

## Early-years Educators' Attitudes to Science and Pseudo-science: the case of astronomy and astrology

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**SUMMARY** *The present study surveys Greek early-years educators' attitudes to astrology and ascertains whether they are able to distinguish between astronomy as the science and astrology as the pseudo-science. One hundred and three early-years educators participated in this study. Results indicate that a large fraction (60%) of the educators subscribe more or less to the astrological principles and an equally large percentage (59%) view both astronomy and astrology as scientific, i.e. can not distinguish between science and pseudo-science. Findings warrant significant concern. Possible effects on young children's attitudes are briefly discussed, as well as possible solutions to the problem, chiefly involving lessons that will address and challenge the educators' views through an in-service education programme aimed at improving their scientific 'literacy' and their critical thinking in this field.*

**RÉSUMÉ** *Cette étude examine l'attitude des enseignants grecs du primaire vis-à-vis de l'astrologie et détermine s'ils sont capables de faire la différence entre l'astronomie comme science et l'astrologie comme pseudo-science. Cent trois enseignants du primaire ont participé dans cette étude. Les résultats indiquent qu'une grande partie (60%) des enseignants souscrivent plus ou moins aux principes astrologiques et qu'une aussi grande partie (59%) considère l'astrologie et l'astronomie comme des sciences c'est à dire n'arrivent pas à faire la différence entre science et pseudo-science. Les constatations justifient une inquiétude importante. Les éventuelles répercussions sur l'attitude des enfants sont brièvement discutés, de même que les solutions possibles à ce problème, comportant en particulier des cours qui vont traiter les opinions des enseignants à l'aide des enseignements destinés à perfectionner leurs 'connaissances scientifiques' et leur pensée critique dans ce domaine.*

**RESUMEN** *Este estudio examina a cual nivel los enseñantes griegos de niños de edad temprana tienen creencias astrológicas y determina si pueden distinguir entre la astronomía como ciencia y la astrología como pseudo-ciencia. Ciento tres enseñantes de niños de edad temprana participaron a este estudio. Los resultados indican que un porcentaje alto (el 60%) de los enseñantes esencialmente comparte los principios de la astrología y un porcentaje igualmente alto (el 59%) considera científicas tanto la astronomía como la astrología, es decir, no puede distinguir entre la ciencia y la pseudo-ciencia. Los hallazgos generan bastante preocupación. Se discuten brevemente los efectos posibles sobre las actitudes de los niños y*

*también las posibles soluciones para el problema, principalmente basadas en clases que se dirigirán a las creencias pseudo-científicas de los enseñantes por medio de un programa interno de formación que tendrá el objetivo de mejorar sus conocimientos de ciencias y su pensamiento crítico en cuanto a ésta materia.*

**ZUSAMMENFASSUNG** *Der Beitrag untersucht, in welchem Grad die Erzieher in Griechenland astrologische Ansichten haben und erforscht, ob sie zwischen Astronomie als Wissenschaft und der Astrologie als Pseudowissenschaft unterscheiden können. Erzieher haben 103 a in dieser Untersuchung teilgenommen. Aus den Ergebnissen lässt sich erkennen, dass ein Grossteil (60%) der Erzieher die Prinzipien der Astrologie billigen und dass ein genauso grosser Prozentsatz (59%) sowohl die Astronomie als auch die Astrologie als Wissenschaften betrachten, d.h. sie können nicht zwischen Wissenschaft und Pseudowissenschaft unterscheiden. Die Ergebnisse versetzen uns in Unruhe. Wir werden uns mit den möglichen Auswirkungen auf die Haltung der Kinder auseinandersetzen und möglichen Lösungen des Problems vor allem durch ein Bildungsprogramm der Erzieher mit dem Ziel ihre Kenntnisse in den Naturwissenschaften und ihr kritisches Denken in diesem Bereich zu verbessern.*

## **Introduction**

Pseudo-science has been around at least as long as science itself (Trefil, 1978) and is still rife in modern society, not only in the adult population but also among teenagers (Preece & Baxter, 2000). Pseudo-science, which literally means false science, refers to the ideas 'for which their proponents claim scientific validity, but which in actuality lack empirical support, or were arrived at either through faulty reasoning or poor scientific methodology' (Eve & Dunn, 1990, p. 10).

One of the most typical—and perhaps the most prominent—examples of pseudo-science and superstition is astrology (Sagan, 1996), which currently enjoys unmatched popularity in the western world, and which has become a big business. Many scientists and educators are concerned about this popularity. Gallup polls in the USA (e.g. Paulos, 1988) have concluded that 50–55% of teenagers 'believe in astrology', and a survey (Robertis & Delaney, 1993) conducted in Canada's third largest university showed that even science students are in a large proportion favourably disposed towards astrology.

In an attempt to reverse the trend of astrology's popularity, scientists in 1975 drafted an anti-astrology statement, which was signed by 192 leading scientists (including 19 Nobel prize winners) and which was widely publicised in the daily and periodical press. Unfortunately, however, it had little effect (Culver & Ianna, 1988; Thagard, 1980). A plethora of astrological publications praising astrology's accuracy in predicting people's character and future, horoscope columns and articles in daily newspapers and popular magazines, and live TV programmes in which astrologers urge viewers to consult them, continued to inject all kinds of lies into society, taking advantage of the unwary and the defenceless.

The popularity enjoyed by astrology at the expense of science in the age of technological revolution and the space shuttle is disquieting. Researchers suggest that the wider spread of pseudo-scientific beliefs in recent decades (Gardner, 1988) is highly unlikely to be purely coincidental with the decline in science literacy detected in the general public over the last three decades (Eve & Dunn, 1990). American, British and

Canadian studies (e.g. Einsiedel, 1990) have shown that strikingly large percentages of the population lack basic knowledge, such as that the Earth goes around the sun and that the revolutionary period of the Earth around the sun is one year. The general population is also confused when it comes to distinguishing astronomy from astrology. One contributing factor here is the attitude of many scientists, which is often one of disgust, compounded by their refusal to become involved in something that seems to them obvious nonsense. This, however, leaves a vacuum that is readily filled by astrologers. A significant proportion of astrologers claim that astrology is a "science", usually with an eye-catching adjective attached. Thus in recent years the scientific community has endured references to astrology as the "Aquarian science", the "spiritual science", the "divine science", and the most direct "rip-off" of all, the "star science" (Culver & Ianna, 1988, p. x). However, not only do the majority of astrologers reject the scientific method, but the bulk of the astrological community does not even display a reasonable understanding of it (i.e. of the method through which knowledge of the world around us and of modern technology has been established) and the body of astrological knowledge has been proved by researchers to be neither scientifically sound nor scientifically useful (Culver & Ianna, 1988; Sagan, 1996). This indeed was explicitly stated centuries ago, when the 12th-century philosopher Maimonides argued that: 'It is forbidden to engage in astrology, to utilize charms, to whisper incantations ... All of these practices are nothing more than lies and deceptions used by ancient pagan peoples to deceive the masses and lead them astray ... Wise and intelligent people know better' (as cited in Sagan, 1996).

There is general agreement that the problem is so large that it should be addressed by the education system itself, and that scientists and teachers at all levels must make a special effort to speak out against astrology and use it as an example of pseudo-science (Bok & Jerome, 1975; Kruglak, 1978; Robertis & Delaney, 1993). Such an effort focuses the attention directly on the educators' own attitudes to astrology, as an important potential source of pseudo-scientific beliefs in the population (Eve & Dunn, 1990). There is, however, little information on the prevailing attitudes of educators. Search of ERIC (online version, 1966 to the present) found that only limited research has been conducted into this matter. A couple of studies carried out in the USA, one that examined the science literacy of scientists and science educators (Showers, 1993) and another that examined the extent to which high school biology teachers hold pseudo-scientific beliefs (Eve & Dunn, 1990), showed that these groups have significant beliefs in superstition and pseudo-science. Another study that was carried out in India investigating views of the images of science and scientist among teachers of children 12–14 years of age showed that when teachers were asked how scientists should respond to claims of a scientific basis for astrology, an overwhelming majority felt that they should actively subscribe to it. They also expressed the view that they must either propagate it to the rest of the world or 'at least "prove" it with a computer, perceived as the modern icon of infallibility' (Rampal, 1992, p. 431).

The effects of the attitudes of teachers favourably disposed towards astrology could be even more serious when it comes to children of much younger ages. Children at a very young age can be more easily influenced by their teachers' views, cannot challenge their teachers' views, and are more prone to superstition. Children experience science for the first time between the ages of 4 and 6 through the educational system, and it is then that science education ought to help them eliminate superstition and the abject mystification of technology and natural phenomena (Haubler *et al.*, 1988).

In view of all the above, the present survey of those given responsibility for introducing young children to science was undertaken, in order to sample their opinions and attitudes to astrology and to ascertain whether they are able to distinguish between astronomy as the science and astrology as the pseudo-science. Apart from its obvious sociological interest, such a study can also provide an insight into educators' 'science literacy', their understanding of science and the likely content of science courses designed for them.

### **A Brief History of Astrology**

Initially astrology arose out of a blend of imagination, fear and religious superstition (Sagan, 1996). It is an ancient practice that flourished in Mesopotamia more than 4000 years ago and was a response to the Sumerian religion, which was very concerned with the heavens (Olson, 1982).

In its early stages astrology was an observationally based activity, which tried to establish correlations between celestial and terrestrial events. The great expedition of Alexander the Great through the Orient brought astrology to Europe. Both the ancient Greeks and the Romans were culturally influenced by astrology. The focus was more on the temperament and moral qualities of the individuals concerned. This led to the development of horoscopic astrology, which became very popular. There was, however, opposition from such notable figures as Lucretius and Cicero (Thagard, 1980).

Ptolemy codified the principles and practices of astrology in his *tetrabiblos*, written in the second century AD; this is still regarded as a fundamental text by western astrologers (Culver & Ianna, 1988; Thagard, 1980).

During the Renaissance, when modern science started to develop, astrology was widely practised, and was popular both among intellectuals and the general public, a state of affairs that continued through the 17th century. Astrology declined in popularity in the 18th century, when it was attacked by figures such as Voltaire. People started gaining interest in astrology again in the 1930s (Thagard, 1980). Today, at the dawn of the new millennium, astrology is ubiquitous, and its selling by the mass media continues unabated.

### **The Study**

#### *Context*

The present study was carried out in Greece, and is part of a long-term evaluation study of early-years educators in science. It was carried out simultaneously with a survey investigating the educators' knowledge and understanding of basic science concepts and natural phenomena (Kallery & Psillos, 2001). In Greece early-years educators are required to implement a curriculum that introduces children of 4–6 years of age to scientific concepts and natural phenomena. This curriculum was based on curricula of other countries with a greater tradition in this level of education, such as those of Belgium, France, Canada and Cyprus. It is divided into five developmental areas:

- education and psychomotor development;
- education and social-emotional and moral development;
- education and aesthetic development;
- education and mental development of the child;
- education and skill development (motor and cognitive).

Science is included in the area of education and mental development of the child. The curriculum proposes 'teacher-organised' activities that will help children become acquainted with concepts such as sound, light and magnetism, activities through which children can develop their ability to distinguish objects by their colour, weight, temperature, or by the properties of their matter; and activities that will foster discovery of and familiarisation with the natural environment, and more specifically with animals, plants, geophysical phenomena, weather phenomena and 'outer space'. Activities based on this last topic area help children become acquainted with issues relating to the Earth, the moon, the sun, the relative position and motion of these celestial bodies and the phenomenon of day and night.

### *Method and Sample*

One hundred and three in-service early-years educators from both urban and rural areas of Greece agreed to participate in this study. They were all females (the majority of early-years educators in Greece are female) and had 1–27 years of teaching experience, with an average of 13 years. Their ages ranged from 25 to 55. They had all taken mandatory physical science courses as part of their secondary education, but had taken no physical science courses during their basic education and preparation for their teaching career.

The study was designed to sample early-years educators' opinions and attitudes towards astrology as well as to test their awareness of the distinctions between astronomy (science) and astrology (pseudo-science). Teachers were asked to complete a questionnaire (Table I) containing items adapted from Einsiedel (1990), Kruglak (1978), Rampal (1992), Robertis & Delaney (1993) and Rosenthal (1993). This questionnaire was completed by the educators immediately after they had answered the science questionnaire used to collect data on their knowledge and understanding of science concepts and phenomena. Some of the questions included in the latter concerned astronomy topics that the educators deal with during their work and in everyday life.

The questionnaire was first piloted with a small population of 15 local educators, a group similar to the final sample, before being distributed to different places in Greece. Care was taken to maintain anonymity throughout the administration of the questionnaire, in order to avoid any apprehension on the part of the educators regarding the procedure and their consequent refusal to respond.

The questions were mutually exclusive and were unbiased with respect to the treatment of astrology and astronomy. They were also capable of relatively simple interpretation. Questions (b)–(d) were meant to sample the educators' opinions and attitudes to astrology while questions (e) and (f) were to determine educators' awareness of the differences between astrology and astronomy. The nature of the questions was such that conclusions should not be solely based on any single one of them. For example, the purpose of question (b) was to check how interested educators are in astrology. However, some people may read their horoscope for amusement, or may not, for a variety of reasons (e.g. lack of sources), read their horoscope too often but still believe in astrology. Also question (f) attempts to determine whether respondents really know the difference between astronomy and astrology or just think they do (question (e)). Therefore data from more than one question should be combined in order to get true indications (Robertis & Delaney, 1993).

TABLE I. The questionnaire

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(a) *My sign of the zodiac is:*

1. Don't know \_\_\_\_\_ 2. Aries \_\_\_\_\_ 3. Taurus \_\_\_\_\_ 4. Gemini \_\_\_\_\_ 5. Cancer \_\_\_\_\_  
 6. Leo \_\_\_\_\_ 7. Virgo \_\_\_\_\_ 8. Libra \_\_\_\_\_ 9. Scorpio \_\_\_\_\_ 10. Sagittarius \_\_\_\_\_  
 11. Capricorn \_\_\_\_\_ 12. Aquarius \_\_\_\_\_ 13. Pisces \_\_\_\_\_

(b) *How often do you read your horoscope?:*

1. Occasionally \_\_\_\_\_ 2. Quite often \_\_\_\_\_ 3. Almost every day \_\_\_\_\_ 4. Never \_\_\_\_\_

(c) *Your horoscope usually is:*

1. Very accurate \_\_\_\_\_ 2. Almost accurate \_\_\_\_\_ 3. Inaccurate \_\_\_\_\_ 4. Doesn't apply \_\_\_\_\_

(d) *Astrology holds that one's character and destiny can be understood from the positions of the sun, planets and stars. You subscribe to these principles of astrology:*

1. Completely \_\_\_\_\_ 2. More or less \_\_\_\_\_ 3. Not at all \_\_\_\_\_

(e) *Which of the following would you classify as science?:*

1. Only astrology \_\_\_\_\_ 2. Only astronomy \_\_\_\_\_ 3. Both astronomy and astrology \_\_\_\_\_  
 4. Neither astronomy nor astrology \_\_\_\_\_

(f) *Can astronomers predict people's future and character by studying the heavens?:*

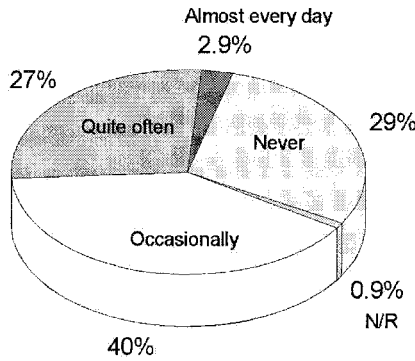
1. No \_\_\_\_\_ 2. Yes \_\_\_\_\_ 3. Don't know \_\_\_\_\_
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## Data Analysis and Findings

Analysis of the educators' responses to question (a) showed that all but one of them knew what their zodiac sign was. Analysis of the responses to the rest of the questions gave the integrated results presented in Figs 1 through 5. N/R (No Response) denotes the number of educators that did not answer the question.

Results indicate that the majority (70%) of the educators pay attention to their horoscope either occasionally (39.8%) or quite often (27.2%). A surprisingly large percentage (60%) of them subscribe more or less to the principles of astrology. An equally large percentage (59.3%) view both astronomy and astrology as scientific, that is, they cannot distinguish between astronomy (science) and astrology (pseudoscience). Considerably fewer than half (38%) of the educators know that only astronomy is a science. This interpretation is supported by the responses to question (f) since, as noted earlier, this question attempts to determine whether educators really know the difference. The analysis of the responses to this question show that almost half (44.7%) of the educators are not aware of what astronomers can or cannot do, while 27% of them believe that astronomers can predict people's character and future.

Chi-square analysis of the educators' responses to questions (d), (e) and (f) for three age groups (25–30, 30–40 and 40–55 years of age) showed independence of the variables for questions (d) and (e) ( $\chi^2_{4; 0.05} = 4.02 < 9.488$  and



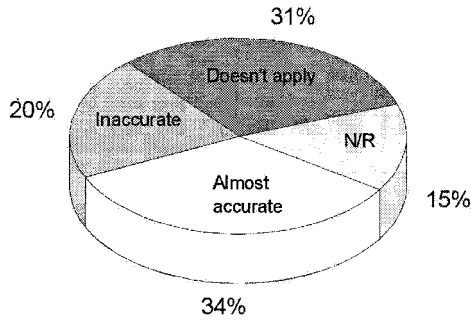
Question	No.	%
<b>b)Attention to horoscope:</b>		
Occasionallly	41	39.8
Quite often	28	27.2
Almost every day	3	2.9
Never	30	29.1
N/R	1	0.9

FIG. 1. Results of analysis of responses to question (b).

$\chi^2_{8; 0.05} = 4.015 < 15.507$ , respectively) but proved statistically significant dependence of them for question (f) ( $\chi^2_{4; 0.05} = 12.02 > 9.488$ ). The most interesting finding is that although the differences between the youngest age group (25–30) and the oldest age group (40–55) are not that marked (see Fig. 6), the highest percentage of those who believe that astronomers can predict people’s character and future is found among the youngest educators of the sample.

Unfortunately, no examination of differences of opinions and attitudes between the two sexes was possible in the present study, since males were not represented in our sample of early-years educators. However, studies carried out in other populations (public or students) in other countries have showed that females are more likely to pay attention to their horoscopes and to subscribe to astrology. They are also significantly less often aware of the distinctions between astrology and astronomy than males (e.g. Kruglak, 1978; Preece & Baxter, 2000).

Analysis by specific criteria—the answers to individual questions (Robertis & Delaney, 1993)—gave the results presented below. The analysis by specific criteria makes it possible to see the corresponding trends.



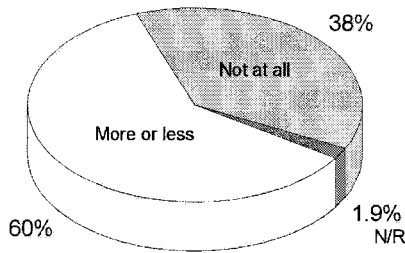
Question	No.	%
<b>c) Horoscope accuracy:</b>		
Very accurate	0	0
Almost accurate	35	33.9
Inaccurate	21	20.4
Doesn't apply	32	31
N/R	15	14.5

FIG. 2. Results of analysis of responses to question (c).

Analysis by *attention paid to horoscope* (question (b)) showed that educators who pay attention to their horoscope quite often also tend to find it almost accurate, subscribe more or less to the principles of astrology, cannot distinguish astronomy from astrology and tend to believe that astronomers can predict the future. Of those educators who pay attention to their horoscope occasionally, a large percentage (59%) subscribe to the principles of astrology. An equally large percentage (56%) confuse astronomy and astrology and are not aware of what astronomers can or cannot do. Most of those educators who never pay attention to their horoscope do not subscribe to the principles of astrology and acknowledge astronomy as the only science (73% and 67%, respectively). However, a sizable fraction (40%) of this group seem to have no knowledge of what scientists can or cannot do. It is also interesting to note that the percentages of educators who do not pay attention to their horoscope but do subscribe more or less to astrology or cannot distinguish astrology from astronomy, that is, who acknowledge both as sciences, are not negligible (23% and 27%, respectively).

Results of the analysis by *subscription to the principles of astrology* (question (d)) showed that educators who more or less subscribe to astrology pay attention to their horoscope either quite often or occasionally cannot distinguish between astronomy and



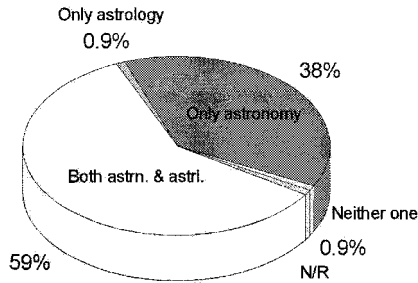


Question	No.	%
<b>d) Subscribe to astrology:</b>		
Completely	0	0
More or less	62	60.2
Not at all	39	37.9
N/R	2	1.9

FIG. 3. Results of analysis of responses to question (d).

astrology, and either believe that astronomers can predict one's future and character or are not aware of whether they can or cannot do this. Also, more than half (55%) of the educators who subscribe more or less to the principles of astrology ('believing' educators) find their horoscope almost accurate. However, 16% of the 'believing' educators, while subscribing to astrology, still acknowledge astronomy as the only science. The majority of those educators who do not subscribe to the principles of astrology ('sceptical' educators) acknowledge astronomy as the only science and believe that astronomers cannot predict people's future and character (72% and 64%, respectively). However, the percentages of the 'sceptical' educators who are not aware that astrology is not a science and also of whether scientists can or cannot predict the future are still significant (21% and 36%, respectively).

Results of the analysis by *which is a science* (question (e)) showed that educators who acknowledge astronomy as the only science either never pay attention to their horoscope or check it only occasionally tend not to subscribe to the principles of astrology and not to believe that scientists (astronomers) can predict people's future and character. However, the percentages of those educators who, while acknowledging astronomy as the only science, still subscribe more or less to the principles of astrology and are not aware of whether scientists can or cannot predict one's future and character are still sizable (26% and 38%, respectively). Educators who confuse astronomy and

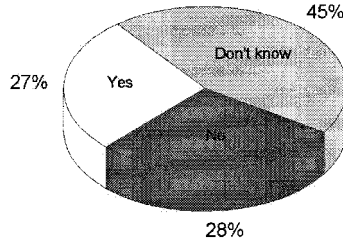


Question	No.	%
<b>e) Classify as science:</b>		
Only astrology	1	0.9
Only astronomy	39	37.9
Both	61	59.3
Neither one	1	0.9
N/R	1	0.9

FIG. 4. Results of analysis of responses to question (e).

astrology, that is, who acknowledge both as sciences, tend to subscribe more or less to the principles of astrology (85%) and either believe that scientists can predict the future or are unaware of whether they can or cannot do so (46% and 49%, respectively). Results also show that these educators have a higher probability of paying attention to their horoscope quite often and tend to find it almost accurate.

In summary, in each case, 'believing' educators have a higher probability of paying attention to their horoscope, more or less subscribing to astrology and confusing astronomy and astrology. 'Sceptical' educators tend to pay less or no attention to their horoscopes, do not subscribe to the principles of astrology and acknowledge astronomy as the only science. However, there are 'sceptical' educators who seem to lack knowledge of the abilities of scientists (astronomers) and of the fact that astrology is not a science. It is also interesting to find out that there are educators who acknowledge astronomy as the only science but still subscribe to the principles of astrology. An explanation to this apparent anomaly can be drawn from these persons' answers to question (f). An examination of these answers showed that the majority of these educators declare ignorance of the abilities of scientists (astronomers). These educators, in other words, may think they know the difference between astronomy (science) and astrology (pseudo-science), while in reality they do not.



Question	No.	%
<b>f) Can astronomers predict future:</b>		
No	29	28.1
Yes	28	27.2
Don't know	46	44.7
N/R	0	0

FIG. 5. Results of analysis of responses to question (f).

**Discussion and Conclusions**

The findings of the present study warrant significant concern. A large proportion of early-years educators subscribe to the principles of astrology and do not seem to be able to distinguish astronomy (science) from astrology (pseudo-science). As indicated by the

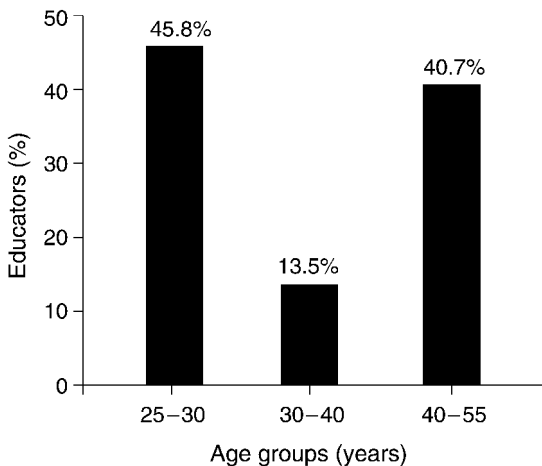


FIG. 6. Can astronomers predict the future? 'Yes'—analysis by age.

analysis by specific criteria, there even are educators who, although 'sceptical', are still not able to distinguish between astronomy and astrology. Disquieting also is the finding of the analysis by age, which indicates that higher percentages of the youngest educators turn out to believe that astronomers (scientists) can predict people's character and future.

The results of the present study give rise to the question of how a pseudo-science like astrology can flourish in an educated segment of the population. There are a number of possibilities. Many scientists (for example, Bok & Jerome, 1975; Culver & Ianna, 1988; Sagan, 1996) discuss belief in astrology as often being the result of an individual's desperation in seeking solutions to serious personal problems. Another possibility is that astrology may offer an attractive and convenient way out of life's responsibilities. Instead of assuming responsibility for one's own actions, one may simply say that the stars were not right or that the stars made him/her do it (Culver & Ianna, 1988). Other scientists (Paulos, 1990; Thagard, 1980) suggest that some people may see science or scientists as something to be feared and are therefore seeking truth along an anti-scientific path. Whatever the reason, scientists agree that practice and belief in astrology 'undermines the rational foundations upon which much of our society has been constructed' and that the embracing of astrology and of other pseudo-sciences may be linked to the larger problem of science literacy (Robertis & Delaney, 1993). There are research findings that justify such correlation. For example, a survey carried out by Einsiedel (1990) that examined the level of science literacy among adult Canadians and their views about astrology showed that more 'scientifically knowledgeable' people displayed a greater likelihood of infrequent or no attention to horoscopes and labelling astrology as not scientific.

In the case of the Greek early-years educators, the results of the study of their knowledge and understanding in the field of science, which, as noted earlier, was carried out simultaneously with the present survey, indicate that the content knowledge of these educators in science and their understanding of basic concepts and phenomena of the natural world is quite limited (Kallery & Psillos, 2001). The educators display conceptions that do not coincide with current scientific ideas and hold misunderstandings even on the phenomenon of day and night (Kallery, 1995). Therefore, in the light of the above findings, it is reasonable to assume that the rejection of rationality and the embracing of astrology by educators may stem from limited knowledge of facts.

However, in addition to these low levels of science literacy, a heavy responsibility for the existing situation is also carried by the media. Poor knowledge and understanding of basic scientific facts are combined with a continuous media bombardment of the population with horoscopes, astrology reports and pseudo-scientific predictions, which may have immediate financial rewards but which also propagate astrological and other pseudo-scientific beliefs and are ultimately detrimental to the scientific health of the population (Robertis & Delaney, 1993). Exposure of the youngest educators of the present sample to the farrago of astrology and superstition of the last three decades at least, from a sensitive age and for a much longer portion of their lives than was the case with educators in the older age groups, may well be the explanation of why higher percentages of them are confused about what scientists can or can not do. Also, the fraction of 'sceptical' educators who lack knowledge of the distinction between science and pseudo-science, which weakens their argument against the latter, could become more vulnerable to astrological beliefs under the heavy influence of the mass media.

Early-years educators' attitudes to astrology could influence young children, since they may interfere with what is presented by the educators to these children. The

curricula for the lower levels of education often give a larger degree of autonomy to the educators teaching at these levels. Therefore, it is quite possible that the educators' attitudes may influence not only what is presented to the young children but also how it is presented to them (Eve & Dunn, 1990). Educators favourably disposed to the principles of astrology view principles of science in a different way and hold beliefs that are at odds with mainstream science. Thus, these educators are likely to be misinforming young children because of their attitudes towards pseudo-science. Moreover, educators favourably disposed towards pseudo-science do not have a sufficient understanding of the scientific method which they are called upon to implement in science activities with young children in order to assist them in becoming acquainted with it and in understanding it as their method of work in science (National Curriculum for the Greek Kindergarten, 1990).

In conclusion, the findings of the present study justify the need for an attempt to deprogram educators' attitudes towards astrology. These attitudes are resistant to change (Rosenthal, 1993). However, attempts made by other researchers for science students (Kruglak, 1978) and for prospective elementary teachers (Rosenthal, 1993) showed that some deprogramming of student attitudes was possible and that teacher response was positive. Lessons that will address and challenge the educators' views through an in-service education programme aimed at improving their science literacy will help them to understand more clearly the nature of science and 'the critical thinking that underlies the process of science' (Moore, 1992).

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