The Birthday: Lifeline or Deadline?

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This study of deaths from natural causes examined adult mortality around the birthday for two samples, totalling 2,745,149 people. Women are more likely to die in the week following their birthdays than in any other week of the year. In addition, the frequency of female deaths dips below normal just before the birthday. The results do not seem to be due to seasonal fluctuations, misreporting on the death certificate, deferment of life-threatening surgery, or behavioral changes associated with the birthday. At present, the best available explanation of these findings is that females are able to prolong life briefly until they have reached a positive, symbolically meaningful occasion. Thus, the birthday seems to function as a 'lifeline' for some females. In contrast, male mortality peaks shortly *before* the birthday, suggesting that the birthday functions as a 'deadline' for males.

Key words: anniversary reaction; birthday; mortality; psychosomatic processes.

INTRODUCTION

In the last 50 years, many studies have found an increase in morbidity or mortality associated with personally significant symbolic occasions (1–31)—a phenomenon labeled the 'anniversary reaction.' One type of symbolic occasion seems to function as a 'deadline,' an event that is dreaded and anticipated with pain. For example, some investigations indicate that a woman may suffer psychological and physical distress on reaching what would have been the due date of her aborted fetus (9, 13). Other studies (4, 7–12, 15, 17–19, 29, 31) suggest that a person may sicken or die when he reaches the age at which his father or mother died.

A different type of symbolic event seems to function as a 'lifeline,' and is anticipated more often with pleasure than with pain (6, 10, 20, 26, 27, 30). In one study of this type, Phillips and King (26) showed that Jewish mortality [n = 1919] dipped 31% below normal before the Jewish holiday of Passover and peaked by the same amount just afterwards. In contrast, non-Jewish mortality produced no such 'dip-peak' pattern around Passover. The date of Passover varies annually, and the Jewish 'dip-peak' mortality pattern moves around with the holiday; thus, the 'dip-peak' cannot be ascribed to seasonal effects. Instead, it seems to occur because some dying patients are able to prolong life briefly until they have reached a positive symbolic occasion. A parallel study of Chinese mortality [n = 1288] around a Chinese holiday (27) produced similar findings and conclusions.

It has been difficult to generalize with confidence from previous studies of the anniversary effect. This is because most

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earlier studies were limited to small samples (typically $n \leq 200$) or individual case histories (4, 7–13, 15, 17–19, 29, 31). Other studies were of limited generalizability because they examined specialized symbolic events (like a Jewish or Chinese holiday) that appealed only to small segments of the population.

In the current paper, we have tried to avoid these limitations by using two very large samples (n_1 = 1,309,334; n_2 = 1,435,815) to examine a symbolic event of very wide significance—the birthday. Each of these samples alone is larger than the combination of all previous samples examined in the literature on anniversary effects.

Earlier studies of mortality around the birthday (1–3, 14, 16, 21, 25) have presented a mixed picture. Several investigations (1, 21, 25) suggest that the birthday functions as a 'lifeline'—there is a dip in deaths before this event and a peak thereafter. However, other research (16) reveals a peak in deaths associated with the birthday and no drop in deaths beforehand, suggesting that the birthday functions as a 'deadline.'

These mixed findings may have arisen for at least two reasons. First, people seem to approach the birthday in two different fashions. For some it is a positive event, anticipated with pleasure, and associated with presents and attention. For others it is a negative occasion, approached with distaste or even dread. For these people, the birthday may "serve as a signal that one promising period of life is over and another less promising one is about to begin" (28). In addition, people may use their birthdays as a time to "reflect on whether they have achieved the goals they set for themselves earlier in life. Some persons taking stock on these occasions are likely to consider that they have failed themselves and their families" (28).

Secondly, studies on the birthday may have generated mixed findings because each such study suffered from a variety of methodological limitations:

1. The study failed to restrict attention to natural causes of death (1, 2, 16, 25), as would be necessary if one sought evidence for the psychosomatic control of the timing of death.

2. The study inappropriately included those who had undergone surgery that contributed to death (1, 2, 16, 21, 25). Studies with this methodological weakness could not separate the effect of the operation from the effect of psychosomatic processes on the timing of death.

3. The study was restricted to specialized sub-segments of the population (e.g., persons under 19 (2), or over 65 (1)).

4. The study analyzed coarse time intervals, i.e., it divided the year into quarters (21) or months (1, 25) rather than weeks or days. This procedure was necessitated because nearly all studies of mortality around the birthday have examined relatively small samples.

5. The study employed incomplete time intervals, i.e., it restricted the investigation to deaths within 1 month of the birthday (16).

The current study circumvents the five limitations described above and shows that people are more likely to die in the week after their birthdays than in any other week of the year.

METHOD

Data to Be Examined

We examined California computerized death certificates for persons dying from natural causes, 1969–

1990. (U.S. computerized death certificates could not be used because they do not list the full birth date.) Our study period begins with 1969, because this was the first year California used the Eighth International Classification of Diseases. Our study period ends with 1990, because mortality data are not available after this year.

As indicated earlier, it is important to omit from the study persons who have undergone surgery that contributed to death. Information on surgery as a contributory cause is available only for 1978 and later. Hence, the period 1978–1990 was used for the main study in this paper (n = 1,435,815), while the period 1969–1977 was used as a pilot study (n = 1,309,334).

We restricted attention to adult decedents, defined as persons whose rounded age at death was at least 18. We omitted persons born on February 29th, because these people often celebrate their birthdays on some other date, which is unknown to the researcher.

Method of Analysis

Correction for Seasonality. When determining whether there is a peak in deaths associated with the birthday, it is important to correct first for the seasonal distribution of deaths and births. The need for this correction is illustrated by the following hypothetical example. Suppose that the seasonal distribution of births and deaths is such that almost all persons are born in late July and that almost all persons die in early August. If this were so, then many people would die just after their birthdays, but this apparent birthday effect' would result from seasonal factors and not from the birthday itself

Table 1 uses hypothetical data to illustrate a standard method, contingency table analysis (32), to correct for the interaction of the seasonal distribution of births and deaths. For ease of exposition, this table examines a hypothetical year, which is comprised of only 2 days (Day 1 and Day 2) rather than 365. Table 1 indicates that 20% of the population (200/1000) died on Day 1. Thus, there is a pronounced seasonal pattern of deaths in this population, because fewer people die at the beginning of the year than at the end.

If the null hypothesis is correct, and the birth date is unrelated to the death date, then 20% of those born on Day 1 (= 0.20 × 400 = 80) should die on Day 1, and 20% of those born on Day 2 (= 0.20 × 600 = 120) should also die on Day 1. By similar methods,

TABLE 1. Application of Contingency Table Techniques to Correct for Seasonal Fluctuations in Births and Deaths (Hypothetical Data)

		DAY BORN: Day 1	DAY BORN: Day 2	Total
DAY DIED	Day 1	*80* **150**	*120* **50**	200
	Day 2	*320* **250**	*480* **550**	800
	Total	400	600	1000

one can calculate the number of deaths expected in each of the cells in Table 1, given the null hypothesis. These expected numbers are displayed in the small boxes in the Table and give the number of persons expected in each cell, after correction for the interaction between the seasonal pattern of births and deaths.

Table 1 also shows, in **bold** type, the observed number of deaths in each cell. Thus, for example, the top left hand cell indicates that 150 persons were born on Day 1 and died on Day 1, while only 80 were expected to. Thus, in this cell, 70 more people died on their birthday than would be expected after correction for the seasonal distribution of births and deaths.

We employed this technique, expanded to a year of 365 days, to estimate the effect of the birthday on mortality, after correction for seasonality.

Tests of Statistical Significance. We tested for statistical significance by replicating the key findings in a fresh data set, and by the t test (32). In general, we relied most heavily on replication to establish the genuineness of our findings, in part because this approach requires no assumptions about the nature of the population from which the data were drawn. This fortunate state of affairs does not hold for the t test (32).

Method of Presenting the Data. The findings will be primarily presented as graphs of weekly mortality around the birthday: some information on *daily* mortality will also be introduced.

A dip in deaths before the birthday will be interpreted to mean that some persons are postponing death to reach the birthday. Alternative explanations for our findings will be evaluated later in the paper.

RESULTS

Figure 1 displays the weekly distribution of adult deaths around the birthday, for those dying from natural causes, in the pilot study of 1969–1977 data (bottom panel) and the main study of 1978–1990 data (top panel). In each data set there are more deaths 0–6 days after the birthday (week 0) than in any other week of the year. Under the null hypothesis, the replication of the "week 0" peak would occur by chance 1/52 of the time ($p = 1/52 = 0.019$, or as evaluated by the t test, $p < 0.0005$, $t = 3.66$, 50 df, for the studentized residual (32, 33)). The pilot study and the main study also reveal a dip in deaths before the birthday and a smaller dip several weeks afterwards.

The fundamental findings in Figure 1 reappear when one examines female mortality alone (see Figure 2, top panel). The data in this panel suggest that females prolong life in order to reach the birthday, which thus functions as a 'lifeline.' In strong contrast, there is a peak in male mortality shortly *before* the birthday, rather than just afterwards (Figure 2, bottom panel). This suggests that the birthday functions as a 'deadline' for males.

We will treat the 'deadline' phenomenon elsewhere; here we concentrate on the birthday as lifeline, and henceforth will focus our analysis on females. Figure 3 shows that the birthday effect appears for both old and young females. In both panels, mortality is higher in week 0 than in any other week of the year, and in both panels there is a dip in deaths before the birthday.

Earlier research (26, 27) showed that deaths from cardiovascular diseases were the most likely to display fluctuations around symbolic occasions. Figure 4 classified female deaths into cardiovascular

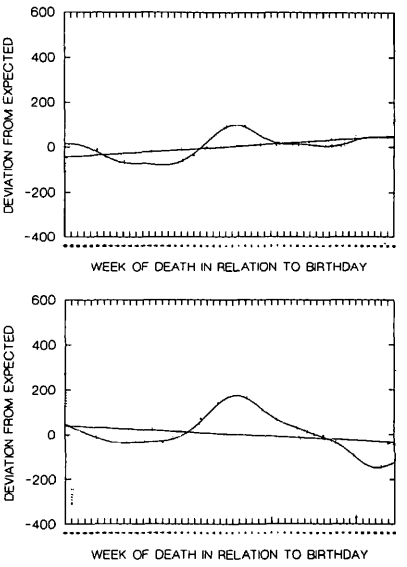

Fig. 1. Weekly fluctuation of mortality around the birthday, for adults dying from natural causes, California, 1969–1977 (bottom panel, n = 1,309,334) and 1978–1990 (top panel, n = 1,435,815). Adults are defined as persons whose rounded age at death was 18 or greater. Data in top panel exclude persons who had undergone surgery that contributed to their death; such people cannot be excluded in the bottom panel, because surgery status was not coded before 1978. In Figures 1–5, the vertical axis refers to the residual number of deaths (the observed number of deaths minus the expected number). This residual is very small compared with the expected and observed numbers of deaths. Hence, the minor random fluctuations in the observed distribution of deaths appear large in comparison with the residuals, resulting in the 'spiky' fluctuations seen in Figures 1–5. The linear regression line in all figures was fitted by the method of ordinary least squares; the curved regression line was fitted by the method of distance weighted least squares (DWLS) (33, 36) in order to smooth the 'spikiness.'

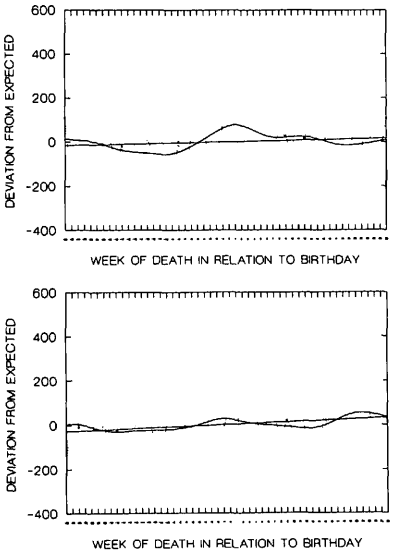

Fig. 2. Number of deaths around the birthday, by sex, for adults dying from natural causes, California, 1978–1990 (bottom panel, males, n = 714,092; top panel, females, n = 721,723). In this and all subsequent figures for California, we have excluded persons who underwent surgery that contributed to death.

diseases and all other natural causes. It is evident that both major cause groups display the fundamental findings seen in the earlier graphs: a peak in week 0, and a drop in deaths beforehand.

Figure 5 indicates that the "week 0" peak appears once again when female mortality is classified by race, rather than age or cause of death. Thus, in the pilot study, the main study, and in each of the six subgroups examined, there are more deaths in the week after the birthday than in any other week of the year. This indicates that the "week 0" peak cannot be plausibly ascribed to chance fluctuations in the data.

Although the post-birthday peak is extremely consistent, it is not very strong. For the 7-day period starting on the birth-

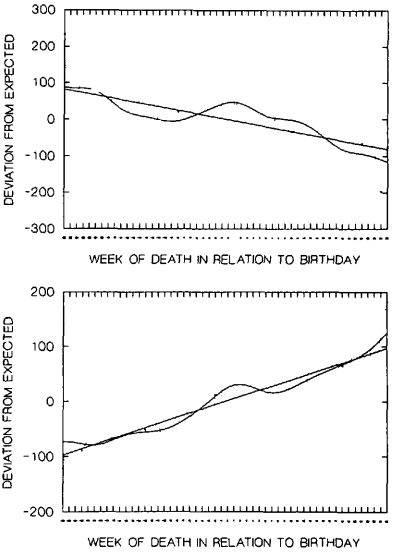

Fig. 3. Weekly fluctuation of female mortality around the birthday, by age, for adults dying from natural causes, California, 1978–1990 (bottom panel, decedents with rounded age less than 70, n = 158,297; top panel, decedents with rounded age equal to or greater than 70, n = 563,426). For young and middle-aged decedents, the number of deaths increases with increasing age—this is why the linear trend line in the bottom panel slopes upwards. For very old decedents, the number of deaths *decreases* with increasing age (because the population drops off very rapidly by age). This is why the linear trend line in the top panel slopes downwards.

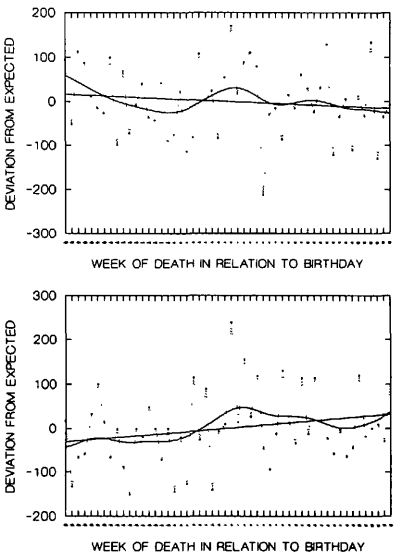

Fig. 4. Weekly fluctuation of female mortality around the birthday, by major causes of death, for adults dying from natural causes, California, 1978–1990 (bottom panel, cardiovascular diseases, n = 423,314; top panel, all other natural causes of death, n = 298,409). Cardiovascular diseases are coded as 390–398, 402, 404, 410–429, 430–438 in the 8th Revision of the International Classification of Diseases (1978 data) and as 390–398, 402, 404–429, 430–438 in the 9th Revision of the International Classification of Diseases (1979–1990 data).

day, the peak ranges from an excess of 3.03% above expected for all females to an excess of 10.8% for black females.

The relatively small size of the peak may occur because psychosomatic processes are inherently weak, or because the birthday is not a powerful, consistently positive experience for most people. One way to assess the relative merits of these two explanations is to identify a group for whom the birthday *is* usually a powerful, consistently positive experience. If this group displays a strong birthday effect, then one can conclude that a) psychosomatic processes are not inherently weak, and b) the relatively small, post-birthday peaks found in Figures 1–5 occur because the birthday is not usually a powerful, positive symbolic occasion for most people.

As implied by our earlier discussion, the birthday can have negative connotations for at least two reasons: First, people

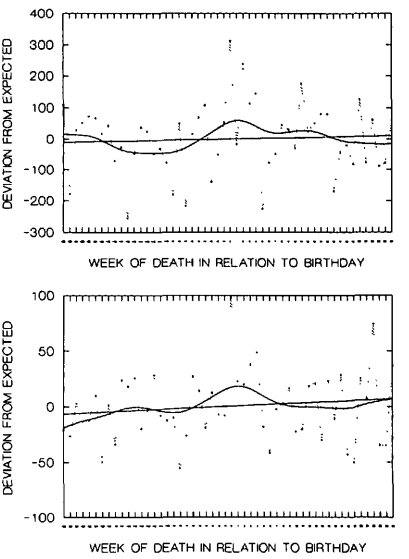

Fig. 5. Weekly fluctuation of female mortality around the birthday, by race, for adults dying from natural causes, California, 1978–1990 (bottom panel, blacks, n = 48,098; top panel, whites, n = 655,138).

may feel insufficiently acknowledged on their birthdays. Secondly, people may take stock on their birthdays and be disappointed in their achievements. One group that is less likely to suffer either of these problems consists of the famous. In contrast to ordinary people, the famous are more likely to receive substantial attention on their birthdays, and, because of their considerable accomplishments, may be more likely than most to feel pride when taking stock on this occasion.

Figure 6 displays the fluctuation of mortality around the birthday for a sample of famous Americans, as listed in the appendix of *Encyclopedia of American History* (34). Because of the small size of this sample ($n = 390$), we have had to classify deaths into bimonthly, rather than weekly intervals. When a similar, coarse classification is used for Figure 1, one discovers that California mortality falls below expected in each of the three bimonthly periods before the birthday and rises above expected in each of the three bimonthly periods after the birthday. As can be seen from Figure 6, this pattern is replicated for famous Americans and would occur by chance with a probability of $(\frac{1}{2})^6 = 1/64$ ($p = 0.016$). It is also evident from Figure 6 that the birthday effect for the famous is large (with a peak of more than 20%).

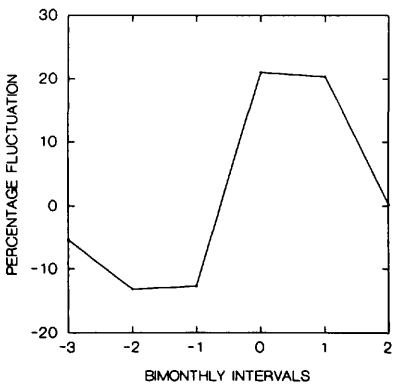

Fig. 6. Fluctuation of mortality around the birthday for famous Americans, from colonial times to 1981 (34). Data exclude persons known to have died from external causes (suicide, homicide, accidents). Because of the small size of the sample ($n = 390$), deaths have been classified into bimonthly, rather than weekly intervals.

These findings are consistent with the hypothesis that psychosomatic processes can be strong in the presence of powerful positive ceremonial occasions. The findings may also be consistent with various alternative explanations, and these are examined below.

Alternative Explanations for the Findings

Computational and/or Statistical Artifacts. As we have noted, the "week 0" peak appears repeatedly in each of the female subgroups examined. The extreme consistency of this finding may result from a computational or statistical artifact; for example, the procedure for calculating the difference between death day and birthday might be flawed in such a way as to produce a peak in deaths in the week after the birthday. This alternative explanation is implausible for two reasons. First, the results in Figure 1 remain the same when the difference between birth date and death date is calculated with an alternative computational procedure. Second, if the birthday peak were indeed a computational or statistical arti-

fact, it should have appeared for males just as it did for females.

The Postponement of Surgery. Some people may postpone life-threatening operations until after their birthdays. If so, the decline in the number of surgeries before the birthday and the increase thereafter could produce a dip in deaths before the birthday and a peak thereafter. This explanation is not plausible, because we excluded from our main sample those undergoing surgery that contributed to death.

Seasonal Distributions of Births and Deaths. As noted earlier, the findings cannot be due to the interaction between the seasonal distribution of births and deaths, because this interaction was corrected for in the analysis.

The Effect of Holidays. The findings in Figures 1–5 may result from the effect of holidays on mortality. This hypothesis is implausible for at least two reasons: a) The contingency-table techniques we used correct for any type of fixed seasonal fluctuations, including those that may be produced by the 'fixed' holidays (New Year's Day, July 4th, and Christmas). b) The birthday-effect persists after one omits from the analysis those dying within 1 week of the major holidays, both fixed and movable: New Year's Day, Memorial Day, July 4th, Labor Day, Thanksgiving, and Christmas.

External Causes of Death. The findings in Figures 1–6 are for natural causes only. Hence, one cannot ascribe these findings to external causes of death, like suicide, the timing of which can be easily manipulated by the patient.

Behavioral Changes Associated with the Birthday. This explanation seems implausible, because the drop in deaths before the birthday begins around 20 weeks beforehand. Some people may begin to anticipate their birthdays that far in advance, but experience suggests that the birthday prompts very few people to change their behavior 20 weeks before its arrival.

Misclassification on the Death Certificate. Through misinformation or inattention, the official who fills out the death certificate may tend to falsely equate the decedent's birthday with his death day. If this were so, the peak in deaths in "week 0" should be concentrated on the birthday itself. Examination of daily mortality in the week after the birthday reveals that mortality does not peak precisely on the birthday, but 3 to 5 days later. This undermines the 'misclassification explanation.'

DISCUSSION

The evidence in this paper suggests that patients do not experience time as an even, homogeneous process. Instead, they seem to behave quite differently in ordinary versus ceremonial time. Women are more likely to die in the week following their birthdays than in any other week of the year. In addition, the frequency of female deaths dips below normal just before the birthday. The results do not seem to be due to seasonal fluctuations, misreporting on the death certificate, deferment of life-threatening surgery, or behavioral changes associated with the birthday.

At present, the best available explanation of the 'dip-peak' around the birthday is that females are able to prolong life briefly until they have reached a positive, symbolically meaningful occasion. Thus, the birthday seems to function as a 'lifeline' for some females. In marked con-

trast, male mortality peaks shortly *before* the birthday, suggesting that the birthday functions as a 'deadline' for males.

The reasons for the male-female difference are not presently understood, but may be related to the following considerations, which are purely speculative. Experience suggests that some people use the birthday as an occasion to take stock of their ambitions versus their accomplishments. The achievement-oriented American society tends to nurture unrealistic ambitions, and therefore it is often not possible to reach goals fostered in the workplace—not everyone can become Chairman of the Board, though many are encouraged to aspire to this position. In the United States, males have been traditionally more likely than females to base their self-esteem on their achievements in the workplace. Thus, the stocktaking associated with the birthday may be particularly likely to make the male aware of the disjunction between his aspirations and his attainments. If this is so, then the birthday may be more likely to function as a negative occasion for males than it does for females.

The birthday of course also has positive elements associated with increased attention from family and friends. As Gilligan (35) and others have argued, females may be more likely than males to value, develop, and maintain social relationships. If this argument is accepted, perhaps females may be more likely than males to experience the positive side of the birthday. In short, the positive aspects of the birthday may outweigh the negative for females, whereas the opposite may be true for males.

These considerations may help to explain why females prolong life until they have reached their birthdays more often than males do. These factors may also explain why the 'lifeline' effect of the birthday appears to be stronger for famous than for ordinary people—highly accomplished people are more likely than others to feel comfortable when taking stock, and are more likely than others to receive positive attention on their birthdays.

This and previous studies have indicated that morbidity and mortality levels are affected, sometimes markedly, by the anticipation or experience of symbolic occasions. These findings may have implications for clinical practice and for research, and these are briefly discussed below.

Possible Implications for Clinical Practice

Because symbolic occasions seem to have psychosomatic effects, physicians taking a medical history may find it useful to enquire about the nature, timing, and significance of events that are meaningful for the patient. In addition, caregivers in nursing homes and similar communities may serve the patient better if they can identify his or her symbolic occasions, and provide social, cultural, and psychological support for these events. Finally, some surgeons may wish to identify symbolically charged occasions, and may prefer to avoid scheduling elective operations that coincide with them.

Possible Implications for Research

This study and its precursors reveal a dip in deaths before symbolic occasions and a rise in deaths thereafter. It may now be appropriate to seek the mechanisms implicated in this 'dip-peak' phenomenon.

One possible research design would use existing hospital records to examine the results of biochemical and psychological tests conducted just before and just after symbolically meaningful occasions. One could learn much about the etiology of the dip-peak phenomenon by discovering which biochemical assays changed markedly before and after the symbolic occasion.

Another research design would measure the size of the 'birthday effect' for specific diseases rather than for the broad disease categories in Figure 4. Is the 'dip-peak' effect larger for chronic or for acute ischemic heart disease? Which diseases produce unusually large (or small) dip-peak effects? Most generally, it would be valuable to rank all diseases by the size of the 'birthday effect' each produces. An investigation of this sort could shed light on biochemical mechanisms leading to the birthday effect and might also enable researchers to rank diseases by the degree to which they are influenced by psychosomatic processes.

Earlier studies of anniversary phenomena tended to examine the impact of *negative* psychological factors on the *morbidity* of *small samples*. The current study has presented a different paradigm for the study of psychosomatic processes, one which also considers the impact of positive psychological factors on the *mortality* of *large samples*.

Researchers using the first paradigm collect a small sample but a great deal of information on each member of that sample. Those using the second paradigm do just the opposite, collecting a large sample and a small amount of information on each sample member. The two styles of research have different strengths and different emphases, and scientific progress is likely to be most rapid if both paradigms are used to examine the subtle and extensive relationships between culture, psychology, and illness.

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