17.5	18 6	20.5
Diff[a]	+6.2	+4 4	−0.8
Derived summated measure			
Descending	21 8	21.9	18.9
Ascending	17.3	19.4	18.6
Diff[a]	+4.5	+2.5	+0.3

[a]Positive numbers indicate a primacy effect in recall.

Table 3. Summary of analysis of variance: Recall of aces, Experiment III.

Source	Direct estimate			Derived summary		
	df	Mean square	*F*	*df*	Mean square	*F*
A. Ascending-descending	1	160 13	13.48**	1	88 82	15.87**
B. Color correlation	2	2.60	.22	2	18.20	3.25*
A × B	2	66.03[a]	5.56**	2	22.07[b]	3.95*
Within cells	54	11.88		54	5.60	

[a]Component interaction effects: (1) Double-correlated vs. Single, $F_{1,54} = 10.31$, $p < .005$; (2) Double-correlated vs. Double-random, $F_{1,54} = 5.303$, $p < .05$.

[b]Component interaction effects: (1) Double-correlated vs. Single, $F_{1,54} = 7.88$, $p <$ 01; (2) Double-correlated vs. Double-random, $F_{1,54} = 2.16$, $p < .25$.

*$p < .05$

**$p < .01$

double-correlated conditions is significant only with the initial estimate measure.

The probability estimation data may be rather simply summarized. When a descending pattern of aces appears, the single-color and the double-random conditions are much alike in showing a good adjustment to the objective dispositional probability (the ratio of aces over all cards up to the trial being considered). In the ascending conditions, in both cases subjects tended to keep their estimates near the 50 percent point. Thus subjects in these conditions persisted in overestimating the probability of aces during the first half of the deck—until the objective probabilities themselves began to approach 50 percent. Interpretation of this tendency is not at all clear, and it does not replicate the probability estimation curves in the first card study (see Figure 2) The apparent insensitivity of the subjects in the ascending conditions may reflect the arbitrary experimental choice of a particular pattern of cards that in this case yields 50 percent aces in the first six trials and then shows nothing but face cards for six trials in a row (see Figure 3).

As one might expect, the probability estimation data for the double-correlated conditions were very different. By the time they had turned over about 10 cards, subjects in this condition began to show very clear awareness of the correlation between the color of the card back and the probability of its being an ace. From this point on, the probability estimates became more and more strikingly affected by the color of the card being predicted.

The general changing-entity hypothesis could hardly be sustained if subjects were totally unaware of the correlation between card color and "aceyness." The clear indication that subjects learn the contingency provides evidence for the validity of the intended manipulation of the correlation between color and face value. It also, however, raises the possibility that the main recall results might be explained in an alternative way—a way not involving assumptions about stable versus unstable entities. If subjects were to embrace the hypothesis that, say, blue always means ace and red means face card, they could infer from their clear knowledge of the number of red and blue cards that there must be a total of 20 aces. By drawing on this contingency clue, then, the subject would be accurate almost by accident and therefore avoid the pitfalls of primacy.

There is no good evidence to support this alternative hypothesis, and most of the evidence argues against the possibility that subjects made such simplifying inferences First of all, the hypothesis implies that subjects in the double-correlated condition would show less variability than subjects in the other conditions In fact, however, when each condition is compared with each other condition for both measures, only one variance comparison is significant and this is in the descending condition on the initial measure where the double-correlated version shows a *higher* variance than the single-color version ($F_{9,9} = 4.49$, $p < .05$).

In addition, when each subject is assigned a score reflecting his sensitivity to the color-ace contingency (by simply taking the sum of probability estimates for the color associated with ace predominance and subtracting the remainder of estimates for each subject), there is no relationship between this sensitivity score and the accuracy of memory. One disturbing fact that seems to point in the direction of the alternative hypothesis is that 8 out of the 20 double-correlation subjects answered "20" on the initial recall measure, as compared with 2 out of 20 double-random subjects and 5 out of 20 single-color subjects. However, the subjects answering "20" in the double-correlated condition actually had lower sensitivity scores than the remaining 12 subjects. Perhaps more important, on the second measure of retention, that derived from summing the trial by trial recall efforts, subjects in the double-correlated and single-color conditions each gave the same number of answers adding to 20 25 percent. It will be remembered that the single-color condition showed a significantly greater primacy effect than the double-correlated condition with this measure as well as the initial recall measure. The evidence seems fairly conclusive, then, that the differences observed are not an artifact of the greater ease of inferring how many aces there must have been in the double-correlated deck.

It is finally of some interest to note the locus of recall errors in the task requiring subjects to reproduce the sequential distribution of aces and face cards. As in the previous studies, recall errors of the later cards are systematically greater than recall

Table 4 Discrepancy between average number of aces recalled and actual number of aces per block for each condition

Trials	1–5	6–10	11–15	16–20	21–25	26–30	31–35	36–40	Algebraic Sum	
Trial block	1	2	3	4	5	6	7	8	1–4	5–8
Ascending single	0	+7	−2	+1	−9	−6	−1 2	−6	+6	−3 3
Descending single	+5	−1 6	+3	−4	+9	+1 0	+8	+3	−1 2	+3 0
Ascending double random	+2	+1 2	0	+4	−6	+1	−1 5	−3	+1 8	−2 3
Descending double random	+2	−8	−4	−7	+5	+5	+1 9	+.7	−1.7	+3 6
Ascending double correlation	−2	+1 3	−3	+2	−5	−4	−1 7	+3	+1 0	−2 3
Descending double correlation	−1	−1 2	−6	−2	−2	0	+.7	+.5	−2 1	+1.0

errors of the early cards in the single and double-random conditions ($t = 5\ 28$, $p <$ 001). Though there is some compensatory distortion of early card frequencies (more aces early in ascending and fewer early in descending), the late trial distortions are great enough to produce primacy in the two control conditions. To put it another way. (1) In the ascending series, the tendency to over-recall the number of early aces is smaller than the tendency to under-recall the number of later aces, and (2) In the descending series, the tendency to under-recall the number of early aces is smaller than the tendency to over-recall the number of later aces (see Table 4). These combined tendencies, giving rise to the primacy results, are exactly what an assimilation hypothesis would require. A misleading expectancy is established on the basis of early returns and subsequent information is distorted to confirm it.

These same tendencies also characterize the double-correlated condition subjects, though the early errors come closer to compensating for the later errors. A comparison between subjects in the double-correlated conditions and other subjects shows that the former are significantly less inclined to concentrate their recall errors on the later trials ($t = 2.11$, $p < .05$). In fact, as the final columns of Table 4 show, double-correlation subjects working with the descending sequence are unique in showing more distortion of the early cards than of the later cards. This apparent failure of assimilation in the double-correlated descending condition is sufficient to prevent any primacy effect.

Discussion and Conclusions

It may seem that we have gone to great lengths to establish a rather simple point about the attribution process. It may also appear that we have substituted risky and unconvincing analogies for theoretically sound generality. But the point is an important one that is not easily established in the realm of person perception itself. We have been interested in the case of an entity manifesting itself over time when the manifestations have different implications for judging the nature of the entity. In three very different settings—the perception of performance, the monitoring of auditory signals, and the observation of series of playing cards—there has been memory distortion in the direction of primacy. That is, early manifestations seem more salient in the recall process. If X's are more frequent than Y's early in the series and Y's predominate in the same proportion late in the series, more X's than Y's will be remembered as characterizing the series.

This appears to be a very widespread phenomenon, given certain limitations of series length and degree of distributional asymmetry. We have attempted to show in the final experiment that the assimilation phenomenon is nevertheless dependent on certain assumptions about the entity whose manifestations are being observed. For assimilation to occur, the entity must be assumed to be stable and the distribution of manifestations unbiased. Otherwise, there is no reason why early events in the series should create expectancies concerning later events in the series. The major proposition of the present paper is that primacy effects in recall data reflect the assimilation of later events in the series to such early-established expectancies.

Data from the final experiment support this proposition: a changing proportion of sequentially revealed aces gave rise to primacy only when each card could be viewed as a random manifestation of a deck having a set proportion of aces. When the changing proportion of manifested aces could be attributed to changes in the underlying entity (as in the double-correlated condition), no primacy effect was observed.

Unfortunately, the concept of assimilation is more descriptive than explanatory. Nevertheless, we can distinguish it from other conceivable explanations of the observed pattern of findings. Although our own contention is that assimilation occurs in memory, a whole range of alternatives would locate the determinants of primacy in the monitoring process itself. At one extreme there is the hypothesis of gross inattention. The subject may simply lose interest in the monitoring process and fail to notice that the manifestations are changing as the series progresses This hypothesis seems untenable on the face of it, since the experimental tasks of sequential probability estimation and the subsequent recording of each event require persistent attention to the unfolding instances.

More subtle forms of inattention and discounting are not so easy to rule out. In the jet study in particular, many subjects appeared to respond to the probability estimation requirement in the most desultory way. While they were sensitive to the immediately preceding event throughout the monitoring task—responding typically in terms of the "gambler's fallacy"—they were not alert to cumulative evidence about the predominance of jets and non-jets in the particular airport. Thus their probability estimations were quite out of touch with the probability index derived from the proportion of past positive instances. Subjects in the first card study showed more sensitivity in their probability estimates than jet-study subjects, and the task in general seemed more engrossing. In the second card study—and especially in the ability studies—the subjects paid close and continuing attention to the cumulative proportion of positive instances. Although it is very difficult to demonstrate that subjects paid as much attention to the later information as they did to the early information, there is no compelling evidence that the primacy effect observed in the card studies reflects decreasing attention.

Anderson (1968; with Jacobson, 1965) has distinguished between attention decrement and discounting in the attempt to account for primacy effects in serial integration tasks. Although it is not immediately obvious how these alternatives can be readily distinguished, Hendrick and Costantini (1970) proposed that discounting should vary with the degree of inconsistency between early and late information, whereas attention decrement should be independent of such inconsistency In two experiments that varied the degree of semantic inconsistency between early and late appearing traits, Hendrick and Costantini found no support for the discounting hypothesis. The attention decrement explanation, on the other hand, was supported when it was found that instructing the subject to pronounce each trait individually changed the evaluative bias from primacy to recency. This and other results (Anderson & Hubert, 1963, Stewart, 1965, Anderson, 1968) are consistent in suggesting that when subjects are required to distribute their attention equally throughout the series, primacy effects do not obtain. When no such pains are taken, however, primacy is characteristically observed.

It is not at all clear whether sequential manifestation studies like those described in the present report reflect the same processes that govern evaluative judgments of strings of inconsistent adjectives. For example, the discounting explanation is plausible in a trait integration study with instructions contending that each trait was provided by a different acquaintance of the person being described. Such instructions almost invite the subject to attribute more validity to some traits than others, or more reliability to some acquaintances than others The discounting of late successes, jets, or aces in an unfolding series seems inherently less plausible.

It may also be argued that the probability estimation task should have forced the subjects to distribute their attention throughout the series in the present studies. After all, the task requires the subject to process each succeeding manifestation in preparation for his next estimate. Instead of the recency effects this attentive monitoring is alleged to produce, however, we have found consistent primacy

Our conclusion, one that is consistent with the data reviewed, implies an interaction between the subject's assumptions about the entity being monitored and his processing of sequential information about that entity. If (a) the entity or disposition is assumed to be stable over time, and (b) its properties can reasonably vary through a wide range at the outset of the series, and (c) there is no reason to assume bias in the distribution of entity manifestations, then a primacy effect is the result of an assimilation process in which the early manifestations establish an expectancy to which later manifestations are adjusted in memory.

Undoubtedly there are many other boundary conditions affecting the occurrence of primacy in the recall of sequentially presented information The present experiments have highlighted the role of prior assumptions about the entity in processing information about its dispositional characteristics. Attributions to unstable entities are likely to be more accurate than attributions to stable entities *when* there are systematic changes in information over time.

Summary

Three experiments were performed to extend the findings of a previous study in which a performer who solved the early problems in a series was remembered as having solved more problems than one who solved the same number of problems later in the series In the first of the present experiments, a primacy effect was again obtained in a task involving the recall of high- versus low-frequency tones. In the second and third experiments, primacy effects were found when subjects tried to recall the number of aces in a series of previously exposed cards. The cards were prearranged so that aces predominated early or late in the series. Primacy did not occur, however, when two "sub-decks" were combined in such a way that the change in the frequency of aces could be attributed to a change in the sub-deck from which the card was drawn. Primacy effects in the recall of "entity manifestations" are thus shown to occur when the entity is stable and its manifestations are expected to be evenly distributed.

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