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Psychology and Coincidences

Caroline A. Watt
Department of Psychology, University of Edinburgh

Abstract: The paper presents a selective review of research suggesting possible normal causes for some coincidences. After a brief discussion of hidden causes, predictions with multiple endpoints, and simple probability, the bulk of the paper focuses on psychological research into judgement and decision-making under uncertainty. Shortcuts in information processing that have been held responsible for apparent weaknesses in everyday statistical intuitions are discussed, as are recent criticisms of this heuristics and biases paradigm. Examples are given of studies demonstrating how perception, judgement and recollection may be biased so as to confirm our preconceptions. Some implications of this research for the study of coincidences are pointed out, and research suggesting promising remedial measures to improve judgement is noted.

The *Little Oxford Dictionary* (1986) defines a coincidence as a 'remarkable concurrence of events without apparent causal connection'. This definition begs 2 questions: what makes some concurrences of events remarkable and not others, and how does one establish an apparent lack of causal connection? By their nature, remarkable coincidences are one-off, unique events that cannot realistically be manufactured and controlled in a laboratory setting. Parapsychologists therefore encounter coincidences after they have occurred, and must use techniques of interview and meticulous description to try to reconstruct a picture of events involved in the coincidence, much as a detective has to piece together evidence suggesting the events in a crime. Because one can never be 100% certain that all possible causal links between concurrent events have been fully investigated and eliminated, the paranormality of individual coincidences will always be a matter of degree of confidence. It is only when many coincidences are collected together and analysed that some common trends or patterns may emerge to suggest possible process-related hypotheses, some of which may be quite normal and others paranormal.

In their article 'Methods for Studying Coincidences', mathematicians Persi Diaconis and Frederick Mosteller (1989) identify 4 factors that, they feel, can account for the vast majority of coincidences. These are: hidden cause, multiple endpoints, the law of truly large numbers, and human psychology. Returning to our dictionary definition, the first factor, obviously, suggests causal connections behind coincidences; the others are related to how we find some concurrences of events more remarkable than others. The term 'human psychology' is extremely broad, however, and overlaps somewhat with the first 3 factors; after all, humans experience coincidences, so by definition human psychology is likely to play a part in all coincidences. One might refine the broad 'psychology' topic into 2 categories which are by no means mutually exclusive in the real world but which represent different schools of psychological research. The first refers to characteristics of our intuitive judgements about probability or likelihood; the second refers to ways in which our perceptions, judgements and recollections are modified so as to confirm our beliefs and expectations.

An earlier version of this paper was presented at an SPR Weekend Course on Psi and Synchronicity, November 1990; some of the other speakers focused on paranormal aspects of coincidences. I would like to thank Charles Honorton, Robert Morris and my referees for their helpful suggestions for improvements.

Unlike Diaconis and Mosteller, I am not confident that all coincidences may be explained away by these factors. Perhaps, though, an understanding of them may help parapsychologists to separate the coincidental wheat from the chaff. In this article I will briefly reiterate Diaconis and Mosteller's arguments on hidden causes, multiple endpoints, and truly large numbers, introducing other related research as we go along. I will then expand considerably upon their brief comments on psychological factors, dealing first with studies of the 'intuitive statistician' and then with ways in which our beliefs affect our perception, judgement and memory. While much of this material may already be familiar to parapsychologists, I hope to provide some service by drawing together many disparate strands of research on human judgement under uncertainty, as well as introducing some of the most recent criticisms of the 'heuristics and biases' literature.

1. Hidden Cause

Marks and Kammann (1980) described 'unseen cause' as 'the second root of coincidence' (their first root is simple probability). A coincidence is not surprising if we discover a simple reason for it. But other surprising coincidences can have perfectly straightforward hidden causes, which we have just not yet discovered. For instance, imagine a case where a woman wakes up from a nightmare in which President Gorbachev is attacked in a coup. She thinks nothing more of it, until she sees from the headlines in the following morning's newspaper that this actually happened. On first inspection this could be a meaningful coincidence, suggesting that in her dream she gained information through precognition or clairvoyance. However, when various members of the family are interviewed, it emerges that she went off early to bed the night before. The rest of the family watched the 10 o'clock news in an adjoining room, and although the woman was asleep, the news could be heard in her room. Even though she did not consciously hear the newsflash announcing the coup, this information may have been subconsciously registered, triggering the nightmare. Thus, further investigation of this coincidence between the contents of a dream and a recent news item revealed a possible hidden cause that made the coincidence less surprising. It's quite likely that a proportion of meaningful coincidences can be explained by a hidden cause. Describing the range of such causes is beyond the scope of the present article, but see Marks and Kammann (1980) and Morris (1986, 1989) for more comprehensive treatments of this topic.

2. Multiple Endpoints

A coincidence can be very impressive if it is very specific. Often, however, a 'close' coincidence is also regarded as impressive, although the chances of a 'close' coincidence happening are far greater than the chances of an exact or specific coincidence.

For example, someone may get the hunch that the phone is about to ring, and it will be Auntie Maude, who hasn't been in touch for years, making the call. As predicted, the phone does ring, only it's Auntie Maude's neighbour. Well, that's still quite an impressive coincidence, but you might also be impressed if it had been Maude's husband Bert on the line, or another auntie, or Maude's daughter...and so on.

The prediction was quite specific, but if the experient allows for 'close' coincidences to count, then the prediction has multiple endpoints. That is, there could be many 'close' coincidences that could also be seen as impressive, although the chances of a 'close' coincidence are so much higher than the chances of Auntie Maude alone being the caller.

What is it that makes a coincidence 'close'? Specific events are members of larger categories (for example, relatives who might telephone); elements in the same category or readily associated with each other (for example, a next-door neighbour of Maude) are seen in degrees of closeness in accordance with the size of the category that is shared (for example, next

door neighbour to Maude is 'closer' than a person who lives in the same town as Maude). Objectively, a close coincidence is more likely and less impressive than an exact coincidence. However, the experiencer of an exact coincidence may be nearly as greatly impressed by a close coincidence, and may even forget how specific the original prediction or hunch was, so that, with hindsight, the experiencer feels 'I knew it would happen' (a well-established phenomenon dubbed 'the hindsight effect' by Fischhoff, 1975).

In the multiple endpoints situation, we begin with a specific prediction and end with several possible outcomes. There exists a corollary to this; the so-called 'selection fallacy' (Falk, 1981-82). Scientists carry out experiments upon a random sample with pre-specified methods and analyses, and if they find the probability of their results to be very low they reject the null hypothesis and see their results as supporting the existence of a process other than chance. When an extraordinary coincidence happens, argues Falk, people often commit the logical error of singling out that one unplanned event and labelling it as significant: 'this is like the archer who first shoots an arrow and then draws the target circle around it' (Falk, 1981-82, p.25). Thus, they start with one unplanned event and proceed, *post hoc*, to regard it as significant. The event has been singled out from a range of possible other events (like categories that are shared or readily associated, as illustrated with the multiple endpoints situation) and the non-occurrence of the other possibile events is overlooked.

3. The Law of Truly Large Numbers

Events that are rare per person occur in quantity when there are large numbers of people. So, although these events are amazing coincidences to the individuals involved, they are utterly predictable if you look at the population as a whole. Of course, the precise array of events surrounding any coincidence is quite unique and can never be predicted; but it is quite predictable that something staggering is happening to someone somewhere at this precise moment. In other words 'with a large enough sample, any outrageous thing is likely to happen' (Diaconis & Mosteller, 1989, p.859).

For example, assume that daily, an incredible coincidence occurs to only one person in a million. This appears quite rare. But the population of Britain is 55 million, so each day there are likely to be 55 amazing coincidences; that makes 20,075 incredible coincidences per year. In a country such as the United States, with a population of 250 million, such incredible coincidences begin to be almost commonplace. Thus, with a large enough number of people you are bound to get amazing coincidences. It's when that statistically predictable coincidence happens to you or to someone you know that it feels spooky and you may attribute meaningfulness to it.

People are not ignorant of the fact that amazing coincidences can occur purely by chance, as only one of many possible events that could have happened. When asked to rate the surprisingness of coincidences that have happened to others, individuals are not very surprised by the accounts. When, however, they compare coincidences that have happened to themselves with those that others have experienced, the self-coincidences are consistently described as more surprising, even though others do not find these coincidences particularly surprising. Further, the more meaningful a self-coincidence is to the person involved, the more surprising it is rated as being (a 'trivial' self-coincidence might involve random numbers that are assigned to us, while a 'meaningful' self-coincidence might involve our personal names or birthdays, Falk, 1989).

This 'egocentric bias' suggests that personal involvement in a coincidence makes it seem subjectively less likely. Although we can appreciate that coincidences happening to others represent only one of a large range of possible events, when coincidences occur to us personally we do not see ourselves as 'part of the statistics'. This is a powerful effect: Falk describes how, when telling academic colleagues of the

increased surprise for self-coincidences, she was often interrupted with 'but you should hear what happened to me....' (Falk, 1989, p.488). Thus, personal involvement is one important consideration in explaining why some concurrences of events are seen as remarkable while others are not.

A similar egocentric bias may explain why, although they may be perfectly aware of the statistics for risk of death in car accidents or for risk of smoking-related disease, individuals consistently underestimate the likelihood that they personally will become victims (Slovic, Fischoff, & Lichtenstein, 1982). Experience perpetuates this myth; the newspapers only report accidents that happen to other people. It is only when someone close to us is involved in an accident or falls ill that we are suddenly reminded that we are not immune to disaster and we are not immortal!

4. Psychology

There are several aspects of human psychology that affect how we judge the likelihood and frequency of coincidences, and that affect our perception and recall of coincidences. Occasionally these psychological factors may contribute to us mistakenly judging a coincidence to be significant or meaningful.

First of all we will consider people as intuitive statisticians. I will describe the findings of research into how we make judgements under uncertainty, including estimations of likelihood or probability, and frequency or base rate information. Secondly I'll describe psychological research into how our perception, judgement and recall can be biased by our beliefs and expectations. Not all of this research has been conducted with coincidences explicitly in mind, but because the experience of coincidences is one form of judgement under uncertainty, readers may see how general psychological research may be relevant to this question.

The Intuitive Statistician

One popular illustration of how we underestimate the likelihood of a concurrence of events is the birthday problem: how many people would you need to gather together before there was a 95% chance that 2 of them would share the same day and month of birthday? The answer is surprisingly (if you are not familiar with this problem) few people; only 48 in fact. For only a 50% chance of 2 individuals' birthdays coinciding, only 23 people need be gathered together. That so few people are needed is usually quite surprising because we typically underestimate the number of different combinations of pairs of birthdays that can occur with a small number of people. We expect that with 365 possible birthdays you'd need a fairly large number of people before there was a coincidence of birthdays.

Diaconis and Mosteller (1989) have developed a simple formula that enables the calculation of the number of people needed to get a coincidence of birthdays or of any other categories: how many people (N) do you need for there to be a 50%/95% likelihood that at least 2 of them will fall in the same category from among a number of categories (c) such as 365 possible birthdates?

Approximately,

$N = 1.2\sqrt{c}$ for 50% chance

$N = 2.5\sqrt{c}$ for 95% chance

Using this formula, Table 1 shows how many people are needed for coincidences between different numbers of categories.

Table 1

Guide to solving the birthday problem, and other coincidences of categories(c)

c	=	100	200	300	365	400	500	600	700
N(50%)	=	12	17	21	23	24	27	29	31
N(95%)	=	25	35	43	48	50	56	61	66

It is interesting to note how slowly N rises as c increases, so that having several hundred more partygoers does not dramatically increase the chances of a coincidence of birthdays.

Diaconis and Mosteller extend this calculation to apply to other, more complex situations, for instance, where there is more than one type of category that could coincide (such as birthdays and year of birth), and where 'close coincidences' are accepted (the multiple endpoints situation described earlier). The formula to estimate the number of people needed for a coincidence within k days in the latter, 'almost birthdays' situation (with a 50-50 chance of a coincidence) is:

$$N = 1.2\sqrt{\frac{c}{(2k+1)}}$$

With c(categories) = 365 and k = 1 day, only around 13 people are needed for a match.

These formulae may be helpful in estimating the likelihood of coincidences where the number of possible categories is known or can be discovered after some research. There remains, however, a large number of events whose frequency is difficult to measure objectively or even to estimate, and which therefore cannot be examined using such formulae. For these, as well as for coincidences that are quantifiable, people may fall back on rough 'rules of thumb'; the so-called cognitive heuristics.

Over the last 20 years cognitive psychologists, led by Amos Tversky and Daniel Kahneman, have developed the idea that people use a number of rules of thumb or cognitive shortcuts in their everyday processing of information. Usually these strategies, called cognitive heuristics, are perfectly adequate to get us through daily life efficiently. When it comes to assessing the statistical likelihood of events such as coincidences, however, it has been argued that the use of these heuristics can introduce a source of bias into our estimations. Hence, this area of research has come to be known as the 'heuristics and biases' school (e.g., Kahneman, Slovic, & Tversky, 1982; Nisbett & Ross, 1980).

As I said in the introduction, there has recently been a backlash against the heuristics and biases movement. Before I describe the reasons for this in more detail, however, I will briefly introduce 2 major heuristics (judgement by representativeness and judgement by availability) whose use may introduce some bias into people's base rate and probability estimates.

Judgement by Representativeness has been proposed to explain an apparent lack of understanding of the 'law of large numbers' (the larger the random sample, the greater its accuracy in estimating the characteristics of the parent population from which it is drawn). It is argued (e.g., Tversky & Kahneman, 1974) that people judge the likelihood of an event according to the sample's similarity to, or representativeness of, the parent population on certain essential features such as means and proportions. Sample size, which should give some indication of the degree to which one could confidently predict characteristics of the parent population, was frequently neglected by subjects in early studies by Kahneman and Tversky.

For instance, subjects were posed this question:

> 'A certain town is served by two hospitals. In the larger hospital about 45 babies are born each day, and in the smaller hospital about 15 babies are born each day. As you know, about 50% of all babies are boys. The exact percentage of baby boys, however, varies from day to day. Sometimes it may be higher than 50%, sometimes lower. For a period of 1 year, each hospital recorded the days on which more than 60% of the babies born were boys. Which hospital do you think recorded more such days?' (Kahneman & Tversky, 1972, p.443).

Subjects' opinions were equally divided between the two hospitals, despite the fact that by the law of large numbers the smaller hospital would be expected to show more deviations from the average

50% figure. Later, however, it was demonstrated that subjects could take account of sample size if the wording of questions was simplified (e.g., Bar-Hillel, 1979); indeed, if sample size was the only information provided, then correct responding could approach 100% (Evans, 1989).

Nevertheless, in the real world, people are faced with lots of possibly irrelevant information, which may distract attention from features such as sample size that should be taken into consideration when making judgements under uncertainty. So in the case of coincidences, if people tend not to take sample size sufficiently into account when judging likelihood, they may not appreciate that an extreme outcome is more likely to occur in a small sample, and may therefore mistakenly attribute significant rarity to a coincidence occurring under these conditions.

The representativeness heuristic has also been proposed to explain the so-called 'conjunction fallacy' (Tversky & Kahneman, 1983). Here, subjects judge the conjunction of 2 events as more probable than one of its components because, it is argued, they judge according to the similarity between the paired events and an original descriptive statement; this is despite the basic tenet of probability theory that a conjunction cannot be more probable than one of its consituents. For example, subjects were given the following description (Tversky & Kahneman, 1983, p.297):

> 'Linda is 31 years old, single, outspoken and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations.'

Subjects were asked to indicate which of 2 alternatives was more probable: 'Linda is a bank teller'; or, 'Linda is a bank teller and is active in the feminist movement'. 85% of the respondents indicated that the latter statement was more probably correct, a finding which Kahneman and Tversky interpret as a blatant violation of the conjunction rule.

Judgement by Availability is the second cognitive heuristic that may influence our judgements about coincidences. When we use availability we estimate frequency in terms of how easy it is to think of examples of something (Tversky & Kahneman, 1974). Like representativeness, judgement by availability is usually a good rule of thumb, but it can lead to biased decisions because availability is influenced not only by objective frequency but also by recency, familiarity and vividness. For example, when we estimate how often earthquakes occur in a 10 year period we are too heavily influenced by whether an earthquake has occurred recently.

The apparent neglect of base rate or frequency information in making probability judgements (the 'base rate fallacy') has been widely attributed to the operation of the availability heuristic (e.g., Borgida & Brekke, 1981). Here, it is argued, base rate information is often less vivid, more abstract, less noticeable than other kinds of information and so it tends to get overlooked. In the earthquake example, the base rate or frequency information refers to data about how many earthquakes have occurred in the last 10 years. Typically, this statistical information is overlooked in favour of the vivid memory of a recent earthquake, leading to an exaggerated estimation of the frequency of earthquakes. Studies that have increased the availability of base rate information (for instance by conveying it graphically rather than in tabular form) have shown that it can be taken into account by subjects.

Another consequence of the availability heuristic is that we pay less attention than we should to negative information - to non-occurrences or non-coincidences - because they are less noticeable. Logically, the failure of something to happen can be just as informative for our decision-making as a positive occurrence. Yet, because non-events are less salient or less memorable, their usefulness for judging the frequency of, say, coincidences, is neglected. Take, for example, a person who believes that she can make people telephone her simply by wishing for it to happen. When she

succeeds, and there is actually a close coincidence between the time of her act of willing and the phone ringing, this is especially memorable. Failures of the phone to ring will tend to be less noticeable. Looking back on her efforts, the lady will tend to have a higher opinion of her skills than objectively she should. This is because the successful coincidences of willing and the phone ringing will be more available than the non-coincidences, and so she is likely to overestimate the frequency of her successes. Confidence in her psychic ability may be further enhanced if she accepts close coincidences - such as phone calls coming up to 30 minutes after she willed them - as satisfactory evidence of her abilities. This is another example of multiple endpoints.

In Edinburgh we often get people calling in who think they are having psychic experiences, such as precognitive dreams. People may be wanting us to confirm their abilities, or to get rid of them. As a first step we need to get a good description of what is going on, so we may ask people to keep a diary, noting every possibly precognitive dream and whether or not it 'came true'. Doing this, people often find that they have been overestimating the frequency of their success rate, presumably because successes are so memorable. Recording actual performance can circumvent the availability heuristic to some extent, and make the non-coincidences less easy to ignore.

The heuristics and biases studies have focused on individual cognitions in relatively simple and sterile situations; subjects are often posed problems in paper and pencil form, for example. Experiments in social psychology, however, which have used more realistic or ecologically valid methodologies, have also demonstrated that availability plays an important role in our perceptions of causality. When something is available, it is more vivid, salient, noticeable, or memorable. Simple experimental manipulations of our focus of attention can dramatically influence our perceptions and causal attributions (for a review, see Taylor & Fiske, 1978), such that causality is attributed to salient stimuli.

In summary, judgement by availability may lead us to overestimate the frequency of coincidences that we expect to occur (such as predicting phone calls), and to neglect actual base rate information that conflicts with our expectations or that has low salience (for example, overlooking failed predictions).

Heuristics and Biases Re-Evaluated

Since the original influential experiments by Kahneman and Tversky which provoked a veritable flood of research, some psychologists and statisticians have begun to question the assumptions behind these studies. Criticisms have centred on: the language used to describe the effects of heuristic use; the statistical models underlying many of the studies asking subjects to make probability judgements; the methodology used to demonstrate heuristic use; and the usefulness of the cognitive heuristics in understanding judgement under uncertainty. I will cover each of these in turn, before summarising their impact on the question of coincidences.

1. Value-Laden Language. In her article 'The Rhetoric of Irrationality', Lola Lopes (1991) points out that the original heuristics and biases papers by Kahneman and Tversky focused on the *process* of judgement under uncertainty, whereas the summary article that appeared in *Science* (Tversky & Kahneman, 1974), and which therefore reached a wide audience, shifted emphasis from heuristic processing to *biased* processing. Strong evaluative language is used in this second article (e.g., 'severe errors of judgment', p.1130) and in follow-up research by other authors (e.g., 'Probability judgements are notoriously inaccurate', Blackmore & Troscianko, 1985, p.459). This language conveys a clearly critical and negative message about subjects' cognitive abilities. This might not be controversial in itself, were it not for the fact that the original experiments by Kahneman and Tversky were logically set up to identify processes rather than to

evaluate performance. Yet it is the 'inadequate intuitive statistician' message that caught the imagination and tinged the research approaches of subsequent investigators.

Lopes argues persuasively that evaluative language does not belong in scientific articles; these should be concerned with description and interpretation rather than value judgements. The 'rhetoric of irrationality' may serve to titillate authors and readers, who can feel themselves superior because (with hindsight) they can solve the probability problems; the strong language also gives the impression (misleading, as we shall see) that there is an obvious correct answer to such problems.

2. *Statistical Models.* Often the authors of papers on heuristics and biases use phrases such as 'subjects' inability to appreciate the laws of probability' or their 'lack of intuitive understanding of the normative theory of prediction'. Whereas anyone reading a standard textbook on statistics could be forgiven for concluding that there is some sort of 'normative probability theory' that provides correct answers to problems posed in some heuristics and biases experiments, those in the know - that is, statisticians - have pointed out that there *is* no normative probability theory; and, worse still, that the statistical assumptions behind the probability problems come from a school of reasoning that is held by only a minority of statisticians.

The most authoritative critic of the model of probability used in most heuristics and biases literature is Gerd Gigerenzer (e.g., 1991a, 1991b; see Gigerenzer et al., 1989, for a description of the historical development of the different statistical schools of thought; and see Gigerenzer & Murray, 1987, for a detailed consideration of these as they have been applied to the study of judgement under uncertainty). In a paper entitled 'How to make cognitive illusions disappear: Beyond heuristics and biases', Gigerenzer (1991a) makes a strong critique of the heuristics and biases school:

> What is called in the heuristics and biases literature the 'normative theory of probability' or the like is in fact a very narrow kind of neo-Bayesian view that is shared by some theoretical economists and cognitive psychologists, and to a lesser degree by practitioners in business, law, and artificial intelligence. It is *not* shared by proponents of the frequentist view of probability that dominates today's statistics departments, nor by proponents of many other views; it is not even shared by all Bayesians....By this narrow standard of 'correct' probabilistic reasoning, the most distinguished probabilists and statisticians of our century....would be guilty of 'biases' in probabilistic reasoning. (pp.86-87)

Gigerenzer proceeds to demonstrate how 'overconfidence bias' (where subjects answering a series of questions show a discrepancy between their perceived success and their actual performance of a task; overview by Lichtenstein, Fischhoff, & Phillips, 1982), the 'conjunction fallacy' and the 'base rate fallacy' can be made to 'disappear' if questions are re-phrased to take account of alternative statistical models and meanings of probability.

Let us return to the 'Linda is a bank teller and is active in the feminist movement' example used to illustrate the conjunction fallacy. Gigerenzer points out that to choose this description of Linda as more likely is a violation of *some* subjective theories of probability, including Bayesian theory, but it is not contrary to the dominant frequentist school of probability, because in this latter model, single specific events cannot be considered in terms of probability; probability theory is about frequencies, not single events. If the Linda problem is rephrased in frequentist terms 'There are 100 persons who fit the description above (i.e., Linda's). How many of them are: (a) bank tellers (b) bank tellers and active in the feminist movement' then the 'conjunction fallacy' largely disappears, with only 22% of subjects choosing option (b) as most likely (Fiedler, 1988).

Some of the 'errors' identified by Kahneman and Tversky and their followers may therefore be due to the researchers' adoption of an inappropriate statistical model rather than to weaknesses in their subjects' reasoning abilities. Further, away from the relatively controlled and clean world of the laboratory, the confusions and complexities of the real world may make the application of any statistical models controversial and rather difficult.

3. *Experimental methodology.* Earlier, when discussing the 'law of large numbers', I cited a study that demonstrated that people are more able to take account of this law if the question is phrased more simply, and if other distracting information is removed. In a similar vein, many of Kahneman and Tversky's original positions have been refined, following demonstrations that variations in experimental methodology cause variations in the appparent influence of cognitive heuristics upon problem solving and judgement under uncertainty. We have already seen how the 'conjunction fallacy' can be made to disappear by rephrasing the question.

Steven Sherman and Eric Corty (1984), for instance, review a number of studies that suggest that the extent to which heuristics are used to solve a problem may depend on the way in which the problem is presented or structured. If there is plenty of time, if the task is not too complex and is clearly presented, if base rate information is made concrete, salient and specific to an individual case, then individuals may reach the normatively correct solution (where there is one). For example, typical biases in judging random sequences can be eliminated simply by instructing subjects that random events may be present or by providing them with a comparison level of nonrandomness (Peterson, 1977).

Related to the question of experimental methodology is another telling criticism of the heuristics and biases paradigm: its lack of ecological validity. There is a considerable gulf between the sorts of paper and pencil probability problems posed to unsuspecting subjects in typical heuristics and biases experiments, and the everyday situations where judgements about probability are made (e.g., when placing a bet; when judging what caused a picture to fall off a wall; when reading about or experiencing coincidences). When such artificial situations are used in conjunction with possibly inappropriate models of probability, any conclusions that may be drawn about the use of cognitive heuristics in more complex situations become severely limited. There is a need for the heuristics and biases researchers to adopt more realistic methodologies; for instance, role-playing, simulations of complex situations, and observational studies of individuals' statistical judgements in their natural environment. As we shall see in the next section, studies of the biasing effects of beliefs and expectations on perception, judgement and memory have successfully used more realistic settings, and have produced findings that have practical applications.

4. *Theoretical usefulness of heuristics.* Sherman and Corty (1984) also note that Kahneman and Tversky's heuristics are rather vague and are often identified *post hoc*. They are insufficiently precisely defined to enable prediction of which particular heuristic will be applied in which specific situation. Gigerenzer (1991a) echoes these criticisms thus: 'All three heuristics...are largely undefined concepts and can *post hoc* be used to explain almost everything. After all, what is similar to what (representativeness), what comes into your mind (availability), and what comes first (anchoring) have long been known to be important principles of the mind' (p.102). Heuristics, he argues, are hardly more than re-descriptions of the phenomena seen in judgement under uncertainty.

Conclusions

Do these criticisms of the heuristics and biases literature negate its applicability to the question of what makes coincidences seem remarkable? Certainly, they seriously weaken those aspects of the literature that deal with probability judgements and pre-

diction where some sort of normative theory of probability has been (questionably) assumed. Further, it is difficult to generalise from the typically artificial methods used, to more complex settings. But although 'overconfidence bias' as typified in the heuristics and biases literature may 'disappear' if an alternative statistical model is adopted, in more realistic situations such as in studies of eyewitness testimony, overconfidence nevertheless remains a problem. Wells and Murray (1984), for instance, reviewed studies of eyewitnesses' confidence in their memory reports and concluded that 'the eyewitness accuracy-confidence relationship is weak under good laboratory conditions and functionally useless in forensically representative settings' (p.165).

Gigerenzer's criticisms have, however, been constructive: he suggests that the study of judgement under uncertainty may explicitly utilise various statistical models to get a clearer idea of which model most closely approximates subjects' intuitive reasoning (one might also have to consider the possibility of individual differences in model selection). Also, many statistical principles, such as the law of large numbers, are uncontroversial, and in this section I have tried to focus on aspects of judgement under uncertainty that are not so vulnerable to criticism of underlying statistical assumptions. The research on the effects of salience or availability on focus of attention and causal attributions, for example, reinforces the apparent importance of availability for judgements under uncertainty (e.g., Taylor & Fiske, 1978, Dow (Watt), 1988). Lopes' comments on evaluative language are well-taken, and are a useful reminder to all concerned with heuristics and biases that they should look out for 'creeping value judgements' in their writings.

We have seen that the degree to which heuristics are used depends greatly on the presentation of problems in the experimental situation, and that careful simplification and manipulation of information can modify or overcome heuristic use. There is no doubt, however, that in the real world, judgements have to be made under much greater uncertainty, with a profusion of distracting information and incomplete data. I believe that it is in these conditions that we are most likely to simplify by resorting to rules of thumb. If relevant information, such as base rates, is readily available and noticeable, then we have seen that it can be applied quite appropriately by individuals. On occasions when all relevant information is not at hand, heuristics may be used. Evans (1989) makes the useful distinction between competence and performance in statistical reasoning. People can be seen in some circumstances competently to apply statistical principles in judgement under uncertainty. What we need to understand is why this competence is not applied under a different set of circumstances.

The final criticism of the cognitive heuristics, that they are vague and *post hoc*, is, to me, the most telling. At the moment cognitive heuristics are largely descriptive (or heuristic!) devices to help psychologists organise their thoughts about other people's thought processes. Description is a necessary stage in the development of theoretical ideas, but the heuristics literature has yet to progress beyond this descriptive phase. We need a theory or theories of judgements under uncertainty to be developed to a stage where they offer 3 things: falsifiable predictions; an explanation of why humans judge the way they do; and predictions of the circumstances under which the various judgemental biases might be expected to operate. Describing theories of human reasoning as 'fragmented', Evans (1991) states, 'while theorists interested in bias emphasize...the role of non-reasoning processes, those interested in competence emphasize ...reasoning processes" (p.97). There is a lack of integration between the various approaches to the study of human reasoning, and Evans makes some constructive recommendations for overcoming this problem. I would agree with Sherman and Corty (1984), however, that cognitive heuristics can potentially identify the processes underlying decision-making, and can

potentially suggest how to solve decision-making problems and improve judgement. For these reasons, they may be useful in evaluating coincidences.

4.2 The Influence of Beliefs and Expectations on Perception, Judgement and Recall

Apart from characteristics of our statistical intuitions that may cause some coincidences to seem remarkable, the sense of meaningfulness of coincidences may be enhanced by other aspects of our information processing. In short, how we perceive, interpret and remember events is, to a large extent, determined by our *a priori* beliefs, expectations and theories (or schemata) about how the world works. Information that is consistent with our expectations is readily assimilated to strengthen our beliefs; on the other hand, information that does not fit with our expectations may be distorted to make it fit, selectively ignored, or forgotten, so that our prior expectations or interpretations of an event or a coincidence are not challenged.

How Beliefs Can Influence Perception and Judgement

Not only do people tend to overlook non-occurrences or their failures to get the coincidences they predicted; they also tend to see relationships where there are none. This is called the "illusory correlation" effect, and usually refers to cases where people associate 2 factors, though statistically no relationship exists. Our theories and stereotypes often lead to our perceiving illusory correlations.

The classic studies showing illusory correlation (Chapman & Chapman, 1967, 1969) were concerned with the question of why clinical psychologists persisted in reporting correlations between patients' responses on a projective psychological test, and aspects of the patients' motivations and emotions. Detailed studies of this Draw-A-Person (DAP) test suggested that responses on the test were totally unrelated to clinical symptoms. Yet clinical psychologists found that paranoid or suspicious patients exaggerated the eyes in their drawings, whereas dependent patients, who like to be fed and cared for, exaggerated the mouth. The Chapmans asked patients in a State hospital to take the DAP test. These drawings were then paired *completely at random* with 6 symptoms, such as suspiciousness and dependence. The Chapmans asked untrained college students to examine the drawings and the symptoms with which they had randomly been paired. Later, the students were asked which features of the drawings had most often been paired with each symptom. The students reported the same kinds of association between symptoms and drawings that the clinicians had, even though it had been arranged that there was no systematic relationship for the students (incidentally, these experiments do not suggest that the DAP test is of no clinical use; it may be helpful to clinicians when taken in the context of a wider clinical investigation).

Sometimes it is valid and efficient for our expectations to influence our interpretation of information; for instance, our knowledge of language may enable us to understand what is being said over a noisy telephone line. At other times, our preconceptions can be misleading; for example, where wishful thinking or preoccupation with a particular idea may lead to a misinterpretation of the caller's words. With regard to the study of coincidences, the challenge is to identify when information may have been distorted or misinterpreted. Though there is no easy answer to this problem, some pointers are given by psychological research.

Nisbett and Ross (1980) identified some factors that increase the likelihood of erroneous bias based on *a priori* beliefs or theories:

1. Confidence in the theory. If this confidence is based on emotional commitment to the theory rather than on a solid factual foundation then it is more likely that we will selectively process information so as to strengthen our beliefs.

2. *Availability of the theory.* The likelihood that a theory will influence how we interpret information depends on its availability; its likelihood of being triggered by the data at hand. If you have recently attended a course in Freudian psychoanalysis, this theory might be very available for you and be readily used to interpret the actions and dreams of people around you. A common example of the possible operation of availability in coincidences is where you learn a new word, then suddenly notice it repeatedly cropping up. It is unlikely that you have never before encountered the word; rather, your attention has been drawn to it, and it has become salient or available for you to notice when it occurs again.

3. *Ambiguity of the information.* Evidently, if information is clear and unambiguous then it may be more difficult (though not impossible) for us to put our own interpretation on that information based on our preconceptions. If, on the other hand, the information is experienced in an ambiguous way - say, in poor light, in confusing circumstances - then it is much easier for us to interpret it so as to fit our expectations. Fading of memory and the operation of our cognitive heuristics can render initially clear information ambiguous. This is why it is so important to take note of, for instance, each prediction that we make, plus whether or not it is fulfilled; and to write down details of a coincidence as soon as possible. The note-taking makes the information less ambiguous than our unassisted memory would.

How Information Often Doesn't Influence Our Beliefs

Psychological research suggests that once we have made up our minds about something we are very resistant to revising our theories. Here, I'll give examples of 3 areas of research into the effects of information on beliefs: firstly, what happens when established beliefs are faced with new information; secondly, the effect of new information on new beliefs; and thirdly, the effect of false information on beliefs.

1. *New Information and Established Beliefs.* Lord, Ross, and Lepper (1979) took 2 groups of university students: one group strongly believed that capital punishment was a deterrent to potential murderers; the other strongly believed it was worthless as a deterrent. Each subject read about the results of 2 supposedly authentic studies on the deterrent effects of capital punishment. One of the studies concluded that capital punishment was an effective deterrent. The other concluded the opposite. Subjects were asked a number of questions after they had read both studies.

There were 3 main findings from this experiment: 1. Whichever study supported a subject's own initial position was found to be significantly 'more convincing' and 'better conducted' than the study opposing their position; 2. When subjects were asked about their beliefs after reading about only one study, which could be in agreement with or in contradiction to their own views, belief in the subject's original position was strengthened if they had just read a supportive study, but belief in the original position was hardly affected at all by reading an opposing study; and, 3. After reading about *both* studies, the subjects were more convinced about the correctness of their initial position than they were before reading about *any* evidence.

In summary, different standards are used for criticizing opposing evidence to those used for criticizing supportive evidence. Mixed evidence, giving equal support to 2 opposing views, does not reduce confidence for holders of either view but instead reinforces confidence for holders of each view.

Perhaps these results were obtained because the subjects were impressionable young students. But even in the supposedly rigorous and objective world of reviewing articles for scientific journals, prior beliefs have a strong influence on evaluations. In a controversial 'real-life' experiment, Douglas Peters and Stephen Ceci (1982) resubmitted 12 already-published research

articles by authors from prestigious American psychology departments to the 12 widely-read and respected American psychology journals in which they had been originally published only 18 to 32 months earlier. The re-submitted articles were virtually identical to the originals, except that the author's name and institution were changed to fictitious ones (e.g., Dr. Wade M. Johnston at the Tri-Valley Center for Human Potential). Only 3 of the resubmissions were recognised as such. Of the remaining 9 articles, 8 were rejected on grounds such as 'serious methodological flaws'. Peters and Ceci suggest that the journal editors and reviewers may have been biased by the original authors' status and institutional affiliation. Findings such as these argue in favour of blind refereeing of academic articles.

Research along these lines provides a useful reminder that our experiences and interpretations of coincidences can be dramatically affected by our prior expectations, and that adopting an 'impartial' scientific cloak may be ineffective.

2. *New Information and New Beliefs.* Moving on now, we consider the effects of new information on new theories; specifically, the effects of the sequential processing of evidence. Usually we do not get all the information for or against a theory, or, in the context of this paper, an explanation of a coincidence, at once; some comes earlier and some comes later. People tend to base their explanations on the earliest evidence; on their first impressions. This is known as the primacy effect. Logically, when evaluating the evidence for or against a theory, all evidence is important, not just the first evidence that is encountered.

For example, in Jones et al. (1968), subjects were asked to observe another person trying to solve 30 multiple choice problems. The problems were described as being of equal difficulty. The person doing the problems always solved the same number; 15. In one condition - the descending condition - he solved a greater proportion of problems early in the series, and fewer later in the series. In the other condition - the ascending condition - he did the reverse, solving few problems to begin with, but solving more later on in the series. Subjects were asked to predict how the target person would perform with a second set of problems, to rate his intelligence, and to try to recall how many problems he had solved in the first set of problems. It was found that early performance received undue weight. The target person who solved relatively more problems early on was seen as being more likely to perform well on a second set of problems; judged as being more intelligent; and remembered as having solved more problems than the other target person.

Studies like this highlight the importance of attempting to gather all relevant information when evaluating coincidences, before forming interpretations. Of course this is difficult, especially in complex situations, but simple procedures such as using the 'birthday problem' formula to estimate the likelihood of a coincidence, may assist in a balanced evaluation of coincidences.

3. *False Information and Beliefs.* The third way in which our initial theories or beliefs fail to be influenced by objectively relevant information is when our theories persevere not in the face of new information, but rather in spite of the discrediting of the information that originally led to the formation of our beliefs or theories.

For example, Anderson (1983) presented subjects with either 2 case histories (vivid, concrete data) or a statistical summary (abstract data). The data suggested either that firefighter trainees who enjoyed risk performed well in their later careers, or that they did not perform well as firefighters. Subjects were then told that the data were fictitious. Later, it was found that they still clung to whatever initial theory they had been led to hold, and the strength of the perseverance of belief was greatest for those subjects who had seen the concrete data (this suggests the operation of salience or availability biases). This is paradoxical, because small numbers of case studies are likely to be less accurate indicators of general population characteristics than sta-

tistical summaries of a wider survey. Anderson concluded that this effect was not due to memory but to the spontaneous generation of causal explanations that seemed to be facilitated by the case histories. In the case of coincidences, of course, the data are also usually concrete; in the form of personal experiences or anecdotes that are told by others.

To sum up this section: we have seen the interplay of human psychology, beliefs, and data. We tend to cling unduly to our own beliefs or theories, even in the face of contradictory evidence, and we apply a double standard to evidence relevant to our beliefs. We have probably all seen this happening in our everyday life; but we may neglect to consider these facts when we ourselves are involved. We can easily see the weak points in other people's beliefs, while being absolutely certain of the truth of our own. This may be one reason why we are less impressed when coincidences happen to other people than when we are closely involved in them ourselves (Falk, 1989).

How Recall Can Change Due to Beliefs and Expectations

Memory is a construction, based partly on our perceptions and partly on our interpretations, and memories tend to fade and alter over time. It appears that when we recollect something we actively reconstruct our memories so as to fit with our theories and expectations. When we recall coincidences that we have heard of or have been involved in in the past, our memory may blur some details and strengthen others so as to make the coincidence seem more impressive than it was to begin with, a process which may be quite unconscious.

In 1971, Bransford and Franks developed their Constructive Model of Memory. Subjects were presented with sets of simple sentences, some of which they had seen a few minutes before and others which were new sentences, including combinations of the earlier sentences. When they were asked to identify those sentences they had seen before, many subjects were convinced they had seen the new combination sentences before. Bransford and Franks proposed that individuals integrate information from individual sentences so as to construct larger ideas; they think they have already seen these complex sentences because they have been combined in memory and, once combined, they cannot break them down into their original components.

This constructive model of memory is not necessarily limited to recall for sets of sentences. People instinctively try to make sense out of any situation - sets of noises, events happening around them, snippets of conversation - and their memories of these events may contain not only just the original events but also the interpretation put on them by the individual.

One example of the study of recollection change in more realistic situations, which are perhaps more relevant to the evaluation of coincidences, is work in the area of eyewitness testimony (e.g., Wells & Loftus, 1984). In a typical experiment, Loftus and Loftus (1975) showed subjects a film of a traffic accident. Soon after that, subjects were asked questions about their memory of the accident. One of these questions, about the speed of the cars, was asked in 2 different ways. Subjects were either asked, 'How fast were the cars going when they smashed into each other?' or they were asked 'How fast were the cars going when they hit each other?' Apparently, subjects used the different inferences suggested by the words 'smashed' or 'hit' to alter their memory of the accident. 'Smashed' implies a more destructive collision than 'hit'. A week later, subjects were given a memory test, where they were asked 'Did you see any broken glass?' Although there was no broken glass in the original film, those subjects who had been asked the 'smashed' question were more likely to say mistakenly that they remembered seeing broken glass.

The sentence-recall experiment showed how information could be misremembered only a short time after its presentation. Generally, the more time that passes after the original incident, the more chance there

is that recollections will change. You can imagine how recall might change over months or years after an original event. This suggests that sometimes a coincidence that was only moderately impressive to begin with can, over time, be recalled differently, as really very striking.

These experiments into sentence recall and eyewitness testimony demonstrated *mis*remembering. Other studies have demonstrated *selective* remembering. Hintzman, Asher, and Stern (1978) explored their hypothesis that coincidences seem to occur more often than chance because of selective remembering of meaningfully related events, by asking subjects to rate a series of concrete nouns and, at another time, a series of pictures of objects, in a task ostensibly unrelated to memory. Some of the nouns and pictures were related to each other, but the rest were unrelated (the authors do not say by what criteria the judgements of relatedness were made). Later, participants were unexpectedly asked to recall as many words from the list of nouns as possible. This was therefore an incidental learning task, and the authors regarded the related nouns and pictures as coincidences. They found that significantly more 'related' words were recalled than 'unrelated' words, suggesting that there was selective remembering of the meaningfully-related words. An experiment of similar design but using events rather than nouns (the former being components of coincidences in the real world) replicated this selective memory retrieval effect (Kallai, 1985, cited in Falk, 1989).

In a review of the literature into 'Alterations in recollections of unusual and unexpected events', Hall, McFeaters, and Loftus (1987) described how new information could be absorbed and interpreted as an original memory. A coincidence, of course, is an unusual and unexpected event. New information might be embedded in a misleading message, or in a biasing question, or in a sketch or photograph. Private remembering of the event, discussion with friends or family, or even questioning by a careless investigator can be a source of misleading opinions and information. The experiment on eyewitness testimony described above showed how careless questioning can bias recollection.

Hall, McFeaters, and Loftus identified 4 major factors (time delay, warnings, question phrasing, and attitude) which affected the change in recollections for unusual or unexpected events. These 4 factors have been fairly well demonstrated in experiments.

The first is the *time delay* between an event, a subsequent misleading message, and a final test of recollection. It seems that changes in recollection are greatest if there is a relatively long time delay before the misinformation is given; presumably so that the original memory can fade. Then, the change in recollection is greatest if people are tested about their recall of the original information while the post-event misinformation is still relatively recent.

Secondly, it has been shown that if people are *warned* just before they are to be exposed to misinformation that the message may contain misleading information, then they are less likely to be influenced to change their original recollections. This effect is quite specific, though. If the warning is not given immediately before the post-event misinformation, then it's not usually effective.

Thirdly, it seems that the way in which a misleading question is *phrased* affects the likelihood of recollection change. After a surprise intruder interrupted their lecture, subjects who were asked, 'Was the moustache worn by the tall intruder light or dark brown?' were less likely to (mistakenly) recall that the intruder had a moustache than those who were asked' "Did the intruder who was tall and had a moustache say anything to the professor?' (Loftus, 1981). The latter question included the misinformation in an auxiliary clause, suggesting that memory is more easily altered if misinformation is casually or unintentionally absorbed, rather than being given direct and critical attention. Also, misinformation that is slowly scrutinized may be rejected, whereas if you give brief and minimal attention to the misinformation, it

may be added easily to the original recollections.

I described earlier how *attitude* can affect how we perceive or remember information. This has also been demonstrated in the experiments into eyewitness testimony. Information that is consistent with attitudes is strengthened in the process of recollection, whereas information that doesn't fit fades, or is replaced. In a classic experiment, subjects were shown a picture of 2 men in an underground train. One of the men was white, the other black. The white man held an open cut-throat razor in his hand. Subjects were asked to describe the picture to others, who in turn described it to others, and so on. It was found that, over time, the razor moved from the white man's hand to the black man's hand (Allport & Postman, 1947).

Summary and Future Directions

Some of the research described in this paper may not be new to parapsychologists, but by drawing together a variety of psychological studies relevant to the evaluation and experience of coincidences, I hope some readers may be stimulated further to consider the implications of this psychological research for the study of coincidences. I am only too aware of the limitations of this paper, which can be subjected to the same sorts of criticisms as have been levelled against the heuristics and biases approach: I have merely cobbled together a number of descriptions of relevant research findings without providing any useful explanatory framework. The various psychological factors I have described may be applied *post hoc* to account for many coincidences. What would be even more useful would be some theory or theories enabling the prediction of the circumstances under which these factors would be expected to operate. This will probably have to await further developments in mainstream psychology, though Hogarth (1981), Gigerenzer (1991a) and Evans (1991) make some constructive suggestions for how researchers could progress beyond the stage of cataloguing heuristics and biases.

A consideration of techniques for overcoming the many biases in our judgements under uncertainty would also have been helpful, but would have made the paper unacceptably long. The interested reader is referred to Kahneman and Tversky (1982), Fischhoff (1982), Nisbett et al. (1982), Evans (1989), and Lopes (1987) for further information on debiasing. Research has also been conducted into ways of improving recollection of real-world events; for example, police have an obvious interest in eyewitness recall, and Roy (1991) describes how the 'cognitive interview' has been shown to improve eyewitness recall. Four questioning strategies are used, which aim to enhance memory retrieval: the witness is encouraged to reinstate mentally the external scene and the internal thoughts that existed at the time of the crime; he or she is asked to report everything, even incomplete or apparently trivial information; events are recounted in a variety of orders; and the witness is encouraged to report events from a variety of different perspectives. The cognitive interview has been shown to facilitate retrieval of more correct information than either the standard police technique or hypnotic techniques.

In the meantime, this paper can only provide a few guidelines for coincidence research: where possible, try to get an estimation of the likelihood of a coincidence (the formulae given when discussing the birthday problem may be helpful here); search for hidden causes; guard against predictions with multiple endpoints, by documenting predictions when they are made and noting failures to confirm predictions; ask whether the interpretation of a coincidence might have been influenced by the use of representativeness and availability heuristics, especially where judgements of likelihood and causality are concerned; have several people (ideally with differing prior beliefs about coincidences) document thoroughly coincidences, to try to some extent to circumvent belief-confirming distortions in perception, judgement and memory; beware of mis-

leading a witness with carelessly phrased questions, and explore techniques (such as the 'cognitive interview') that have been successfully put to practical use by investigators in other fields.

Lest readers think that I'm being too negative about coincidences, I should stress that an understanding of the sorts of factors that can cause us to come to the wrong conclusion about coincidences, and about psi in general, works both ways. This is especially true for situations where belief plays an important role in our judgements and recall of what happened. So, just as someone who really has a strong belief that he or she is a psychic may interpret and recall events so as to back up that belief, similarly someone who's a strong goat - who strongly believes that he or she has absolutely no psychic talent whatsoever - may also interpret and recall events so as to fit with his or her belief. In that case, although something paranormal may be going on, it doesn't get acknowledged as such. Either way, an understanding of human perception, judgement and recall under uncertainty may help us, both to weed out coincidences in which no psi was involved, and to retain those which are of more direct interest to the psychical researcher.

Also, many of the points made in this paper are most relevant for the evaluation of everyday experiences of coincidences. I have not dealt with possible techniques for the deliberate quantitative assessment of coincidences, but would refer the reader to an intriguing paper by William Braud (1983) suggesting a possible methodology for such an assessment.

Looking back to my introductory paragraph, which asked what makes some concurrences of events remarkable and not others, it seems clear that beliefs, expectations and personal involvement play a large role in our amazement at coincidences. You should hear what happened to *me* the other day...

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Department of Psychology
University of Edinburgh
7 George Square
Edinburgh EH8 9JZ
SCOTLAND, UK

Psychologie et coïncidences

Résumé: Cet article présente une revue sélective de la recherche suggérant des causes normales possibles à certaines coïncidences. Après une brève discussion des causes cachées, des prédictions à issues multiples, et de simple probabilité, l'ensemble de l'article se centre sur la recherche psychologique sur le jugement et la prise de décision en situation d'incertitude. On examine les raccourcis utilisés dans le traitement d'information jugés responsables des faiblesses apparentes de nos intuitions statistiques quotidiennes, ainsi que les critiques de ce paradigme d'heuristiques et biais. On donne des exemples d'études montrant comment la perception, le jugement et le rappel peuvent être biaisés afin de confirmer nos préjugés. Certaines implications de cette recherche pour l'étude des coïncidences sont soulignées, ainsi que la recherche suggérant des mesures afin d'améliorer le jugement de façon prometteuse.