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# Statistical analysis of the birth charts of serial killers

by

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### Abstract

*In this study, hypotheses of astrologers about the predominance of specific astrological factors in the birth charts of serial killers are tested. In particular, Mutable signs (Gemini, Virgo, Sagittarius and Pisces), the 12<sup>th</sup> principles (12<sup>th</sup> house, Pisces, Neptune) and specific Moon aspects are expected to be frequent among serial killers as compared to the normal population.*

*A sample consisting of two datasets of male serial killers was analysed: one set consisting of birth data with a reliable birth time (N=77) and another set with missing birth times (12:00 AM was used, N=216). The set with known birth times was selected from AstroDatabank and an astrological publication. The set with unknown birth times was selected from three specialised sources on the Internet.*

*Various control groups were obtained by shuffle methods, by time-shifting and by sampling birth data of 6,000 persons from AstroDatabank. Theoretically expected frequencies of astrological factors were derived from the control samples. Probability-density functions were obtained by bootstrap methods and were used to estimate significance levels.*

*It is found that serial killers are frequently born when celestial factors are in Mutable signs (with birth time:  $p=0.005$ , effect size=0.31; without birth time:  $p=0.002$ , effect size=0.25). The frequency of planets in the 12<sup>th</sup> house is significantly high ( $p=0.005$ , effect size=0.31, for birth times only) and the frequency distribution of Moon aspects deviates from the theoretical distribution in the whole sample ( $p=0.0005$ ) and in the dataset with known birth time ( $p=0.001$ ).*

*It is concluded that, based on the two datasets, some of the claims of astrologers cannot be rejected.*

### Introduction

This investigation is stimulated by astrological research articles about the birth charts of serial killers (Marks, 2002; Wickenburg, 1994). Unfortunately, the hypotheses by astrologer Liz Greene and others about the natal charts of psychopaths and serial killers (Greene & Sasportas, 1987a,b; Greene, 2003) are not tested in these research articles. I feel the challenge to do that in a more detailed study.

Evidence for astrology is largely lacking, though some studies have reported small effect sizes (Ertel & Irving, 1996). It could be reasoned that if some of these astrological effects are genuine, higher effect sizes are to be expected in samples that are more homogeneous with respect to certain behavioural or psychological factors. Serial killers can be considered quite homogeneous with respect to common psychological traits, which manifest at an early age, and with respect to background, which is mostly dysfunctional, involving sexual or physical abuse, drugs or alcoholism (Schechter & Everitt, 1997; Schechter, 2004). If astrology works, then one would say that serial killers should display common factors in their birth charts.

Specific sorts of behaviour, such as animal torture, fire setting, bed-wetting, frequent daydreaming, social isolation and chronic lying, characterize the childhood of serial killers. As adults they are addicted to their fantasies, have a lack of empathy, a constant urge for stimuli, a lack of external goals in life, a low self-control and a low sense of personal power. The lack of empathy or remorse, the superficial charm and the inflated self-appraisal are features of psychopathy. Serial killers have also been said to have a form of narcissistic personality disorder with a mental addiction to kill (Vaknin, 2003). In many psychological profiles of serial killers the central theme is frequent daydreaming, starting in early childhood and associated with a powerful imagination. It leads to the general fantasy world in which the serial killer begins to live as protection against isolation and feelings of inadequacy arising from this isolation (Ressler & Burgess, 1990). Many serial killers enact their crimes because of the detailed and violent fantasies (power, torture and murder) that have developed in their minds as early as the ages of seven and eight. These aggressive daydreams, developed as children, continue to develop and expand through adolescence into maturity, where they are finally released into the real world (Wilson & Seaman, 1992). With each successive victim, they attempt to fine tune the act, striving to make the real life experiences as perfect as the fantasy (Apsche, 1993).

Serial killers, of which 90% are males, must be distinguished from the other type of multiple murderers: rampage killers (Schechter, 2004), which include mass and spree killers. The typical serial killer murders a single victim at separate events, while reverting to normal life in between the killings, and may continue with this pattern for years. In contrast, a mass murderer kills many people at a single event that usually ends with actual or provoked suicide, such as the Columbine High School massacre. A spree killer can be seen as a mobile mass murderer, such as Charles Starkweather and Andrew Cunanan.

The FBI definition of a serial killer states that they must have committed at least three murders at different locations with a cooling-off period in between the killings. This definition is criticized because it is not specific enough with respect to the nature of the crimes and the number of kills (Schechter, 2004). A person with the mentality of a serial killer, who gets arrested after the second sexually motivated murder, would not be a serial killer in this definition. Therefore, the National Institutes of Justice have formulated another description, which was adopted in the present study:

*“a series of two or more murders, committed as separate events, usually, but not always, by one offender acting alone. The crimes may occur over a period of time ranging from hours to years. Quite often the motive is psychological, and the offender’s behaviour and the physical evidence observed at the crime scene will often reflect sadistic, sexual overtones.”*

Five different categories of serial killer are usually distinguished (Newton, 2006; Schechter & Everitt, 1997, Schechter, 2004):

1. **Visionary**. Is subject to hallucinations or visions that tell him to kill. Examples are Ed Gein and Herbert Mullin.

2. **Missionary**. Goes on hunting "missions" to eradicate a specific group of people (prostitutes, ethnic groups). Missionary killers believe that their acts are justified on the basis that they are getting rid of a certain type of person and thus doing society a favour. Examples are Gary Ridgway and Carroll Cole.

3. **Hedonistic**, with two subtypes:

a. *Lust-motivated*: associates sexual pleasure with murder. Torturing and necrophilia are eroticised experiences. An example is Jeffrey Dahmer.

b. *Thrill-motivated*: gets a thrill from killing; excitement and euphoria at victim's final anguish. An example is Dennis Rader.

4. ***Power- and control-seeking***. The primary motive is the urgent need to assert supremacy over a helpless victim, to compensate for their own deep-seated feelings of worthlessness by completely dominating a victim. An example is Ted Bundy.

5. ***Gain-motivated***. Most criminals who commit multiple murders for financial gain (such as bank robbers, hit men from the drug business or the mafia) are not classified as serial killers, because they are motivated by economic gain rather than psychopathological compulsion. Many serial killers may take a trophy from the crime scene, or even some valuables, but financial gain is not a driving motive. Still, there is no clear boundary between profit killers and other kinds of serial killer. For instance, Marcel Petiot liked to watch his victims die through a peephole after having robbed them of their possessions. Here sadism as a psychological motive was clearly involved. Both sadism and greed also motivated Henry Howard Holmes, and sadism was at least a second motive in "bluebeard" killers such as Harry Powers (who murder a series of wives, fiancées or partners for profit). Schechter (2004) argues that all bluebeards, like Henry Landru, George Joseph Smith and John George Haigh, are driven by both greed and sadism. Other investigators, such as Aamodt from Radford University (2008), categorize bluebeards in the group of power-motivated serial killers. Holmes (1996) distinguishes six types of serial killer: visionary, missionary, lust-oriented hedonist, thrill-oriented hedonist, the power/control freak and the comfort-oriented hedonist. In this typology, bluebeards are placed in the comfort type of serial killer group. Other arguments that bluebeards should be included in the present study are that they fit the serial killer definition of the National Institutes of Justice, and that like typical serial killers, they engage in planning activities, target a specific type of (vulnerable) victim, kill out of free will and at their own initiative, avoid being captured, and pretend to be normal citizens while hiding the crimes.

Other multiple killers for profit, such as bank robbers and other armed robbers, hit men from the drugs scene, the mafia or other gangs, are generally not considered serial killers. Neither are other types of multiple murderers such as war criminals, mass murderers (including terrorists), spree killers and murderers who kill their partner out of jealousy. These killers are not incorporated in this study.

Since definite boundaries between the different types of multiple murderers are hard to draw (Newton, 2006), I used a checklist in order to define serial killers in this study and to distinguish between serial killers and the other types of multiple murderer. This checklist is based on the characteristics of serial and rampage killers (Holmes, 1996; Schechter, 2004) and is included in Appendix A.

For reasons of homogeneity, and because females usually have different motives as compared to males and over 90% of serial killers are males, this investigation was restricted to male serial killers.

Some astrologers hypothesize that the birth charts of serial killers show configurations that would make them more susceptible to developing this disorder, especially when they are raised in a dysfunctional family (Greene & Sasportas, 1987a,b; Greene, 2003). It should be emphasized that these astrologers do not assert that a serial killer or a psychopath can be detected from the birth chart.

The aim of this study is to test these astrological hypotheses about serial killers. Some of these hypotheses concern psychopathic killers in general, including serial killers

(Greene, 2003), and some refer to serial killers specifically (Greene & Sasportas, 1987*b*). The following claims are used as major hypotheses in this study:

1. Emphasis on the Mutable signs, especially the Moon sign [1].
2. Emphasis on certain aspects of the Moon, such as Moon-Saturn aspects [2].
3. Emphasis on the sign Pisces, the 12<sup>th</sup> house or Neptune [3].

Other astrological factors are also mentioned in relation to psychopaths. Since serial killers are a subgroup of the broader category of psychopaths, these claims are added here as minor hypotheses:

4. 'Stress' aspects of Mars: Mars-Saturn and especially Mars-Neptune [3].
5. Moon-Chiron and Mars-Chiron aspects [4].

To test these hypotheses, a large sample of published birth records of serial killers is needed. A full birth record consists of the birth year, date, place and time. Only two sources appear to be available: the collection of Lois Rodden's AstroDatabank [5], which contains complete and rated birth data, and one astrological publication that cites birth certificates (Lasseter & Holliday, 1999). Unfortunately, the number of male serial killers available in these sources is quite limited (seventy-seven could be selected). Therefore I expanded the sample by including all the serial killers mentioned in three Internet sources [6,7,8], provided that they meet the selection criteria, that birth dates and places are available and that the names are not already included in the dataset with known birth times. These sources were chosen because they frequently mention birth date and place (no time) as well as extended biographies of many serial killers. By using only the names given in the mentioned sources, this study is repeatable by other investigators.

## Method

### *Sample*

#### **Dataset of serial killers with known birth time**

Timed birth records are obtained from two sources presently available: AstroDatabank and an astrological publication (Lasseter & Holliday, 1999). The category 'homicide serial' in AstroDatabank is not based on the definition of a serial killer by the National Institutes of Justice. Multiple killers such as mass and spree murderers, bank robbers and terrorists appear to be included in this category as well. Therefore, the following selection method was applied.

First, a query was made in AstroDatabank to select all males of the category 'homicide serial' with reliable (Rodden rating AA, A, B) birth data and born after 1800. This rendered 97 males. Next, a filter was applied to the category terms "terrorist", "mafia" and "nazi". The remaining group of 91 males is shown in Appendix B. Verification with biographies on the Internet and the Encyclopedia of Serial Killers (Newton, 2006), using the checklist in Appendix A, revealed that this group contains 10 rampage killers, 4 cases of armed robbery, 7 other multiple killers and one unproven case. Three cases are single homicides, mistakenly categorized as serial killers. Further inspection in AstroDatabank revealed that the categories "homicide single" and "homicide many at once" contained three serial killers, and they were added to the list in Appendix B.

The astrological publication contains 47 male murderers of various kinds: single homicide, mass, spree and serial killers. Most of them (36) are already mentioned in AstroDatabank and eight of the remaining cases are serial killers not mentioned in

AstroDatabank. They were added to the dataset with known birth times (Appendix B, bottom block). A total of 77 serial killers is thus obtained and used in the present study. Appendix B specifies all names, including the rejected names and reasons for rejection.

#### **Dataset of serial killers with unknown birth time**

The encyclopedia of serial killers (Newton, 2006) contains names and biographies as well as a typology, but birth dates and places are only occasionally mentioned. On the following Internet sites, birth data and biographies of serial killers are frequently available: Wikipedia lists serial killers per country for many of which birth data are given [6]; at crimelibrary.com [7] large biographies can be accessed from the complete list of serial killers and the website of Radford University students publishes serial killer timelines that can be used for scientific research [8].

I collected all names from these three websites (collection date: 01-03-2008), eliminated the multiple names, and placed them in the table shown in Appendix C. Birth data were added if available, either from one of the three mentioned websites or from other websites. Names already mentioned in the dataset of known birth times are marked and were not processed. After applying the checklist (Appendix A), a total of 216 serial killers remain from the table in Appendix C that are used for the present study. I applied 12:00 noon as birth time to minimize the error margin. This renders a margin of about 6° on the ecliptic for the Moon and about ½° for the Sun, Mercury and Venus. Since ecliptical signs span 30° each, this renders a good approximation for the slow moving factors, while the Moon sign will have an uncertainty of about 12%. For Moon aspects, the uncertainty is higher, depending on the orb width; the probability of a “false” count is about 25%. This insecurity, added to the fact that reliability ratings are lacking, interpretation of the results for this group must be done with caution.

#### *Control group*

To test the hypotheses that certain astrological factors are frequent or infrequent among serial killers, an adequate control group is essential for making a comparison. Control samples must be obtained in such a way that the possibility of artefacts in the comparison can be ruled out. Artefacts can be caused by demographic effects (seasonal and diurnal variations in birth frequencies) and astronomical effects (planetary positions vary with time of day, day of year, year-to-year and geographical location).

AstroDatabank is equipped with various shuffle methods to obtain very large control groups to eliminate artefacts. The method consists of random shuffling (with replacement) the years, dates, locations and times of the experimental group and calculates planetary positions for each artificial birth. This method is solid but has to be applied with caution. When the dates of the year are reproduced (thus a 6<sup>th</sup> of November birth of a serial killer generates 6<sup>th</sup> of November births in the control group) then this will reproduce some astrological effects present in the experimental group. The birth dates of serial killers may mask the seasonal variation in the population in which they are born. Unless there is reason to assume that serial killers are born in other seasons as compared to the general population, this method has its limitations. Another problem arises when the experimental sample is relatively small, as in the present study. For instance, in the dataset of 77 serial killers (see Figure 2), there are almost four times as many births in November as in October. This difference cannot be attributed to any underlying seasonality because seasonal variations of births are usually in the range of only ± 20% deviation from the annual mean (Roenneberg & Aschoff, 1990). The problem is that shuffle methods reproduce these huge and unnatural variations in the control group as an artefact.

A related problem arises when there are genuine astrological effects hidden in the birth data. For instance, suppose that 50% of the killers are born with Sun, Mars and

Jupiter in Aries. Again, shuffling methods will largely reproduce these configurations in the control group and thereby mask potential astrological effects in the experimental group. An adequate control group should reflect the demographic variations of people born in the same years and locations as those of the serial killers. To avoid this problem, a separate control sample of non-serial killers would be needed, but this is difficult to obtain in practice. In this case, however, many births of people born in approximately the same years and countries as those of serial killers (see Figure 1 and Table 1) are available in AstroDatabank. These subjects can be sampled, and as such represent an independent control group drawn from the same populations as those of the serial killers.

It can be very instructive to compare the results using different methods for generating control groups. I used three different methods:

**Ctrl1.** Independent control group of 6,000 persons drawn from AstroDatabank (method specified in Appendix D).

**Ctrl2.** Control group of 10,000 artificial birth data obtained by shuffling years, months, days, times and locations of all serial killers independently.

**Ctrl3.** Control group of 10,000 artificial birth data obtained by shuffling years, dates, times and locations independently. Months and days are coupled and reproduced; thus a 6<sup>th</sup> of November birth in the experimental group is also a 6<sup>th</sup> of November birth in the control group.

Each of these methods has pros and cons. Method Ctrl1 is very laborious (see Appendix D). Ctrl2 controls for seasonality because seasonal variations can be largely mimicked by monthly figures in which the days of the month do not matter substantially (Roeneberg & Aschoff, 1990). Reproducing the birth times controls for diurnal variations. Ctrl3 controls for seasonal and diurnal variations but reproduces ecliptical degrees of the Sun exactly, which will also reproduce some positions of other planets and of aspects. To control for this effect, a small variation in the year of birth was allowed by involving also the two adjacent years. Thus, for a birth in 1954 we take 1954 or 1953 or 1955, each with equal probability.

The shuffle methods all have in common that they are derived from the experimental sample and, as such, reproduce some of its content. This is not the case with the independent control group of real persons.

The control samples must be very large to reduce the relative contribution of random fluctuations. The larger the sample, the better the estimations of the theoretical frequencies will be. The control samples are used to apply bootstrap methods to generate density traces to estimate significance levels (see: statistical analysis), and the control samples must be very large also for this purpose.

In addition to shuffle methods, a shift procedure is applied to control for demographical-astronomical artefacts. The birth dates of serial killers are shifted an increasing number of days forwards and backwards in time. Astrological variables and statistics are calculated for each time-shifted sample.

### **Astrological factors**

The birth data from the experimental and control groups were automatically imported in programmable astrological software for research purposes [9] to calculate the ecliptical positions of astrological factors: Sun, Moon, planets, Ascendant, Midheaven (MC), the Placidus houses 1 to 12, and the angular separations along the ecliptic (aspects) between pairs of factors. Some of these aspects are claimed to be especially important: 0°, 60°, 90°, 120° and 180°, with a margin ("orb") at both sides of these angles. Some authors apply a small orb of 6° for all aspects, but others, such as Liz

Greene, apply a wider orb as much as  $10^\circ$ , especially for the  $0^\circ$  and  $180^\circ$  aspects, and a smaller orb of  $6^\circ$  for the  $60^\circ$  aspect. To enable comparison, I applied two sets for the orb widths: a set of small orbs of  $6^\circ$  for all aspects and a set of wider orbs with  $10^\circ$  for the  $0^\circ$  and  $180^\circ$  aspects,  $8^\circ$  for the  $90^\circ$  and  $120^\circ$  aspects and  $6^\circ$  for the  $60^\circ$  aspect.

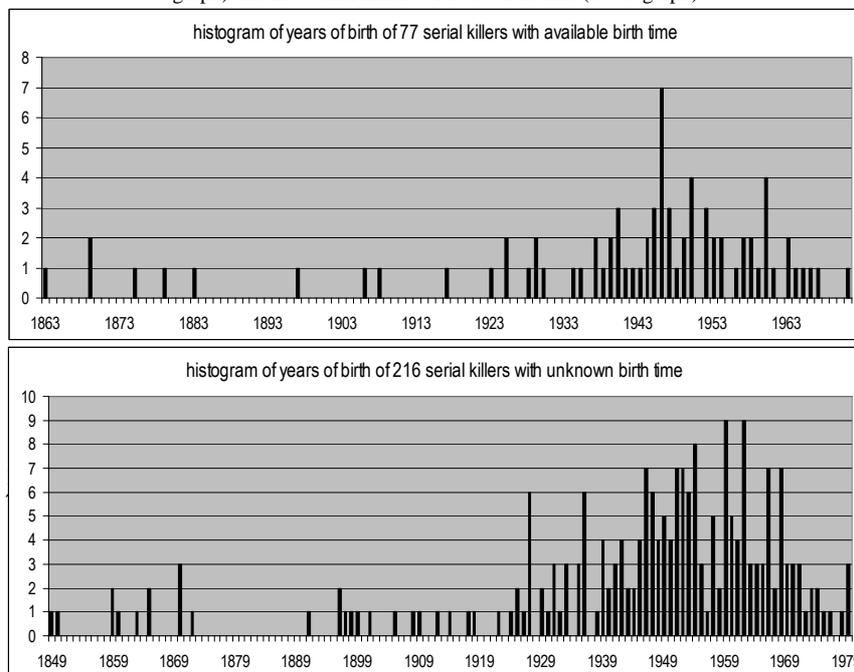
The major, or so-called personal, horoscope factors are Ascendant (AS, the intersection of eastern horizon and ecliptic at birth time), Sun (SO), Moon (MO), Mercury (ME), Venus (VE) and Mars (MA). They move relatively fast along the ecliptic. Uranus (UR), Neptune (NE) and Pluto (PL) are moving too slowly (on average  $4^\circ$ ,  $2^\circ$  and  $1^\circ$  per year respectively) to make comparisons in ecliptical signs. Jupiter (JU) and Saturn (SA), progressing about  $30^\circ$  and  $12^\circ$  per year respectively, take a halfway position and are involved in all analyses. Uranus, Neptune and Pluto were not ignored with respect to diurnal sector positions (houses) and aspects.

### Statistical analysis

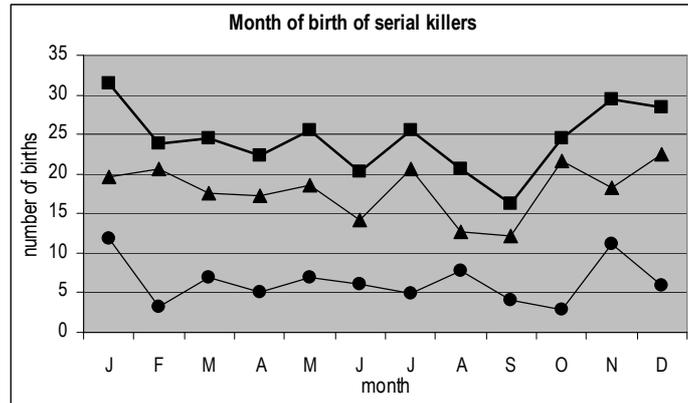
Testing the null hypothesis, that the frequencies of astrological factors in the sample of serial killers do not deviate from the expected (population) frequencies, implies that we must carefully calculate the expected frequencies from proportions in the control group and apply adequate statistical tests.

One of the hypotheses to be tested is the plain frequency of the eight astrological factors in Mutable signs. This frequency is obtained by the sum of SO, MO, ME, VE, MA, JU, SA and AS (if available) in a Mutable sign for each individual. The maximum score of Mutable per individual is eight. The total frequency of Mutable is then obtained by the sum of all individuals. To test whether this total frequency differs between the serial killers and the control group we must estimate the likelihood that a certain total

**Figure 1.** Histograms of years of birth in the datasets of 77 serial killers with known birth time (top graph) and 216 serial killers without birth time (lower graph)



**Figure 2.** Frequency of births per month (corrected for number of days per month) in the dataset of 77 serial killers with known birth time (dots), 216 serial killers without birth time (triangles) and in the whole sample of 293 serial killers (blocks).



**Table 1.** Number of births of serial killers per country and the relative frequencies (rounded to the nearest integer) derived from a matched control group of 6000 persons (Ctrl1) to enable comparison.

Country	77 serial killers, known birth time	Control group	216 serial killers, unknown birth time	Ccontrol group	All serial killers	Control group
USA	44	44	106	122	150	175
Canada	3	3	6	6	9	8
Mexico	1	0	1	1	2	1
South America	4	4	7	8	11	10
France	7	6	9	14	16	20
Germany	5	4	13	12	18	12
Italy	5	6	2	11	7	19
England	3	5	12	15	15	18
Scotland	2	2	2	5	4	7
Belgium	1	1	-	-	1	4
Austria	1	1	4	2	5	2
Sloweria	-	-	2	0	2	0
Rumenia	-	-	1	0	1	0
Netherlands	-	-	3	3	3	3
Poland	-	-	5	1	5	1
Sweden	-	-	2	1	2	1
Spain	-	-	3	2	3	2
Ireland	-	-	2	2	2	2
Czechia	-	-	3	0	3	0
Hungary	-	-	1	1	1	1
Denmark	-	-	1	1	1	1
Norway	-	-	1	0	1	0
Russia	-	-	6	2	6	2
Iran	-	-	1	0	1	0
China	-	-	2	1	2	1
Vietnam	1	0	-	-	1	0
Japan	-	-	9	1	9	1
Africa	-	-	3	1	3	1
Australia	-	-	9	4	9	3

frequency occurs. We cannot assume a priori that this frequency is normally distributed since we are dealing with multiple correlated variables, because many factors are measured at each subject at one point in time. With the bootstrap method it is possible to obtain a density trace, or histogram, of the total frequency of Mutable. Such a histogram

can be obtained by taking a large number, say 500, of resamples with size  $N$  ( $N$  = number of serial killers) drawn with replacement from the control group. By using adequate statistical software [10] we can simply derive density traces and probability estimates for any experimentally obtained frequency.

Similar bootstrapping procedures can also be applied to test the total frequency of the other variables, such as the score in the 12<sup>th</sup> house, Pisces, and aspects with Neptune.

To test to the hypothesis that aspects of the Moon with each of the eleven other factors (SO until Pl, AS and MC) are significantly deviating from expectancy, we must follow a slightly different approach. We don't want to test the total frequency of Moon aspects because some aspects, such as Moon-Saturn, are expected to be frequent while other aspects, such as Moon-Jupiter, are expected to be infrequent. We need to answer the question whether the overall deviation between experimentally observed frequencies and theoretically expected frequencies (summed over all aspects) is large enough to reject the null hypothesis. This is in fact a goodness-of-fit test between two distributions.

As an index of overall departure from the expected frequencies, we can take the sum of the weighted squared differences in observed and expected frequencies as a good measure for this test statistic:

$$\chi^2 = \sum_{i=1}^m \frac{(O_i - E_i)^2}{E_i}$$

This is a one-way chi-square test statistic in which  $O$  = experimentally observed frequency,  $E$  = theoretically expected frequency derived from the control group,  $i$  = index of the aspect, and  $m$  = number of categories. Since the sum of the observed frequencies must equal the sum of the expected frequencies,  $m$  must be 12: eleven aspects plus the frequency of no aspect.

When the fit between the observed and expected frequencies is perfect then this measure is zero, and in the case that the two distributions are quite different it must be large. Now in order to approximate the probability of an experimentally obtained value for  $\chi^2$ , we need to know the sample distribution of this test statistic. Since each individual has either zero, one or more Moon aspects, we are dealing with multiple correlated variables and the probability distribution of this test statistic is therefore unknown [11]. With bootstrap methods, however, it is possible to derive estimates of p values for any value of the test statistic, and that accounts for the effect of the correlated variables. Therefore it is important that the control frequencies are good estimators of the theoretical population frequencies.

#### *Independent Bootstrap Method*

Bootstrapping techniques are an ideal means to tackle problems related to unknown probability distributions (Bollen, 1992; Waller, 2003; see also [12]). The bootstrap method for hypothesis testing is a frequency-based statistical test. One draws many independent resamples (random with replacement) from the independent control group for which the null hypothesis holds (Bollen, 1992) and calculates the test statistic per resample. A histogram, or density trace, of these simulated values provides an estimate of the probability density of the test statistic under the null hypothesis. The proportion of the simulated values exceeding the observed value in the sample of serial killers provides a Monte Carlo estimate of the upper tail p value.

Significance levels do not render information about the size of a significant result of astrological variables. The effect size of an individual significant result, such as the total frequency of Mutable, can be calculated by Glass's delta (Becker, 2000):

$$d = \frac{\bar{x}_O - \bar{x}_E}{\sigma_E}$$

defined as the difference between the means ( $O$  = observed,  $E$  = expected as derived from the control group) divided by the standard deviation of the control group. The mean ( $\bar{x}$ ) is the total frequency of the variable divided by  $N$  (number of subjects) and the standard deviation ( $\sigma$ ) is calculated from the individual scores of Mutable in the control group (Ctrl1,  $N=6000$ ). This formula applies to normally distributed variables; hence this must be checked by a test for normality applied to the bootstrap histogram. An effect size of  $\leq 0.2$  is small, of  $0.5$  is medium and of  $\geq 0.8$  is large.

Estimation of the effect size of the overall deviation from the control frequencies of Moon aspects requires simulations that are beyond the scope of this study.

### Results for the serial killers with known birth time

#### Hypothesis 1

Hypothesis 1 states that serial killers have an emphasis of Mutable signs, especially for the Moon sign. Table 2 shows the observed frequencies (top panel) for 77 serial killers, together with the expected frequencies derived from the control group of real births (Ctrl1). For comparison, the Quality-totals for methods Ctrl2 and Ctrl3 are shown below the totals for Ctrl1. The right-hand panels show the frequencies grouped in the three Qualities of Mutable, Cardinal and Fixed signs.

There is a high total frequency of Mutable (235), and each of the eight factors has a surplus in the Mutable signs. The bootstrap histogram in Figure 3 shows the sample distribution of the total of factors in a Mutable sign. According to a Shapiro-Wilk test for normality ( $p=0.23$ ) we cannot reject the idea that the Mutable total is normally distributed. The experimental value of 235 is in the upper region of significance were  $p=0.002$  (one-tailed), as indicated by the critical values for the best-fitting distributions. The largest contribution to the surplus (+32) of Mutable signs comes from the Moon (+8).

These results support Hypothesis 1. The effect size for the excess of Mutable is 0.31 (Glass's delta), a size that is between small and medium.

The low frequency of factors in Fixed signs is striking ( $p=0.001$ , normal, two-tailed). This was not predicted. A low frequency of Fixed signs has been claimed only for Mercury (Greene, 2003a).

#### *Comparison of different control methods*

In Table 2 the bootstrap  $p$  values [13] are given for the comparison between the frequency of Mutable in serial killers and those of the other control methods. The frequencies per sign show relatively large differences between the three control groups in some cells. These differences are averaged out for the most part in the frequencies of the three Qualities: comparison with all three control methods indicates a highly significant result. Control method 3 renders the lowest effect, a result that probably arises from the reproduction of month-day combinations.

#### Hypothesis 2

Hypothesis 2 states that the frequency distribution of Moon aspects in serial killers deviates from the frequency distribution of Moon aspects in the control group. In other words, some aspects, as Moon-Saturn, should be frequent and some other aspects, as Moon-Jupiter, infrequent, such that the deviation over all aspects is significant. Note that this does not imply that the total frequency of Moon aspects is expected to be high.

As mentioned previously, I applied two sets of orb widths, small orbs and wide orbs. The results are presented in Table 3. Figure 4 plots the bootstrap histogram of the goodness-of-fit test statistic for the Moon aspect totals (Table 3, row ‘Total’, including no aspect). The corresponding  $\chi^2$ -value for the serial killers is highly significant for both the small orbs and the wide orbs (wide orbs:  $\chi^2=19.4$ , bootstrap  $p < 0.005$ ). The frequent aspects of Moon to MC, Saturn and the infrequent aspects to Sun take a heavy share in this result. When we exclude Ascendant and MC from this analysis (considering the aspect-totals with planets only) the result remains significant ( $\chi^2=10.9$ , bootstrap  $p=0.05$ ).

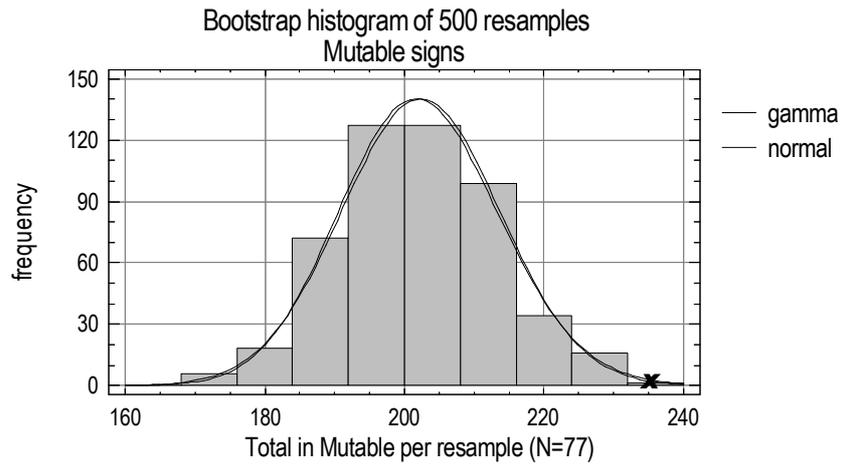
These findings support Hypothesis 2. Moon-Saturn aspects are frequent, in agreement with the claim (Greene, 2003j,h), and this result is individually significant ( $p=0.03$ , t-test, one-tailed). Moon-MC aspects ( $p=0.001$ , t-test, two-tailed) contribute most, but this finding is not predicted by any hypothesis.

**Table 2.** Top panel: frequencies of 8 celestial factors in 12 ecliptical signs and 3 Qualities for N=77 serial killers with known birth time (C=Cardinal, F=Fixed, M=Mutable). Lower panel: theoretically expected frequencies derived from a control group of 6000 persons (‘Ctrl1’). ‘Ctrl2, Ctrl3’: totals for control groups 2 and 3. ‘ $p_M$ ’: one-tailed bootstrap probability (normal distribution) for the total of factors in Mutable (235) in comparison with each of the three control methods

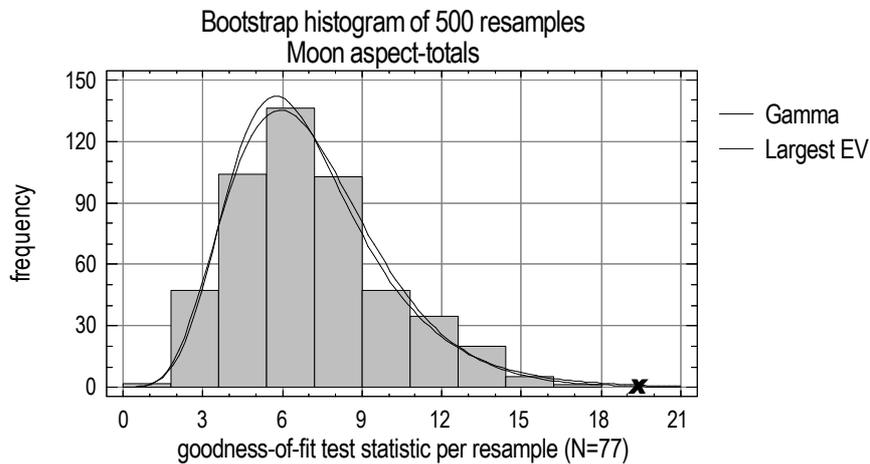
obs	Ar	Ta	Ge	Cn	Le	Vi	Li	Sc	Sg	Cp	Aq	Pi	N	C	F	M	$p_M$
SO	8	1	12	5	5	5	4	7	8	13	4	5	77	30	17	30	
MO	8	3	5	6	4	9	4	5	9	10	3	11	77	28	15	34	
ME	5	5	9	5	5	6	1	11	10	10	3	7	77	21	24	32	
VE	7	7	6	4	5	5	7	7	10	6	6	7	77	24	25	28	
MA	8	5	5	7	6	9	4	7	8	5	7	6	77	24	25	28	
JU	9	7	8	3	4	6	10	11	4	9	1	5	77	31	23	23	
SA	6	4	3	8	7	6	8	5	9	8	4	9	77	30	20	27	
AS	4	7	7	5	6	9	14	4	12	1	3	5	77	24	20	33	
Total	55	39	55	43	42	55	52	57	70	62	31	55		212	169	235	
exp	Ar	Ta	Ge	Cn	Le	Vi	Li	Sc	Sg	Cp	Aq	Pi	N	C	F	M	
SO	6.3	6.0	6.5	6.6	6.8	6.2	6.3	5.9	5.8	7.0	6.5	6.9	77	26	25	26	
MO	6.9	6.5	6.9	6.1	6.0	5.9	6.8	6.3	6.3	6.0	6.6	6.8	77	26	25	26	
ME	6.1	5.6	5.2	6.0	6.8	6.4	6.1	7.1	7.0	7.5	6.4	6.9	77	26	26	25	
VE	7.3	5.9	6.1	7.2	5.5	7.2	4.9	7.3	6.0	5.3	8.0	6.2	77	25	27	25	
MA	5.3	5.7	7.0	8.3	8.0	7.4	6.8	6.6	5.9	5.5	5.4	5.1	77	26	26	25	
JU	6.5	8.3	6.4	4.9	4.3	6.2	9.0	8.7	6.6	6.0	4.8	5.1	77	26	26	25	
SA	6.1	5.1	3.8	8.1	7.8	5.8	6.8	5.7	8.9	7.6	4.7	6.6	77	29	23	25	
AS	4.0	4.6	6.0	7.6	8.4	7.7	8.3	8.2	8.0	5.6	4.7	3.9	77	25	26	26	
Total	48	48	48	55	54	53	55	56	55	50	47	47		209	205	203	0.005
Ctrl2	46	49	46	54	51	49	53	61	62	59	46	42		211	206	199	0.002
Ctrl3	46	45	52	54	48	49	52	58	63	64	42	42		216	193	207	0.008

In Table 3 (wide orbs, bottom rows) the  $\chi^2$  values and associated  $p$  values are given for the comparison of observed Moon aspects with those of different control methods. It can be seen that there is practically no difference between the three control groups, and the results remain significant in all cases. All aspects have about the same probability.

**Figure 3.** Histogram of bootstrap values of the total of 8 factors in Mutable, obtained by 500 resamples (each 77 subjects) randomly drawn with replacement from an independent control group of 6000 persons (Ctrl1). Mean: 202.4, standard deviation 11.4. The best fitting distributions according to the log likelihood statistic are the normal ( $p=0.42$ , KS-test) and the gamma ( $p=0.47$ , KS-test). The value of 77 serial killers with known birth time (235) is in the upper region of statistical significance ( $p=0.002$ , normal, one-tailed)



**Figure 4.** Histogram of chi-squared goodness-of-fit values for correlated data (Moon aspect totals) obtained by 500 resamples (each 77 subjects) drawn from an independent control group of 6000 persons (Ctrl1). The theoretically expected frequencies are derived from the means of the control group. The best fitting distributions according to the log likelihood statistic are the gamma ( $p=0.97$ , KS-test) and Largest Extreme Value ( $p=0.71$ , KS-test). The corresponding  $\chi^2$  value of serial killers (19.4) is in the extreme upper region of statistical significance ( $p=0.001$ , gamma)



**Hypothesis 3**

Hypothesis 3 states that the 12<sup>th</sup> principle is emphasized. The 12<sup>th</sup> principle is represented by the 12<sup>th</sup> sign of Pisces, the 12<sup>th</sup> house and by Neptune, the planet that astrologers associate with both. Since Pisces is a Mutable sign, this part of the hypothesis overlaps with Hypothesis 1. The frequency of planets in Pisces and in the 12<sup>th</sup> house can be put to

the test directly, but to put Neptune in a testable form is less equivocal. Most mentioned in this context are aspects to Neptune, especially the 'stress' aspects [3]. Therefore I will test whether stress aspects to Neptune are frequent.

**Table 3.** Frequency of Moon aspects for 77 serial killers with known birth time ('obs'). Top panel: small orbs. Lower panel: wide orbs. 'exp': expected frequencies derived from a control group of 6000 persons (Ctrl1); 'none': no aspect. 'Total': sum of 0°, 60°, 90°, 120° and 180°; ' $\chi^2$ ': chi-square goodness-of-fit test statistic for the comparison of aspects of serial killers and those of the control group (row 'Total'); ' $p$ ': bootstrap probability of  $\chi^2$  value for the comparison with control groups; 'Ctrl2, Ctrl3': expected number of aspects for control groups 2 and 3.

Small orbs														
obs	SO	ME	VE	MA	JU	SA	UR	NE	PL	AS	MC	none	$\chi^2$	$p$
0°	2	2	5	3	1	6	1	4	2	3	5			
60°	2	7	3	5	3	4	3	5	4	0	9			
90°	4	1	2	5	6	10	6	6	2	8	6			
120°	4	3	9	8	9	8	6	8	5	6	7			
180°	0	1	5	3	0	2	3	3	2	3	4			
Total	12	14	24	24	19	30	19	26	15	20	31	613		
exp	SO	ME	VE	MA	JU	SA	UR	NE	PL	AS	MC	none		
0°	2.3	2.3	2.3	2.4	2.8	2.5	2.5	2.6	2.3	2.9	2.6			
60°	5.3	5.1	5.4	5.0	4.7	4.8	4.9	5.0	5.3	5.0	5.3			
90°	5.3	4.8	5.2	5.5	4.9	5.3	5.0	4.8	5.1	5.5	5.3			
120°	5.2	5.8	5.1	5.7	4.8	5.2	4.9	5.4	5.0	5.2	5.1			
180°	2.5	2.8	2.9	2.6	2.4	2.7	2.8	2.8	2.7	2.3	2.8			
Total	20.6	20.8	20.8	21.1	19.7	20.4	20.0	20.6	20.2	20.8	21.1	621	18.8	0.002
Wide orbs														
obs	SO	ME	VE	MA	JU	SA	UR	NE	PL	AS	MC	none	$\chi^2$	$p$
0°	3	4	8	5	1	6	2	10	3	5	8			
60°	2	7	3	5	3	4	3	5	4	0	9			
90°	6	4	4	7	8	12	8	7	4	13	8			
120°	7	5	11	9	9	11	7	8	8	8	10			
180°	0	3	6	3	1	3	4	5	5	6	7			
Total	18	23	32	29	22	36	24	35	24	32	42	530		
exp	SO	ME	VE	MA	JU	SA	UR	NE	PL	AS	MC	none		
0°	4.0	4.3	3.8	4.0	4.5	4.1	4.0	4.2	4.0	4.5	4.3			
60°	5.3	5.1	5.4	5.0	4.7	4.8	4.9	5.0	5.3	5.0	5.3			
90°	6.9	6.5	6.9	7.2	6.7	6.9	6.7	6.5	7.0	7.4	6.8			
120°	6.7	7.5	7.0	7.4	6.4	7.0	6.7	7.3	6.7	6.9	6.8			
180°	4.1	4.3	4.8	4.4	4.1	4.3	4.4	4.4	4.3	4.0	4.4			
Total	27.0	27.7	27.9	27.9	26.4	27.1	26.7	27.5	27.3	27.8	27.7	546	19.4	0.001
Ctrl2	27.0	27.3	26.8	28.3	27.6	27.4	27.1	27.7	28.0	27.8	27.4	544	20.2	0.001
Ctrl3	27.9	27.1	27.0	27.6	27.5	28.3	28.0	27.5	26.8	27.0	26.8	545	21.2	0.001

### 12<sup>th</sup> house

Table 4 shows the obtained frequencies of serial killers (top panel) and the theoretically expected frequencies (bottom panel) in the twelve Placidus houses. Table 5 presents the frequency of planets in the 12<sup>th</sup> house separately. Figure 5 shows that the total frequency of the 12<sup>th</sup> house is significantly high. Neptune, and secondly Mars, take the heaviest share in these results. The distribution in Figure 5 does not significantly deviate from the normal (Shapiro-Wilk,  $p = 0.57$ ). It can be seen in Table 5 that the

frequency of the 12<sup>th</sup> house is significantly high in comparison with all control methods. The effect size for the 12<sup>th</sup> house frequency is 0.31 (Glass's delta).

Analogous to the three Qualities of Cardinal, Fixed and Mutable, three house types exist: Angular (houses 1, 4, 7, 10) that corresponds with Cardinal signs, Succeedent (2, 5, 8, 11) corresponding with Fixed and Cadent (3, 6, 9, 12) corresponding with Mutable signs. Table 4 (right hand panels) shows the result for these house types. Cadent houses (especially the 12<sup>th</sup>) are frequent and Succeedent houses (especially the 5<sup>th</sup>) are infrequent, corresponding with the low score of planets in Fixed signs. The parallel finding of frequent Mutable signs and frequent Cadent houses is remarkable but was not predicted.

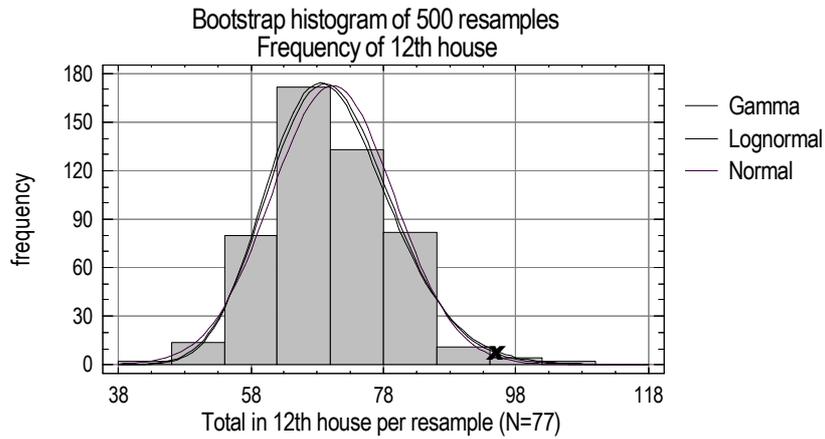
**Table 4.** Top panel: Frequencies of 10 factors in 12 houses for 77 serial killers with known birth time. Lower panel: theoretically expected frequencies derived from a control group ('Ctrl1') of 6000 persons. 'Ctrl2, Ctrl3': totals derived from control groups 2 and 3. Right panels: house types: A (Angular), S (Succeedent) and C (Cadent).

Obs	1	2	3	4	5	6	7	8	9	10	11	12	N	A	S	C
SO	9	5	7	10	4	4	5	5	7	7	5	9	77	31	19	27
MO	5	4	9	6	2	7	8	8	7	7	5	9	77	26	19	32
ME	6	5	9	9	5	7	3	3	10	5	5	10	77	23	18	36
VE	3	8	7	5	7	9	1	7	5	4	10	11	77	13	32	32
MA	5	5	7	8	4	2	12	7	5	4	5	13	77	29	21	27
JU	6	9	4	6	6	5	8	5	6	11	6	5	77	31	26	20
SA	13	5	3	3	2	8	5	8	5	5	10	10	77	26	25	26
UR	4	2	4	6	5	7	6	12	15	7	5	4	77	23	24	30
NE	7	10	4	2	6	3	9	5	5	5	6	15	77	23	27	27
PL	7	2	3	6	4	8	2	10	4	14	8	9	77	29	24	24
<b>Total</b>	65	55	57	61	45	60	59	70	69	69	65	95		254	235	281
Exp	1	2	3	4	5	6	7	8	9	10	11	12	N	A	S	C
SO	7.2	6.7	6.8	6.0	4.9	5.8	5.6	5.5	5.9	7.4	7.3	8.0	77	26.2	24.4	26.4
MO	6.7	6.3	6.6	6.7	6.1	6.4	6.5	5.9	6.2	6.5	6.7	6.5	77	26.4	25.0	25.7
ME	7.4	6.8	6.8	5.9	5.7	5.6	5.7	5.5	6.0	6.8	7.1	7.9	77	25.7	25.0	26.3
VE	7.2	6.5	6.4	5.9	6.0	5.9	5.6	6.0	6.2	6.7	7.5	7.3	77	25.3	26.0	25.6
MA	6.6	6.2	6.1	6.6	6.0	5.7	6.3	6.7	6.6	6.5	7.0	6.7	77	26.0	25.9	25.1
JU	6.3	6.6	6.7	6.2	6.7	6.5	6.0	6.2	6.3	6.8	6.2	6.6	77	25.3	25.6	26.1
SA	6.8	6.6	6.2	6.6	6.1	6.4	6.3	6.0	6.3	6.8	6.4	6.5	77	26.5	25.2	25.3
UR	5.8	5.8	5.0	5.2	5.3	6.1	7.0	7.6	7.6	7.1	7.4	7.2	77	25.1	26.1	25.8
NE	6.6	6.2	6.3	6.7	6.5	6.4	6.3	6.2	6.9	6.5	6.4	6.0	77	26.1	25.4	25.6
PL	5.0	5.4	5.6	5.6	5.2	5.2	7.5	7.8	7.5	7.4	7.3	7.6	77	25.4	25.8	25.9
<b>Total</b>	65	63	62	61	59	60	63	63	65	69	69	70		258	254	258
Ctrl2	68	66	64	64	62	58	62	63	65	65	68	66		259	258	253
Ctrl3	67	66	64	64	62	58	62	63	66	65	67	66		258	258	254

**Table 5.** Frequency of planets in the 12<sup>th</sup> house compared with the corresponding frequencies derived from three control methods. 'not' = in other houses. 'Total': total in 12<sup>th</sup> house. 'p': one-tailed bootstrap probability for the total of the 12<sup>th</sup> house in comparison with the total derived from control groups (see Figure 5)

12th house	SO	MO	ME	VE	MA	JU	SA	UR	NE	PL	Not	Total	p
<b>Serial killers</b>	9	9	10	11	13	5	10	4	15	9	665	95	
<b>Ctrl1</b>	8.0	6.5	7.9	7.3	6.7	6.6	6.5	7.2	6.0	7.6	700	70	0.008
<b>Ctrl2</b>	6.8	6.3	6.7	7.1	6.5	5.9	6.2	7.0	6.5	7.0	704	66	0.001
<b>Ctrl3</b>	6.9	6.2	6.8	7.0	6.4	6.0	6.5	7.0	6.5	7.1	704	66	0.001

**Figure 5.** Histogram of bootstrap frequencies for the total of ten factors in the 12<sup>th</sup> house obtained by 500 resamples drawn from an independent control group of 6,000 persons (Ctrl1). Mean: 70.3, standard deviation: 9.2. The best fitting distributions according to the log likelihood statistic are the gamma ( $p=0.19$ , KS-test), the lognormal ( $p=0.18$ , KS-test) and the normal ( $p=0.14$ , KS-test). The frequency of serial killers with known birth time (95) is in the upper region of statistical significance ( $p=0.008$ , gamma, one-tailed)



**Table 6.** Stress aspects ( $0^\circ+ 90^\circ+ 180^\circ$ , wide orbs) of Neptune in 77 serial killers with available birth time in comparison with the results from three control methods. 'p': bootstrap probability (normal distribution, see Figure 6) for the comparison of the total of Neptune stress aspects with the total of the control groups.

Stress aspect	Serial killers	Ctrl1	Ctrl2	Ctrl3
NE/SO	18	15.0	15.1	14.8
NE/MO	22	15.2	15.7	15.9
NE/ME	18	15.3	15.3	15.6
NE/VE	22	15.4	15.1	15.5
NE/MA	15	14.3	13.9	13.3
NE/JU	14	14.5	13.1	13.0
NE/SA	15	15.3	15.0	14.8
<b>Total</b>	124	104.9	103.1	103.0
<b>p</b>		0.02	0.01	0.01

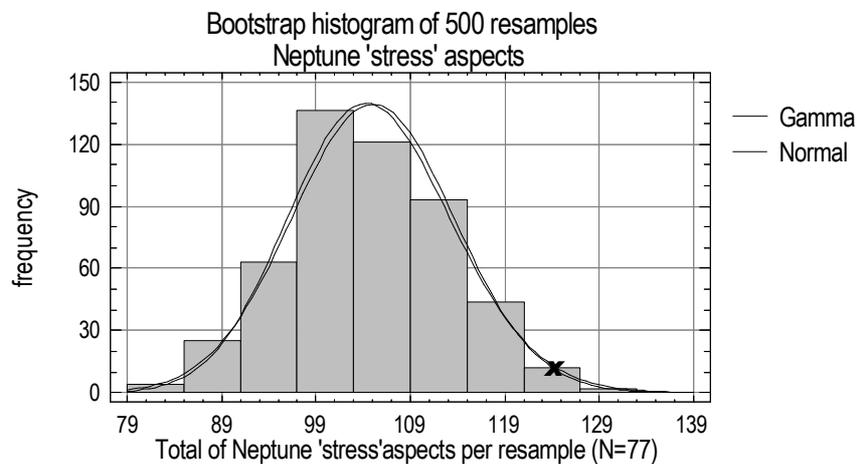
*Pisces*

The total frequency of Pisces (55, see Table 2) is relatively large, but this is not significant (bootstrap  $p=0.15$ , normal distribution, one-tailed).

*Neptune 'stress' aspects*

Table 6 presents the results for 'stress' aspects ( $0^\circ+90^\circ+180^\circ$ ) of Neptune. The frequency is significantly higher than expected in comparison with the control groups, as shown in Figure 6.

**Figure 6.** Histogram of bootstrap frequencies for the total of 'stress' aspects ( $0^\circ+90^\circ+180^\circ$ ) with Neptune obtained by 500 resamples (each 77 subjects) drawn from an independent control group of 6,000 persons (Ctrl1). Mean: 105.0, standard deviation: 8.6. The best fitting distributions according to the log likelihood statistic are the gamma ( $p=0.32$ , KS-test) and the normal ( $p=0.13$ , KS-test). The corresponding frequency of serial killers with known birth time (124) is in the upper region of statistical significance ( $p=0.02$ , normal, one-tailed)



**Results for the serial killers without birth time**

The dataset of 216 serial killers with lacking birth time was analysed in the same manner as the first sample. A computation of the degree of the Ascendant and the distribution of houses is not possible without a time of birth and was therefore skipped. Expected frequencies were derived from a new control group (Ctrl1, N=6000), because the years of birth are different from the group with known birth time (see Figure 1).

**Hypothesis 1**

Table 7 shows the results for the twelve signs. The total frequency of the seven factors in Mutable signs (570) is significantly high, as can be seen in Figure 7. Sagittarius accounts for the greatest part of this result. In contrast to the findings in the group with known birth times, the major contributors to the excess are Jupiter and Mars. The total frequency of Mutable is significant in comparison with each control method. The effect size of this result is 0.25 (Glass's delta). In accordance with the previous finding in the serial killers with available birth times, we cannot reject Hypothesis 1.

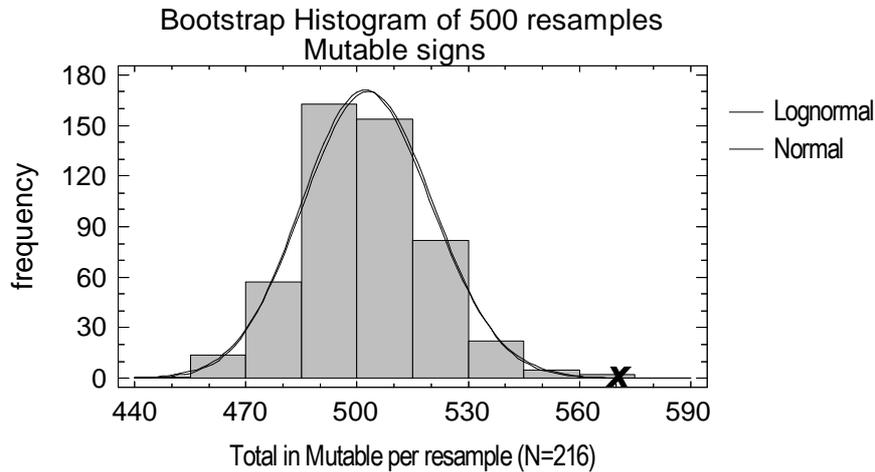
**Hypothesis 2**

The aspects of the Moon for the serial killers with lacking birth times are shown in Table 8. Aspects to Ascendant and MC are unknown.

**Table 7.** Top panel: observed frequency of factors in 12 signs and 3 Qualities for 216 serial killers without birth time (12:00 AM local time used). Bottom panel: theoretically expected frequencies derived from a control group of 6000 persons (Ctrl1). See legend of Table 2 for further details

obs	Ar	Ta	Ge	Cn	Le	Vi	Li	Sc	Sg	Cp	Aq	Pi	N	C	F	M	$p_M$
SO	18	13	17	16	19	12	20	18	23	20	15	25	216	74	65	77	
MO	19	18	17	13	16	24	11	23	20	22	15	18	216	65	72	79	
ME	10	17	16	15	14	15	19	17	25	22	24	22	216	66	72	78	
VE	19	15	13	20	10	22	12	21	20	16	32	16	216	67	78	71	
MA	12	11	27	26	18	33	15	17	23	10	14	10	216	63	60	93	
JU	14	11	27	16	17	21	16	21	24	11	12	26	216	57	61	98	
SA	18	13	10	16	16	20	17	20	22	24	18	22	216	75	67	74	
Total	110	98	127	122	110	147	110	137	157	125	130	139		467	475	570	
exp	Ar	Ta	Ge	Cn	Le	Vi	Li	Sc	Sg	Cp	Aq	Pi	N	C	F	M	
SO	17.0	17.8	18.1	17.9	20.4	17.8	18.0	17.0	15.9	18.3	18.3	19.5	216	71	74	71	
MO	18.6	18.8	18.4	17.6	17.1	17.9	17.8	17.7	17.7	17.3	18.7	18.5	216	71	72	73	
ME	16.8	15.6	14.7	16.8	19.2	18.5	18.3	19.3	18.3	19.5	19.2	19.6	216	72	73	71	
VE	20.9	15.8	17.2	19.2	16.6	23.1	13.9	20.1	16.9	14.5	21.6	16.2	216	69	74	73	
MA	13.7	16.8	19.4	20.7	21.4	21.4	20.4	19.5	17.8	14.8	15.7	14.2	216	70	73	73	
JU	17.3	18.7	18.3	19.2	16.8	17.9	18.6	21.3	20.3	15.1	15.3	17.1	216	70	72	74	
SA	17.1	15.2	11.1	12.7	18.6	16.9	20.0	20.3	20.9	25.6	18.2	19.4	216	75	72	68	
Total	121	119	117	124	130	133	127	135	128	125	127	125		498	511	503	1E-3
Ctrl2	117	129	133	139	136	124	110	132	138	117	118	120		483	514	515	4E-3
Ctrl3	123	125	138	140	130	123	112	128	137	114	117	125		490	499	523	8E-3

**Figure 7.** Histogram of bootstrap values of the total of seven factors in Mutable, obtained by 500 resamples (each 216 subjects) randomly drawn with replacement from an independent control group of 6,000 persons (Ctrl1). Mean: 503.0, standard deviation 17.6. The best fitting distributions are the lognormal ( $p=0.69$ , KS-test) and the normal ( $p=0.47$ , KS-test). The corresponding value of serial killers without birth time (570) is in the extreme upper region of statistical significance ( $p=0.001$ , normal, one-tailed)



**Table 8.** Frequency of Moon aspects for 216 serial killers with unknown birth time. See legend of Table 3 for further details

Small orbs												
obs	SO	ME	VE	MA	JU	SA	UR	NE	PL	none	$\chi^2$	p
0°	8	6	3	5	5	10	3	6	6			
60°	16	17	21	12	17	14	15	20	7			
90°	15	10	15	9	12	14	11	18	16			
120°	9	8	14	11	11	16	15	14	14			
180°	5	7	9	5	10	4	11	6	9			
total	53	48	62	42	55	58	55	64	52	1455		
exp	SO	ME	VE	MA	JU	SA	UR	NE	PL	none		
0°	6.9	6.8	6.5	6.4	7.7	6.3	7.4	7.2	6.5			
60°	15.4	14.5	15.4	13.8	12.2	14.1	14.1	12.7	14.7			
90°	15.7	13.7	15.3	15.4	13.9	14.8	14.7	14.7	13.3			
120°	14.2	15.7	14.2	15.2	14.5	14.0	13.7	16.0	13.7			
180°	7.4	7.7	7.6	8.2	7.0	7.3	7.5	8.2	7.9			
total	59.6	58.5	59.1	59.0	55.3	56.4	57.5	58.7	56.1	1424	9.3	0.14

Wide orbs												
obs	SO	ME	VE	MA	JU	SA	UR	NE	PL	none	$\chi^2$	p
0°	13	9	6	9	8	16	9	9	11			
60°	16	17	21	12	17	14	15	20	7			
90°	19	18	23	14	13	17	16	23	19			
120°	14	13	14	15	14	22	19	18	20			
180°	11	9	16	8	19	11	15	10	13			
total	73	66	80	58	71	80	74	80	70	1292		
exp	SO	ME	VE	MA	JU	SA	UR	NE	PL	none		
0°	11.9	11.9	10.6	10.8	13.1	11.5	12.0	11.5	10.9			
60°	15.4	14.5	15.4	13.8	12.2	14.1	14.1	12.7	14.7			
90°	19.9	18.6	20.3	19.5	19.0	19.7	19.0	19.0	18.7			
120°	19.5	20.2	19.5	19.7	19.2	18.2	19.2	21.1	19.0			
180°	12.0	12.2	12.9	13.8	11.6	12.7	12.2	12.9	12.4			
total	78.7	77.4	78.7	77.7	75.1	76.2	76.5	77.2	75.7	1251	9.5	0.13
Ctrl2	77.3	76.9	77.4	75.0	75.1	77.1	76.5	75.5	76.5	1257	7.9	0.23
Ctrl3	75.2	74.9	77.5	76.9	76.2	80.1	72.4	76.0	75.5	1259	7.7	0.25

The distribution of Moon aspect totals is not significant ( $\chi^2=9.5$ , bootstrap  $p=0.13$ ). This result does not confirm the significant findings with the dataset of known birth times. The difference between the two datasets will be analysed in the next section.

**Results for the whole sample**

The datasets of 77 serial killers with available birth time and 216 serial killers with unknown birth time are mutually exclusive and can be taken together to form a sample of 293 different serial killers for whom at least the date and place of birth are known. Additionally, I shall analyse how well the results for the two separate datasets resemble each other.

**Hypothesis 1**

In Table 10, the results for the whole sample of 293 serial killers are presented. The total frequency of the astrological factors in Mutable signs is highly significant (bootstrap  $p=1E-6$ ; see Figure 8). Jupiter, Mars and the high frequency of the sign Sagittarius bear the heaviest share in this result. The effect size is 0.26 (Glass’s delta). This finding supports Hypothesis 1.

**Table 9.** Stress aspects ( $0^\circ+90^\circ+180^\circ$ , wide orbs) of Neptune. 'p': bootstrap probability for the comparison of the total of stress aspects with the expected total derived from the control groups

Stress aspect	Serial killers	Ctrl1	Ctrl2	Ctrl3
NE/SO	52	43.0	42.1	42.3
NE/MO	42	43.5	42.8	43.9
NE/ME	45	42.9	41.1	40.8
NE/VE	48	44.4	44.3	44.4
NE/MA	40	41.4	42.1	39.1
NE/JU	48	43.7	41.7	39.7
NE/SA	58	51.1	53.0	48.6
<b>Total</b>	<b>333</b>	<b>309.9</b>	<b>307.2</b>	<b>299.0</b>
<b>p</b>		0.057	0.039	0.010

The Fixed signs show a very significant deficit (bootstrap  $p=0.0005$ ), which is mainly caused by Sun, Mars, and Jupiter and by the low frequency of the sign Leo.

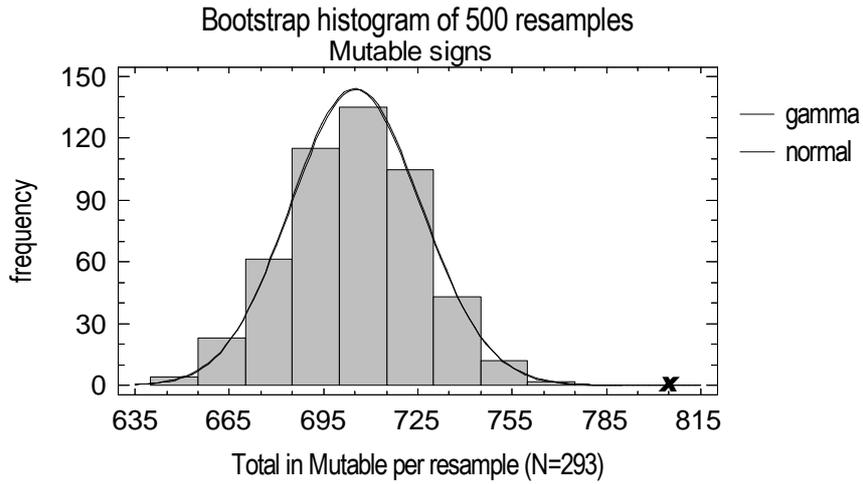
In Figure 9, the totals per sign (from Table 10) are radar-plotted as percentage deviation relative to the theoretically expected frequencies derived from Ctrl1.

Both datasets, with known birth times and lacking birth times, show a very significant excess of factors in the Mutable signs. A major question to be answered is how well the two datasets correspond in detail. Figure 10 shows the weighted residuals per sign for the two datasets and the whole sample. The large surplus of the Mutable signs Sagittarius and Pisces and the large deficit of the fixed signs Taurus and Leo are reproduced. Most of the other signs reproduce fairly well but Capricorn and Aquarius not. The Qualities of Cardinal and Fixed show some differences that are mainly due to the signs Capricorn (a large excess in the set of known birth times) and Aquarius (a large deficit in the set of known birth times).

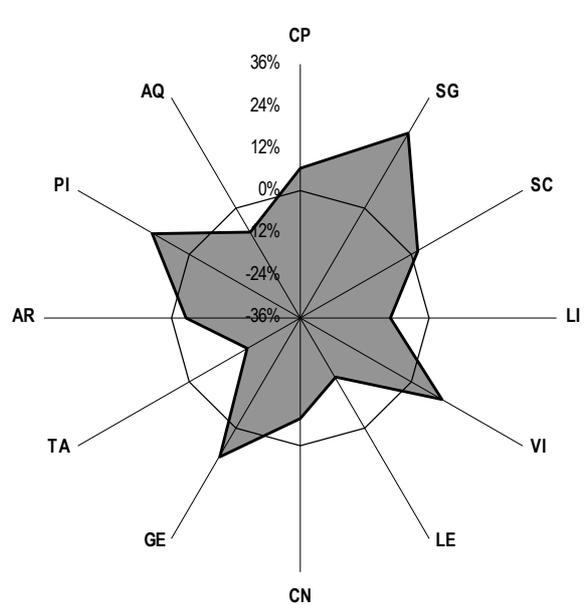
**Table 10.** Top panel: frequency of factors in 12 signs and 3 Qualities for the whole sample of 293 serial killers. Ascendant is given for 77 serial killers. Bottom panel: theoretically expected frequencies derived from a control group of 6000 persons (Ctrl1)

Obs	Ar	Ta	Ge	Cn	Le	Vi	Li	Sc	Sg	Cp	Aq	Pi	N	C	F	M	$p_M$
SO	26	14	29	21	24	17	24	25	31	33	19	30	293	104	82	107	
MO	27	21	22	19	20	33	15	28	29	32	18	29	293	93	87	113	
ME	15	22	25	20	19	21	20	28	35	32	27	29	293	87	96	110	
VE	26	22	19	24	15	27	19	28	30	22	38	23	293	91	103	99	
MA	20	16	32	33	24	42	19	24	31	15	21	16	293	87	85	121	
JU	23	18	35	19	21	27	26	32	28	20	13	31	293	88	84	121	
SA	24	17	13	24	23	26	25	25	31	32	22	31	293	105	87	101	
AS	4	7	7	5	6	9	14	4	12	1	3	5	77	24	20	33	
<b>Total</b>	<b>165</b>	<b>137</b>	<b>182</b>	<b>165</b>	<b>152</b>	<b>202</b>	<b>162</b>	<b>194</b>	<b>227</b>	<b>187</b>	<b>161</b>	<b>194</b>		<b>679</b>	<b>644</b>	<b>805</b>	
exp	Ar	Ta	Ge	Cn	Le	Vi	Li	Sc	Sg	Cp	Aq	Pi	N	C	F	M	
SO	23.9	24.1	25.4	24.8	26.9	22.7	23.9	22.5	21.9	24.8	25.5	26.5	293	97	99	97	
MO	25.6	24.8	25.4	22.5	23.3	24.3	25.5	23.9	24.2	23.7	25.1	24.7	293	97	97	99	
ME	23.1	21.8	20.3	24.0	24.6	24.4	23.5	26.1	25.8	26.2	26.0	27.2	293	97	98	98	
VE	28.7	22.2	23.7	26.1	22.7	29.1	18.4	26.6	23.7	20.5	28.4	22.9	293	94	100	99	
MA	19.6	23.2	25.9	28.3	29.2	28.7	26.7	26.3	23.1	20.7	21.5	19.7	293	95	100	98	
JU	23.7	26.7	24.0	23.5	21.2	23.6	29.1	30.2	26.7	21.2	20.4	22.7	293	97	99	97	
SA	22.8	21.1	15.8	21.8	26.1	22.6	26.1	26.6	28.7	32.8	23.1	25.5	293	103	97	93	
AS	4.0	4.6	6.0	7.6	8.4	7.7	8.3	8.2	8.0	5.6	4.7	3.9	77	25	26	26	
<b>Total</b>	<b>172</b>	<b>169</b>	<b>166</b>	<b>179</b>	<b>183</b>	<b>183</b>	<b>181</b>	<b>190</b>	<b>182</b>	<b>176</b>	<b>175</b>	<b>173</b>		<b>707</b>	<b>716</b>	<b>705</b>	1E-6
Ctrl2	159	165	163	174	179	172	164	206	211	200	170	165		697	720	711	3E-6
Ctrl3	170	148	189	176	167	169	167	195	211	221	160	160		734	670	729	2E-4

**Figure 8.** Histogram of bootstrap values of the total of astrological factors in Mutable, obtained by 500 resamples (each 293 subjects) randomly drawn with replacement from an independent control group of 6000 persons (Ctrl1). Mean: 705.4, standard deviation 20.8. The best fitting distributions are the gamma ( $p=0.92$ , KS-test) and the normal ( $p=0.87$ , KS-test). The value of serial killers (805) is in the extreme upper region of statistical significance ( $p=1E-6$ , normal, one-tailed)



**Figure 9.** Totals of eight factors per sign ( $\Sigma$  SO,MO,ME,VE,MA,JU,SA,AS) for the whole sample of 293 serial killers, radar-plotted as weighted deviation from the theoretically expected values derived from the control group (Ctrl1) of 6000 persons. The level of 0% marks the theoretical frequency

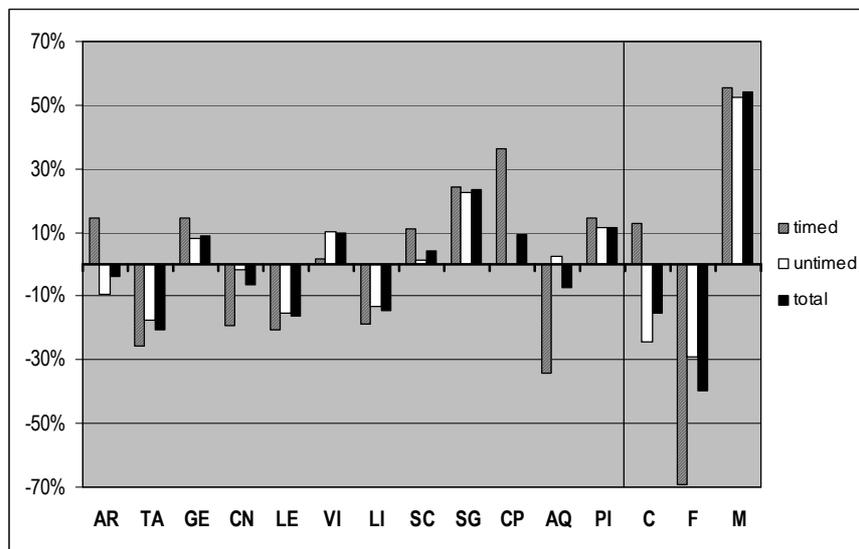


To investigate whether the differences between the two datasets are significant or not, I applied a two-way (2 x K) chi-square test to compare the two observed frequency distributions over the signs (K=12) and over the Qualities (K=3). Table 11 shows the results. Only Jupiter in the Qualities is significantly different, and this is due to a large excess of Mutable signs in the set of unknown birth times. The other  $p$  values are above the level required for significance, indicating that we can accept the null hypothesis that the two datasets do not render different results.

### Hypothesis 2

The Moon aspects for the whole sample are shown in Table 12. The chi-square g.o.f. value for the aspect totals is highly significant as shown in Figure 11 (wide orbs:  $\chi^2=21.6$ , bootstrap  $p=0.0005$ ; small orbs:  $\chi^2=19.3$ , bootstrap  $p=0.002$ ).

**Figure 10.** Totals of seven factors (no Ascendant) per sign and Quality, plotted as weighted deviation (%) from the theoretical frequencies derived from control groups (Ctrl1). Striped rectangles: 77 serial killers with known birth time; white rectangles: 216 serial killers with unknown birth time; black rectangles: whole sample of 293 serial killers. C=Cardinal signs, F=Fixed signs, M=Mutable signs



The deficit of Moon-Mars aspects and the surplus of Moon-MC aspects have most weight in this result, but these deviations were not predicted. The results remain significant when Ascendant and MC are excluded from the analysis ( $\chi^2=14.4$ , bootstrap  $p=0.01$ ). The few aspects with Mercury and Mars and the excess of Moon-Saturn aspects contribute most to this. The excess of Moon-Saturn is not individually significant, however. Hence, we can conclude that the aspects of the Moon deviate from expectancy, confirming Hypothesis 2, although the specific aspects that deviate most were unpredicted. Comparison of the Moon aspects for the two datasets in Figure 12 shows that the amplitude of the excesses and deficits is much higher in the dataset of known birth times than those of the unknown birth times. This finding may be due to the error margin of about  $6^\circ$  for the position of the Moon in the group with lacking birth times. The bar graph shows that the sign of the deviation (excess or deficit) is equal in both datasets, except for Moon-Mars aspects.

**Table 11.** Comparison between the datasets of known and unknown birth times for factors in signs and in qualities. ' $\chi^2$ ': two-way chi-square test statistic (expected values obtained by: row total x column total / N); ' $p$ ': bootstrap probability of  $\chi^2$  value.

factor	12 signs		3 qualities	
	$\chi^2$	$p$	$\chi^2$	$p$
SO	12.7	0.3	1.8	0.4
MO	7.2	0.8	5.2	0.07
ME	12.7	0.3	0.7	0.7
VE	7.3	0.8	0.4	0.8
MA	7.3	0.8	1.1	0.6
JU	18.3	0.09	7	0.03
SA	3.1	0.99	0.8	0.7
Total	12.8	0.48	2.4	0.25

**Table 12.** Frequency of Moon aspects for the whole sample of 293 serial killers. Ascendant and MC are known for only 77 subjects. See Legend of Table 3 for further details.

Small orbs														
obs	SO	ME	VE	MA	JU	SA	UR	NE	PL	AS	MC	none	$\chi^2$	$p$
0°	10	8	8	8	6	16	4	10	8	3	5			
60°	18	24	24	17	20	18	18	25	11	0	9			
90°	19	11	17	14	18	24	17	24	18	8	6			
120°	13	11	23	19	20	24	21	22	19	6	7			
180°	5	8	14	8	10	6	14	9	11	3	4			
Total	65	62	86	66	74	88	74	90	67	20	31	2068		
exp	SO	ME	VE	MA	JU	SA	UR	NE	PL	AS	MC	none		
0°	9.0	9.1	8.9	8.6	11.0	9.3	9.6	9.8	8.6	2.9	2.6			
60°	20.2	19.4	21.5	18.8	16.3	18.5	18.6	17.9	20.0	5.0	5.3			
90°	21.4	19.3	19.8	21.6	19.0	20.6	20.2	19.4	18.7	5.5	5.3			
120°	19.5	21.7	18.7	21.2	19.4	19.1	19.0	20.7	18.8	5.2	5.1			
180°	9.2	10.2	10.2	11.0	9.4	10.0	10.4	10.8	10.1	2.3	2.8			
Total	79.4	79.7	79.2	81.2	75.1	77.4	77.7	78.6	76.2	20.8	21.1	2045	19.3	2E-3
Wide orbs														
obs	SO	ME	VE	MA	JU	SA	UR	NE	PL	AS	MC	none	$\chi^2$	$p$
0°	16	13	14	14	9	22	11	19	14	5	8			
60°	18	24	24	17	20	18	18	25	11	0	9			
90°	25	22	27	21	21	29	24	30	23	13	8			
120°	21	18	25	24	23	33	26	26	28	8	10			
180°	11	12	22	11	20	14	19	15	18	6	7			
Total	91	89	112	87	93	116	98	115	94	32	42	1822		
exp	SO	ME	VE	MA	JU	SA	UR	NE	PL	AS	MC	none		
0°	15.8	16.2	14.8	14.7	18.0	16.3	15.6	15.5	14.8	4.5	4.3			
60°	20.2	19.4	21.5	18.8	16.3	18.5	18.6	17.9	20.0	5.0	5.3			
90°	27.4	26.0	26.2	27.9	25.9	27.3	25.8	25.3	26.6	7.4	6.8			
120°	27.0	27.6	25.9	27.5	25.7	24.8	26.1	27.7	25.2	6.9	6.8			
180°	15.0	16.0	17.5	18.5	15.6	16.7	16.9	17.5	16.8	4.0	4.4			
Total	105.5	105.2	105.9	107.4	101.6	103.6	103.1	103.8	103.4	27.8	27.7	1796	21.6	5E-4
Ctrl2	103.6	104.2	105.7	105.5	103.3	102.0	106.1	105.1	105.7	27.1	28.4	1794	17.5	5E-3
Ctrl3	106.1	104.7	108.0	102.4	102.3	105.9	102.4	102.9	102.7	28.6	29.2	1796	21.0	6E-4

The resemblance of the profiles of the Moon aspects in the two experimental groups is tested with a two-way (2 x 10) chi-square test. The results are shown in Table 13. The result is not significant and we reject the idea that the two distributions are different.

### Hypothesis 3

#### *Pisces*

The total frequency of the sign Pisces (194, see Table 10) is only marginally significant, as graphically presented in Figure 13.

#### *Neptune stress aspects*

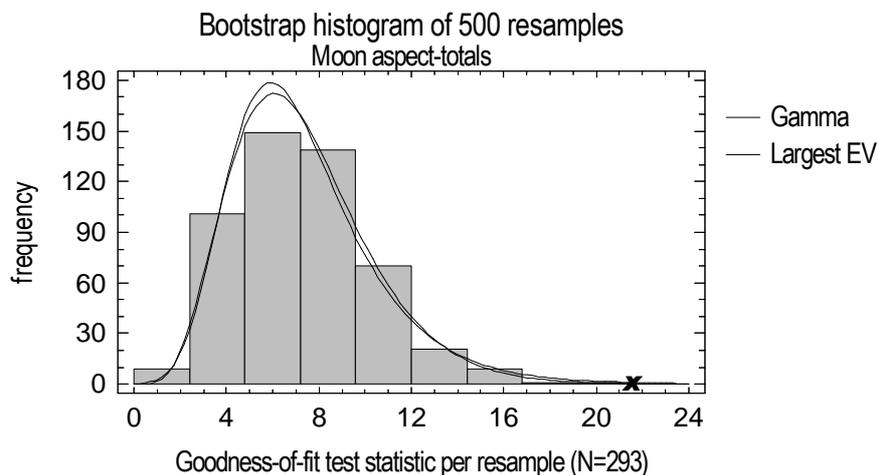
Table 14 shows the results for the comparison of Neptune stress aspects of all serial killers and the theoretical frequencies as derived from three control methods. The total frequency of Neptune stress aspects is significantly high in comparison with the corresponding value derived from control groups. The effect size is only weak (0,14, Glass's delta).

This result is consistent in both groups of known and unknown birth times (see Tables 6 and 9).

### Hypothesis 4

Hypothesis 4 states that stress aspects ( $0^\circ$ ,  $90^\circ$  and  $180^\circ$ ) of Mars with Saturn and especially Neptune should be frequent in serial killers. Table 15 shows the results for the whole sample of 293 serial killers. Mars-Saturn and Mars-Neptune aspects are about as frequent as expected. The other stress aspects of Mars with slow planets are just about what could be theoretically expected.

**Figure 11.** Histogram of chi-squared goodness-of-fit values for correlated data (Moon aspect totals) obtained by 500 resamples (each 293 subjects) drawn from an independent control group of 6000 persons (Ctrl1). The theoretically expected frequencies are derived from the means of Ctrl1. The best fitting distributions according to the log likelihood statistic are the gamma ( $p=0.59$ , KS-test) and Largest Extreme Value ( $p=0.25$ , KS-test). The corresponding value of the g.o.f. test statistic in 293 serial killers (21.6) is in the extreme upper region of statistical significance ( $p=0.0005$ , gamma).



**Table 13.** Comparison of Moon aspect totals for the dataset with known birth times and the dataset with missing birth times. ' $\chi^2$ ': two-way (2 x 10) chi-square test statistic (expected values obtained by: row total x column total / N). ' $p$ ': bootstrap probability of chi-square value.

Aspect-total	SO	ME	VE	MA	JU	SA	UR	NE	PL	none	$\chi^2$	$p$
Known birth time	18	23	32	29	22	36	24	35	24	450		
Missing birth time	73	66	80	58	71	80	74	80	70	1292	7.4	0.27

**Hypothesis 5**

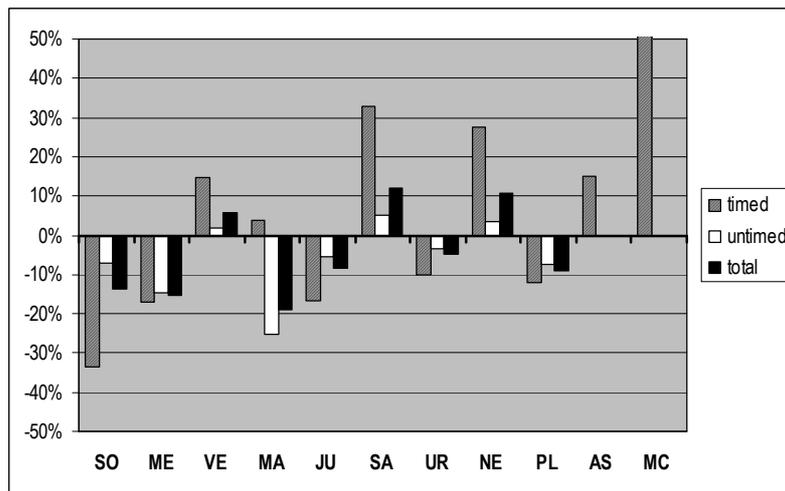
Hypothesis 5 states that Moon-Chiron and Mars-Chiron aspects are frequent among serial killers. Table 16 shows aspects of Chiron with fast-moving factors for the combined sample of 197 serial killers. Moon-Chiron and Mars-Chiron are just as frequent as could be expected from chance alone, and this also holds for the other aspects with Chiron.

**Shift control results**

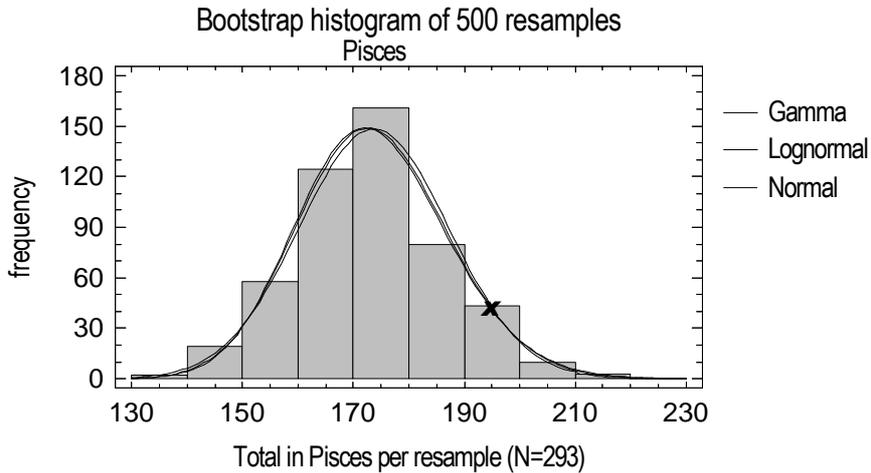
Figure 14 shows the total frequency of factors in Mutable signs (thick line, left axis) and the goodness-of-fit test statistic of Moon aspects (thin line, right axis) per shift-magnitude in days from the original births of 293 serial killers.

The frequency of Mutable is maximal at the original births and decreases in positive and negative direction from the zero shift. Secondary peaks at the 7-days shifts are probably related to the Moon, which shifts 3 signs in this shift magnitude. The goodness-of-fit test statistic for the Moon aspects shows only one peak at the original birth dates. There is no gradual levelling off since the Moon progresses relatively fast. These results demonstrate that demographical and astronomical artefacts do not account for the significant results of these variables.

**Figure 12.** Moon aspect totals (wide orbs) plotted as percentage deviation from the theoretical expectancies derived from a control group of 6000 persons (Ctrl1). Striped rectangles: dataset of timed births; white rectangles: dataset of untimed births (AS and MC not given); black rectangles: the whole sample of 293 serial killers



**Figure 13.** Histogram of bootstrap frequencies for the total of factors in Pisces obtained by 500 resamples (each 293 subjects) drawn from an independent control group of 6000 persons (Ctrl1). The best fitting distributions according to the log likelihood statistic are shown. The corresponding frequency of serial killers (194) is marginally significant ( $p=0,065$ , normal, one-tailed)



**Table 14.** ‘obs’: stress aspects ( $0^\circ+ 90^\circ+ 180^\circ$ , wide orbs) of Neptune for the whole sample of 293 serial killers. ‘p’: one-sided bootstrap probability for the comparison of the total of Neptune stress aspects with those of the control groups. The  $p$  values are obtained from a normal distribution (mean 414.7; standard deviation 17.5) fitted to the bootstrap histogram derived from Ctrl1.

	Obs	Ctrl1	Ctrl2	Ctrl3
NE/SO	70	58.7	57.0	54.9
NE/MO	64	58.2	59.9	58.7
NE/ME	63	57.7	55.8	56.5
NE/VE	70	59.4	59.1	63.3
NE/MA	55	55.3	54.4	54.0
NE/JU	62	58.6	56.0	56.0
NE/SA	73	65.9	67.9	63.4
Total	457	413.9	410.1	406.8
p		0.008	0.004	0.002

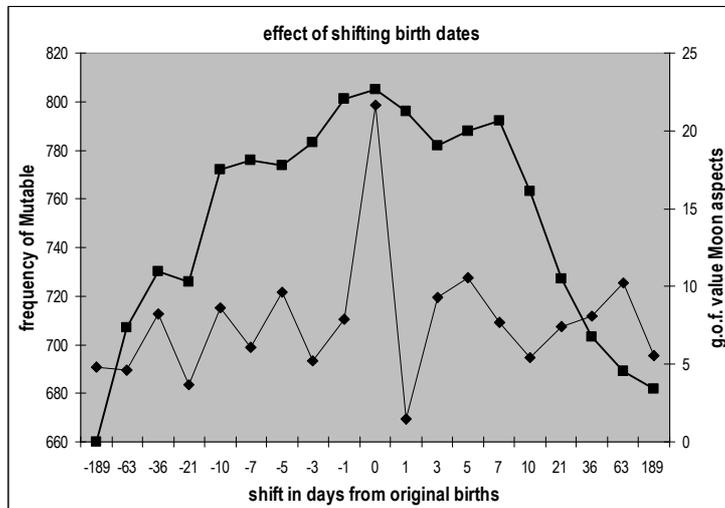
**Table 15.** Stress aspects of Mars with slow-moving planets in 293 serial killers (wide orbs). ‘obs’: frequency in serial killers. ‘exp’: theoretically expected frequencies derived from Ctrl1. ‘ $p(\chi^2)$ ’: probability of chi-squared goodness-of-fit value over 4 categories ( $0^\circ, 90^\circ, 180^\circ, \text{no aspect}$ )

		0°	90°	180°	no aspect	total	$p(\chi^2)$
MA/SA	obs	22	19	22	230	63	0.78
	exp	19.4	22.8	20.5	230.3	63	
MA/UR	obs	15	27	15	236	57	0.90
	exp	17.3	25.2	13.6	236.9	56	
MA/NE	obs	16	26	13	238	55	0.98
	exp	17.5	25.3	12.6	237.7	55	
MA/PL	obs	20	36	10	227	66	0.14
	exp	20.1	25.7	14.2	233.0	60	
Total	obs	108	60	931	241	241	0.83
	exp	99	61	938	234	234	

**Table 16.** Comparison between experimentally obtained and theoretically expected aspect frequencies (wide orbs) of the planetoid Chiron (CH) in 293 serial killers. 'obs': aspect frequency in 293 serial killers. 'exp': theoretically expected frequencies derived from Ctrl1.  $p(\chi^2)$ : probability of chi-squared goodness-of-fit value for the distribution over 6 categories (0°,60°,90°,120°,180°,no aspect)

Chiron aspects		0°	60°	90°	120°	180°	no aspect	aspect-total	$p(\chi^2)$
CH/SO	obs	16	14	21	27	18	197	96	0.50
	exp	17.0	19.3	26.4	25.8	13.6	191	102	
CH/MO	obs	16	15	26	31	12	193	100	0.79
	exp	17.3	18.1	25.9	26.9	16.2	189	104	
CH/ME	obs	13	22	34	22	15	187	106	0.50
	exp	17.7	22.2	26.0	26.0	14.5	187	106	
CH/VE	obs	17	14	26	25	16	195	98	0.78
	exp	17.4	19.9	24.8	21.7	14.5	195	98	
CH/MA	obs	11	22	35	25	16	184	109	0.87
	exp	13.9	20.0	30.6	26.7	14.1	188	105	

**Figure 14.** Effect of time-shifting the birth dates for the whole sample of 293 serial killers. The original birth dates are shifted with various amounts as indicated on the x-axis. Thick line: Total of astrological factors in Mutable signs. Thin line: value of goodness-of-fit test statistic for the distribution of Moon aspects in comparison with the theoretical frequencies derived from control group Ctrl1. Note that the original birth dates render the largest results.



**Conclusion and discussion**

In this study, I tested three major and two minor hypotheses of astrologers about serial killers. Data with reliable birth time were selected from AstroDatabank [5] and from Lasseter & Holliday (1999), and data without birth time from several relevant Internet sources [6,7,8]. In advance I made a checklist for selection criteria because clear boundaries between the different types of multiple killers do not exist.

The findings support the major hypotheses. The two minor hypotheses are not supported.

If we consider the celestial factors Sun, Moon, Mercury, Venus, Mars, Jupiter and Saturn and also the Ascendant, serial killers show a far higher emphasis on Mutable signs than expected ( $p = 1E-6$ ). Mars and Jupiter contribute most to the excess of Mutable. The prediction 'especially for the Moon sign' was confirmed in the group with timed birth data, but not in the group with lacking birth time.

Secondly, I found that the distribution of the aspects between the Moon and the other factors deviated from expectancy ( $p = 0.0005$ ). A high frequency of Moon-MC and a low frequency of Moon-Mars aspects are the main contributors. Deviations of these specific aspects were not predicted. A high frequency of Moon-Saturn aspects is observed only in the dataset with known birth times. The low frequency of Mars aspects is observed only in the group with unknown birth times.

Thirdly, I found a far higher frequency of celestial factors in the 12<sup>th</sup> house than expected. Neptune, in astrological theory the planet corresponding with this house, contributes most. Furthermore, we observe a high frequency of Pisces (only marginally significant) and far more 'stress aspects' of Neptune than expected.

With respect to the two minor hypotheses, 'stress aspects' of Mars with slow-moving planets (Jupiter, Saturn, Uranus, Neptune and Pluto) do not deviate significantly from the theoretically expected frequencies, and aspects of the planetoid Chiron with the personal factors (Sun, Moon, Mercury, Venus and Mars) do not deviate from what could be expected by chance alone.

Since five hypotheses were tested, the alpha level must be set at  $0.05/5 = 0.01$  in order for any hypothesis to be genuinely significant. Mutable signs ( $p=1E-6$ ), Moon aspects ( $p=5E-4$ ), the 12<sup>th</sup> house ( $p=0.008$ ) and Neptune stress aspects ( $p=0.008$ ) are all genuinely significant, implying that the overall result over five hypotheses is significant. Hypotheses 1 and 3 partly overlap, which implies that the frequency of Pisces should not be counted again in Hypothesis 3.

Should the results indeed be addressed to astrological effects or to other factors? Could there be a serious selection bias?

One possibility is that the serial killers mentioned in the data sources are preselected to fit astrological assumptions. That cannot be completely excluded for the serial killers mentioned in the sources with known birth time. Birth times are usually collected by astrologers, or people with astrological interest, and publication may occasionally be omitted when the chart doesn't fit the preconceived ideas of what a serial killer chart should look like. The used Internet sources can be considered as being completely free from such bias. It is important that comparison between the dataset from the Internet and the dataset with known birth time does not reveal significant differences. This indicates that selection bias, if any, is very small.

My own choice to select some data and eliminate others was in a few cases arbitrary where it was not unequivocal from the biographies what type of killer a subject is. Other investigators might have made other choices. In these cases I determined the score percentage on items in the serial killer checklist given in Appendix A, and selected the killer type that had the highest score. Because this was done beforehand according to circumscribed criteria, it didn't bias the investigation on astrological grounds and cannot have lead to systematic errors.

The insecurity of the ecliptical position of the Moon in the dataset with lacking birth time may be responsible for the smaller effect of the Moon in this dataset as compared to the dataset with known birth time. This holds for the frequencies of the Moon in Mutable signs (Hypothesis 1) and for the Moon aspects (Hypothesis 2). The p value of Moon aspects (without Ascendant and MC) is 0.05 in the set with known birth time versus  $p=0.13$  in the set with unknown birth time, even though the second set is much larger. It could be argued that this implies that the result is not reproducible and not significant overall. However, the Moon aspects in the whole sample are significant ( $p=0.0005$ ) and the excesses or deficits are similar in both datasets (except for Moon-Mars aspects, see Figure 12). The fact that the deviations of specific aspects are qualitatively similar but quantitatively less leads to the conclusion that the insecurity of the Moon is the most likely candidate for the small effect size in the set of lacking birth times.

The assumption of astrologers Liz Greene and the late Howard Sasportas, that the Moon plays a significant role in the birth charts of serial killers with respect to signs and aspects cannot be rejected on the basis of the present findings. The effect sizes of the Moon by sign and by aspect are, nevertheless, small. The finding of Liz Greene of frequent Moon- $120^\circ$ -Saturn aspects among serial killers (Greene, 2003h) is substantiated in the present datasets but the frequency is not even individually significant. The suggestion of Liz Greene that Moon-Saturn aspects are most effective in mixed aspects, such as the combination with Moon-Neptune aspects (Greene, 2003l), needs further study.

The additional finding of a significant low frequency of Fixed signs is not predicted by astrologers, except for Mercury. It was argued that psychopaths have a low boredom threshold and short attention span, and Mercury in Mutable signs, by analogy, would fit this characteristic (Greene 2003a). However, the low frequency of Fixed signs is mainly caused by Sun, Mars and Jupiter, not Mercury. Mutable signs and Fixed signs are opposites in astrological analogy. The observed low frequency of the combination Fixed signs - Succedent houses, which are corresponding in astrological theory, and the high frequency of the combination Mutable signs - Cadent houses, also corresponding, would be in line with this analogy.

### Endnotes

1. It has been hypothesized that people with an emphasis on Mutable signs are more vulnerable to contradictory experiences and feelings in early childhood (Greene & Sasportas, 1987b). Sasportas hypothesizes that this may be applicable to a serial killer. A low boredom-threshold and short attention span, part of the clinical picture of psychopaths, is attributed to Mutable signs as well (Greene, 2003b). Mercury in Mutable signs, in contrast to Mercury in Fixed signs, is also mentioned in this context (Greene, 2003a).
2. The "critical role of the Moon" (Greene, 2003d) refers to specific positions, such as the Moon in Mutable signs, and aspects, such as Moon-Saturn. This is based on the assumption that lack of empathy, lack of relatedness and the dissociation from feelings (as in psychopaths) is a lunar function (Greene, 2003b,c). It is also claimed that the Moon reflects the primal bond with the mother, who often plays a negative role in the youth of serial killers. Moon-Saturn and Moon-Uranus aspects would be a predisposition for dissociation (Greene, 2003f,i). Moon-Saturn aspects, especially trines, would be frequent in the charts of psychopathic killers (Greene, 2003h). Mixed aspects, such as Moon-Saturn or Moon-Uranus together with Moon-Neptune or Moon-Pluto would be a strong indicator for dissociation (Greene, 2003l). Not all Moon aspects are expected to be high: Moon-Jupiter aspects are probably low (Greene, 2003j).

3. This assumption is based on the strong fantasy life, receptiveness to collective stimuli, display of charm, conning, parasitic lifestyle and isolation of psychopaths (Greene, 2003*e*). It also reflects the sense of weakness and impotence, which is denied and projected on others to restore an illusory sense of power (Greene & Sasportas, 1987*a*). Neptune and the 12<sup>th</sup> house are associated with the victim-persecutor theme (Greene, 2003*m,n*) and a strongly placed Neptune (in 12<sup>th</sup> house or by stress aspects) may be linked to sadism (Greene, 2003*o*; Greene, 2000). Mars-Neptune aspects are also mentioned in this context (Greene, 2003*g*). Pisces, the 12<sup>th</sup> house and Neptune represent the so-called 12<sup>th</sup> principle.
4. Astrologer Liz Greene has hypothesized that the comet or planetoid Chiron, discovered in 1977, plays a role in the charts of psychopathic killers. Chiron-Moon and Chiron-Mars aspects would be especially frequent (Greene, 2003*q*).
5. Rodden, L. & McDonough, M. *AstroDatabank*, version 3.0, AstroDatabank Company, 708 Grove St. Worcester MA 01605, USA.
6. Wikipedia at the URL: [http://en/de/fr/nl.wikipedia.org/wiki/Serial\\_killer](http://en/de/fr/nl.wikipedia.org/wiki/Serial_killer)
7. Serial killers, the complete list in Crimelibrary at URL: [http://www.crimelibrary.com/serial\\_killers/complete\\_list.html](http://www.crimelibrary.com/serial_killers/complete_list.html)
8. Serial Killer Timelines biographies written by Radford University students at URL: [http://maamodt.asp.radford.edu/Psyc%20405/serial\\_killer\\_timelines.htm](http://maamodt.asp.radford.edu/Psyc%20405/serial_killer_timelines.htm)
9. Cremer, J. *Planetdance*. Astrological software for researchers. URL: <http://planetdance.dyndns.org/>
10. StatGraphics Centurion XV, version 15.2.06.
11. The goodness-of-fit test statistic for correlated data does not follow a chi-squared distribution.
12. NIST/SEMATECH, "e-Handbook of Statistical methods", at URL: <http://www.itl.nist.gov/div898/handbook/eda/section3/bootplot.htm>
13. Bootstrap *p* values are derived from the histogram of the independent control group Ctrl1 as recommended (Bollen, 1992).

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## Appendix A

### SERIAL KILLER CHECKLIST

#### Characteristics of serial killers (“men hunters” or “predators”)

- two or more murders at separate events (1-3 victims per event)
- victim selection (targeting a specific, usually vulnerable, type of victim)
- planning activities before the killings
- avoids being captured
- murders are the result of own decision and done out of free will
- cooling-off period between murder events, reverts back to normal life while hiding the crimes (this period ranges from hours to years)
- sadism, psychological or physical
- motive is psychological gratification (such as sex, power, comfort)
- usually kills because he needs to kill
- usually, but not always, overkill (body mutilation, dismemberment)
- occasionally ritualistic behaviour

#### Characteristics of rampage killers (“human time bombs”)

##### *Mass murder:*

- four or more victims within a relatively short time (hours, sometimes days)
- usually, but not always, at one location
- mostly not sexually motivated
- often ends with (provoked) suicide
- does not revert back to normal life between each kill
- mostly no sadism involved
- no overkill, usually shoots victims
- mostly no victim selection, kills males and females

##### *Spree killer (mobile mass murderer):*

- two or more victims at different locations during a longer period (days or weeks)
- prevents being captured, is usually on the run
- usually motivated by revenge
- does not revert back to normal life between each kill
- mostly no sadism or sex involved
- no overkill, usually shoots victims

##### Exclude from analysis:

Rampage killers, bank robbers, armed robberies, hit men from the drugs scene, the mafia or other gangs, war criminals, terrorists, murderers who kill their partner out of jealousy.

### Appendix B

Serial killers with known birth time obtained by a query in AstroDatabank to select all males of the category 'homicide serial' with reliable (Rodden rating AA, A, B) birth data after the year 1800, and excluding the category terms 'terrorist', 'mafia' and 'nazi'. Three serial killers were found elsewhere in AstroDatabank (right panel, below). Eight serial killers from another source are added (right panel, bottom). 'x': excluded from the dataset. Source is AstroDatabank unless otherwise indicated.

Name		comment	name		comment
Assis, Francisco			Landru, Henri Desire		
Audouit, Ludovic	x	mass murderer; killed family at one event	Lastennet, Claude		
Bar-Jonah, Nathaniel			Lemons, Marvin		
Berdella, Bob			Louis, Emile		
Berkowitz, David			Manson, Charles	x	ordered his gang to ritual killings / mass murder
Bernardo, Paul			Mathurin, Jean-Thierry		
Bonin, William			Mullin, Herbert		
Bosket, Willie	x	armed robbery; stabbed 2 men at robbery, killed boy in a fight	Nilsen, Dennis		
Brady, Ian Stewart			Olson, Clifford		
Brunot, Martin Lewis	x	mass murderer; killed wife and 2 sons at one event	Pacciani, Pietro		
Buell, Robert			Paulin, Thierry		
Bundy, Ted			Petiot, Dr. Marcel		
Buono, Angelo			Pignon, Gerard	x	single homicide: accomplice in one murder
Carpenter, David			Ponte, Kenneth	x	suspected of killing a woman, charge dropped in 2008
Carvalho, Clarence			Profeta, Michele	x	armed robbery
Chapman, Irving	x	fatal car accidents due to drunk driving	Puch, Carlos		
Clark, David R.	x	beat a man to death, killed policeman at his arrest	Raffin, Pascal	x	serial arsonist
Coleman, Dennis	x	single homicide, mistakenly categorized as serial	Ramirez, Rafael		
Collins, John Norman			Ramirez, Ricardo		
Corll, Dean Arnold			Richey, Tom	x	single homicide
Cottingham, Richard			Romand, Jean-Claude	x	mass murderer
Cunanan, Andrew	x	rampage killer; see crimelibrary.com	Shawcross, Arthur		
Dahmer, Jeffrey			Smith, Edgar Herbert	x	killed a girlfriend in a conflict, killed a woman 19 years later during a robbery
Dillon, Thomas			Sobhraj, Charles		
Dutroux, Marc			Starkweather, Charles	x	spree killer (Wikipedia)
Eberling, Richard			Stayner, Cary		
Ferguson, John Errol	x	mass murderer: 6 victims at one event, drugs related.	Stevanin, Gianfranco		
Furlan, Marco			Succo, Roberto	x	rampage killer; see: <a href="http://www.iofilm.co.uk/feats/interviews/r/roberto_succo.shtml">www.iofilm.co.uk/feats/interviews/r/roberto_succo.shtml</a>
Gacy, John Wayne			Sutcliffe, Peter		
Gallego, Gerald			Tingler, Richard	x	mass murder at armed robbery, drugs related
Gamper, Ferdinand			Tissier, Patrick		
Gaynor, Alfred			Troppmann, Jean-Baptiste	x	mass murderer of a family
Gein, Edward			Vacher, Joseph		
Girard, Henri			Weidmann, Eugen		
Goode, Arthur			West, Frederick		
Haarmann, Fritz			Whitney, Dennis	x	spree killer; see: <a href="http://www.skcentral.com/readarti">www.skcentral.com/readarti</a>

				cle.php?article_id=532
Harvey, Donald			Williams, Wayne	
Hatcher, Charles Ray			Woodfield, Randall Brent	
Heath, Neville				
Heirens, William			Bartsch, Jurgen	serial killer, mistakenly categorized as homicide single
Homicide 1179	x	multiple murderer; first murder was accidental, two were hired hits, fourth was a fellow prisoner	Costa, Antone	serial killer, mistakenly categorized as mass murderer
Homicide 2562			Lupo, Michele	serial killer, mistakenly categorized as mass murderer
Homicide 7910				
Jackson, Arthur	x	bank robber and stalker	Bland, Warren James	source: "Zodiac of Death", from birth certificate
Joubert, John			Chase, Richard Trenton	source: "Zodiac of Death", from birth certificate
Kalhauser, John	x	domestic/vengeance/jealousy: killed one man, tried to kill his wives' boyfriend; possibly killed his new wife after she filed for divorce (not proved)	Debardeleben, James Mitchell	source: "Zodiac of Death", from birth certificate
Kearney, Patrick			Heidnik, Gary	source: "Zodiac of Death", from birth certificate
Kemper, Edmund			McDuff, Kenneth Allen	source: "Zodiac of Death", from birth certificate
Kimes, Kenneth Jr.	x	multiple murderer, not mentioned as serial killer in the Encyclopedia of serial killers, wikipedia and crimelibrary.com	Rolling, Danny	source: "Zodiac of Death", from birth certificate
Kinman, Donald			Russell, George Waterfield	source: "Zodiac of Death", from birth certificate
Kniesek, Werner			Suff, William Lester	source: "Zodiac of Death", from birth certificate
Kraft, Randy				
Kurten, Peter				

## Appendix C

Serial killers with unknown birth time (12:00 AM local time) from three Internet sources [25,27,29].  
All serial killers from these three sources are mentioned and multiple names are removed. 'x':  
excluded from the dataset, reason for exclusion given in column 'comment'.

name		comment	name		comment
<i>From Wikipedia[ref]:</i>			Murphy, Lenny		
Abel, Wolfgang	X	date not given & not found	Nagayama, Norio		
Adams, John Bodkin			Nakamura, Seisaku	x	date not given & not found
Albright, Charles	X	Wrongly convicted [29]	Neilson, Donald	x	Armed robbery
Alegre, Patrice			Nelson, Earle Leonard		
Al-Hubal, Abdallah	X	date not given & not found	Nesset, Arnfinn		
Allen, Howard			Ng, Charles		
Andermatt, Roger	X	date not given & not found	Nielsen, Dennis	x	mentioned in Appendix B
Angelo, Richard			Nishiguchi, Akira		
Artieda, Ramiro	X	date not given & not found	Ogorzow, Paul		
Asratyan, Valeriy	X	date not given & not found	Okubo, Kiyoshi		
Atkins, Benjamin			Olson, Clifford Robert	x	mentioned in Appendix B
Ausonius, John			Onoprienko, Anatoly		
	X	date not given & not found		x	Multiple murderer: killed own wife for another relationship, killed a man in prison to escape
Bailey, Leslie			Opdam, John		
Ball, Joe			Ott, Wolfgang	x	date not given & not found
Baoshan, Bai	X	date not given & not found	Pacciani, Pietro	x	mentioned in Appendix B
Barbeault, Marcel			Palmer, William	x	
	X	date not given & not found	Pandher, Moninder Singh	x	date not given & not found
Barbosa, Daniel			Pándy, András		
Bartsch, Jürgen	X	mentioned in Appendix B	Panzram, Carl		
Baumeister, Herb			Paulin, Thierry	x	mentioned in Appendix B
Bean, Alexander	X	date not given & not found	Peiry, Michel		
Behram, Thug	X	date not given & not found	Pekalski, Leszek		
Bellen, Michel	X	date not given & not found			
	X	mentioned in Appendix B		x	gamble-addict , poisoned familymembers and creditors to get rid of his debts
Berdella, Robert			Peterson, Christopher		
Berkowitz, David	X	mentioned in Appendix B	Petiot, Marcel	x	mentioned in Appendix B
Bernardo, Paul	X	mentioned in Appendix B	Petrovs, Kaspars	x	date not given & not found
Bianchi, Kenneth			Pichushkin, Alexander		
Biegenwald, Richard Fran			Pickton, Robert		
Bijeh, Mohammed			Pleil, Rudolf		
Bilancia, Donato			Plut, Silvo		
Bingelhelm, Simon	X	date not given & not found	Poehlke, Norbert	x	date not given & not found
Birnie, David	X	date not given & not found	Pomeroy, Jesse		
Bishop, Arthur Gary	X	date not given & not found	Pommerenke, Heinrich	x	date not given & not found
Bittaker, Lawrence			Price, Craig		
Black, Robert			Prince, Cleophus	x	date not given & not found
Boden, Wayne	X	date not given & not found	Pruett, Marion Albert	x	date not given & not found
Bogoslevsky, Rostislav	X	date not given & not found	Puch, Carlos Robledo	x	mentioned in Appendix B
Bonin, William	X	mentioned in Appendix B	Quansah, Charles	x	date not given & not found
Bonner, Nicolai	X	date not given & not found	Quick, Thomas		
Bounds, Dallen	X	Revenge/jealousy	Rader, Dennis		
Bradford, William Richard			Raghav, Raman	x	date not given & not found
Brady, Ian	X	mentioned in Appendix B	Rais, Gilles de	x	born before 1800
Browne, Robert Charles			Ramirez, Richard	x	mentioned in Appendix B
Brudos, Jerry			Ray, David Parker		
Bundy, Ted	x	mentioned in Appendix B	Reid, Paul Dennis	x	Mass murderer at robberies
			Resendiz, Angel Maturino	x	mentioned in Appendix B
Bunting, John					
Buono, Angelo	x	mentioned in Appendix B	Rezala, Sid Ahmed		

Burke, William	x	date not given & not found	Ridgway, Gary Leon		
Bury, William Henry			Rifkin, Joel		
Calva, José Luis			Rimaru, Ion		
Carignan, Harvey			Robinson, Harvey Miguel		
Carpenter, David	x	mentioned in Appendix B	Robinson, John Edward		
Chanal, Pierre			Rogers, Dayton Leroy		
Chapman, George			Rolling, Danny	x	mentioned in Appendix B
Chase, Richard Trenton	x	mentioned in Appendix B	Rooyen, Gert van	x	date not given & not found
Chiatti, Luigi			Ross, Michael		
Chikatilo, Andrei			Rowntree, Mark	x	date not given & not found
Christiansen, Thor Nis			Runbo, Gong	x	date not given & not found
Christie, John Reginald			Rung, Thomas		
Clark, Hadden	x	date not given & not found	Ryakhovsky, Sergei	x	date not given & not found
Clark, Ronald E.	x	date not given & not found	Saldivar, Efen		
Cole, Carroll			Sanchez, Altemio		
Coleman, Alton			Sappington, Marc	x	Spree killer
Conahan, Daniel			Schaefer, Gerard John		
Constanzo, Adolfo de Jesus			Schenk, Hugo		
Cooke, Eric Edgar			Schmid, Charles		
Corll, Dean	x	mentioned in Appendix B	Schmidt, Wolfgang		
Corona, Juan	x	date not given & not found	Scripps, John Martin		
Costa, Antone	x	mentioned in Appendix B	Seda, Heriberto		
Cottingham, Richard	x	mentioned in Appendix B	Seefeldt, Adolf		
Covington, Juan			Sells, Tommy Lynn		
Crawford, John Martin			Sharif, Abdul Latif	x	date not given & not found
Cream, Thomas Neill			Shawcross, Arthur	x	mentioned in Appendix B
Cullen, Charles			Shipman, Harold		
Cunanan, Andrew	x	mentioned in Appendix B	Shulman, Robert		
Dahmer, Jeffrey	x	mentioned in Appendix B	Siebert, Daniel Lee		
Däter, Olaf	x	date not given & not found	Silveria, Robert Joseph		
Dengiz, Özgür	x	date not given & not found	Singleton, Larry		
Denke, Carl			Sithole, Moses	x	date not given & not found
Denyer, Paul			Slivko, Anatoly	x	date not given & not found
DeSalvo, Albert			Smith, George Joseph		
Diaz, Robert	x	Spree killer	Smith, John	x	date not given & not found
Dinsdale, Peter	x	Arsonist	Smith, Lemuel		
Dodd, Westley Allan			Sobhraj, Charles	x	mentioned in Appendix B
Dominique, Ronald	x	date not given & not found	Solomon, Morris	x	date not given & not found
Duffy, John	x	date not given & not found	Speck, Richard	x	Mass murderer
Duncan, Joseph Edward			Spesivtsev, Alexander		
Dupas, Peter Norris			Spillman, Jack Owen	x	date not given & not found
Dutroux, Marc	x	mentioned in Appendix B	Spruit, Gerard		
Dzhumagaliev, Nikolai	x	date not given & not found	Staniak, Lucjan	x	date not given & not found
Eckert, Volker			Stano, Gerald Eugene		
Edwards, Mack Ray	x	date not given & not found	Starkweather, Charles	x	mentioned in Appendix B
Eijk, Willem van			Stayner, Cary	x	mentioned in Appendix B
Engleman, Glennon	x	date not given & not found	Straffen, John		
Erskine, Kenneth	x	date not given & not found	Stumpp, Peter	x	date not given & not found
Erskine, Scott	x	date not given & not found	Stutzbach, Henry	x	date not given & not found
Escalero, Francisco Garcia			Succo, Roberto	x	mentioned in Appendix B
Evans, Donald Leroy	x	date not given & not found	Suff, William Lester	x	mentioned in Appendix B
Evans, Gary	x	Armed robberies / revenge: killed three accomplices	Suradji, Ahmad	x	date not given & not found
Eyler, Larry			Sutcliffe, Peter	x	mentioned in Appendix B
Fernandez, Raymond			Swango, Michael		
Fierro, Rodolfo	x	date not given & not found	Swann, James	x	date not given & not found
Fish, Albert			Taskinen, Antti	x	date not given & not found
Ford, Wayne Adam			Tchayka, Alexander	x	date not given & not found
Fourniret, Michel			Thwala, Siphos	x	date not given & not found
Francois, Kendall			Toole, Otis		
Franklin, Joseph Paul			Travis, Maury		

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Fraser, Leonard			Trobec, Metod		
Fuchs, Franz			Tschikatilo, Andrei R		
Fukiage, Sataro	x	date not given & not found	Turner, Chester		
Fyfe, William Patrick			Unterweger, Jack		
Gacy, John Wayne	x	mentioned in Appendix B	Vacher, Joseph	x	mentioned in Appendix B
Gallego, Gerald	x	mentioned in Appendix B	Vargas, Dorangel		
Garavito, Luis			Vega, Jose Antonio R		
Garrow, Robert			Villegas, Manuel Delgado		
Gary, Carlton			Vlassakis, James		
Gaskins, Donald Henry			Wagner, Robert		
Gein, Ed	x	mentioned in Appendix B	Wallace, Henry Louis		
Georges, Guy			Watson, Charles	x	Mass murderer
Glatman, Harvey			Watts, Coral Eugene		
Glover, John Wayne			Weidmann, Eugen	x	mentioned in Appendix B
Godino, Cayetano Santos			West, Frederick	x	mentioned in Appendix B
Gonzalez, Daniel	x	date not given & not found	Wilder, Christopher		
Gorton, Jeffrey Wayne			Williams, Wayne	x	mentioned in Appendix B
Gosmann, Klaus	x	date not given & not found	Woodcock, Peter		
Goudeau, Mark			Woodfield, Randall Brent	x	mentioned in Appendix B
Greenwood, Vaughn			Xinhai, Yang		
Grossman, Karl			Xitavhudzi, Elias	x	date not given & not found
Gufler, Max			Yates, Robert Lee		
Gust, Frank	x	date not given & not found	Young, Graham Frederick		
Haapoja, Matti	x	robbery-murders / killed guards at escape from prison	Young-chul, Yoo	x	date not given & not found
Haarmann, Fritz	x	mentioned in Appendix B	Zelenka, Petr		
Hagedorn, Erwin			Zikode, Mhlengwa	x	date not given & not found
Haigh, John George			Alegre, Patrice		
Hanaei, Saeed	x	date not given & not found	Bodein, Pierre		
Hansen, Robert			Zon, Hans van		
Hardy, Anthony			<b>Additional names from CrimeLibrary:</b>		
Hare, William	x	date not given & not found	Anderson, Robert Leroy	x	date not given & not found
Harvey, Donald	x	mentioned in Appendix B	Armstrong, John Eric		
Hatcher, Charles	x	mentioned in Appendix B	Avery, Steven	x	wrongly convicted, later accused of 1 murder
Hauert, Erich	x	date not given & not found	Baker, Allan	x	date not given & not found
Heaulme, Francis			Collins, John Norman	x	mentioned in Appendix B
Heidenberger, Egon			Courtney, Joel Patrick		
Heidnik, Gary	x	mentioned in Appendix B	Crump, Kevin	x	date not given & not found
Heirens, William	x	mentioned in Appendix B	Davis, Richard Allen	x	One murder
Hertogs, Koos	x	date not given & not found	Davis, Richard Dean		
Hidaka, Hiroaki	x	date not given & not found	DeBardeleben, Mike	x	mentioned in Appendix B
Holmes, H.H.			Deeming, Frederick Bailey	x	Mass murderer of his own family
Holst, Thomas	x	date not given & not found	DeMeo, Roy	x	mafia
Honka, Fritz			Dillon, Thomas	x	mentioned in Appendix B
Imiela, Arwed			Dumollard, Martin		
Iqbal, Javed	x	date not given & not found	Durrant, Theo	x	date not given & not found
Ireland, Colin			Ford, Dr. Larry C.	x	one murder related to weapon business
Irvin, Leslie	x	date not given & not found	Gilyard, Lorenzo		
Jablonski, Philip Carl			Gotti, John	x	Mafia
Jarabo, José María	x	Spree killer	Graham, Harrison		
Jefferies, Mark	x	date not given & not found	Hussein, Uday	x	War, son of Saddam Hussein
Jespersion, Keith			Jones, Jeremy Bryan		
Johnson, Russell	x	date not given & not found	Kunowski, Andrezej	x	One murder
Johnson, Vincent			Lewingdon, Gary	x	date not given & not found
Jordan, Gilbert Paul			Lewingdon, Thaddeus	x	date not given & not found
Joubert, John	x	mentioned in Appendix B	Luckman, Paul	x	One murder

Kaczynski, Theodore			McCafferty, Archibald B	x	date not given & not found
Kallinger, Joseph			Mengele, Dr. Josef	x	nazi
Katsuta, Kiyotaka			Miller, James	x	date not given & not found
Kearney, Patrick	x	mentioned in Appendix B	Mullen, Michael	x	date not given & not found
Kemper, Edmund	x	mentioned in Appendix B	Neelley, Alvin	x	date not given & not found
Kiss, Bela	x	date not given & not found	Norris, Roy		
Knowles, Paul John			O'Neill, Darren		
Kodaira, Yoshio			Packer, Alfred	x	date not given & not found; ate dead bodies for survival in winter
Koli, Surrender	x	date not given & not found	Pierce, William "Junior"	x	One murder; date not given & not found
Koltun, Julian	x	date not given & not found	Porter, Father James	x	Committed no murders
Kraft, Randy	x	mentioned in Appendix B	Ranes, Danny	x	date not given & not found
Krajcir, Timothy			Ranes, Larry	x	date not given & not found
Kroll, Joachim			Rees, Melvin	x	date not given & not found
Kudzinowski, Peter	x	date not given & not found	Reid, Robin	x	One murder
Kuklinski, Richard	x	date not given & not found	Rogers, Glen		
Kulik, Vasily			Ruloff, Edward	x	date not given & not found
Kurita, Genzo			Russell, George Waterfield	x	mentioned in Appendix B
Kürten, Peter	x	mentioned in Appendix B	Sagawa, Issei	x	One murder
Lake, Leonard			Selepe, David	x	date not given & not found
Landru, Henri	x	mentioned in Appendix B	Soto, Erno	x	date not given & not found
LeBaron, Ervil	x	leader of religious fundamentalists; ordered to kill rivals and opponents	Spanbauer, David	x	januari 1941, no day found
Lee, Derrick Todd			Spangler, Robert		
Legere, Allan	x	date not given & not found	Todd, Sweeney	x	Birth date unreliable and before 1800
Leonski, Eddie			Weaver, Ward		
Letter, Stephan			Wilken, Stewart		
Long, Bobby Joe			Worrell, Christopher	x	date not given & not found
Lopez, Pedro Alonso			Zarinsky, Robert	x	date not given & not found
Louis, Émile	x	mentioned in Appendix B	<b>Additional names from Radford University:</b>		
Lucas, Henry Lee			Anderson, Dale		
Lüdke, Bruno			Bland, Warren James	x	mentioned in Appendix B
Lupo, Michael	x	mafia	Blank, Daniel	x	date not given & not found
Maake, Cedric	x	date not given & not found	Campbell, Charles	x	Mass murderer
MacDonald, William	x	date not given & not found	Colson, Robert		mass murderer; killed his family of 5 at one event for insurance money
Mackay, Patrick			Conde, Rory		
Maeue, Hiroshi			Copeland, David	x	mass murderer, bombing; killed 4 at one event, wounded many
Malvo, Lee Boyd	x	spree killer	Copeland, Ray	x	date not given & not found
Manson, Charles	x	mentioned in Appendix B	Daveggio, James		
Manuel, Peter			Durousseau, Paul		
Marchwicki, Zdzislaw			Erler, Bob	x	date not given & not found
Marroquín, Raúl Osiel	x	date not given & not found	Evonitz, Richard		
Matsunaga, Futoshi			Gillis, Sean Vincent		
Maudsley, Robert			Hickey, Frank		
Maust, David Edward			Hopewell, Raymont		
Mazurkiewicz, Wladyslaw	x	date not given & not found	Krebs, Rex Allen		
McDuff, Kenneth	x	mentioned in Appendix B	Lindsey, William Darrell		
McGray, Michael Wayne	x	date not given & not found	Rhodes, Robert Ben		
Meirhofer, David	x	date not given & not found	Rode, Adolph James		
Mendenhall, Bruce			Roth, Randy		
Milat, Ivan			Starrett, Danny	x	One murder
Miyazaki, Tsutomu			Wardrip, Farion		
Modzieliewski, Stanislaw	x	date not given & not found	Warren, Lesley Eugene		

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Mondria, Aalt	x	date not given & not found	Wood, James Edward	
Moore, Peter	x	date not given & not found	Koernig, Robert	AstroDatabank, category C
Mrázek, Václav			Serial killer 39667	AstroDatabank, category C
Muhammad, John Allen	x	spree killer		
Mullin, Herbert	x	mentioned in Appendix B		

**Appendix D**

Method for generating an independent control group from AstroDatabank (Ctrl1)

The algorithm for obtaining the control group of real births from AstroDatabank is specified in the following steps:

1. Calculate the percentages of serial killer births per country/country-group (see Table 1).
2. Construct a frequency histogram of the years of birth of the serial killers (see Figure 1, top).
3. Apply a weighted moving average procedure of 3 years to these frequencies (weight factors 1:2:1). The resulting smoothed frequencies are  $fs_i$  for years  $i$ .
4. Select births of celebrities and non-celebrities from ADB in years  $i$ , excluding serial killers and births that occurred in other countries as obtained in step 1.
5. Calculate the percentage USA births obtained in step 4; if this percentage is higher than the percentage mentioned in step 1, randomly eliminate births from the USA to arrive as close as possible to the required percentage.
6. Determine the minimal birth frequency ( $f_m$  in year  $m$ ) in the group obtained in step 5; calculate the ratio  $f_m/fs_m$ .
7. Multiply all frequencies  $fs_i$  (step 3) by the ratio  $f_m/fs_m$ . The resulting frequencies per year must be drawn from the births obtained in step 5.
8. Select the required number of births per year at random.