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ORIGINAL PAPER

Spontaneous Anomalystic Phenomena, Pragmatic Information and Formal Representations of Uncertainty

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Abstract I discuss the application of the Model of Pragmatic Information to the study of spontaneous anomalystic mental phenomena like telepathy, precognition, etc. In these phenomena the most important effects are related to anomalous information gain by the subjects. I consider the basic ideas of the Model, as they have been applied to experimental anomalystic phenomena and to spontaneous phenomena that have strong physical effects, like poltergeist cases, highlighting analogies and differences. Moreover, I point out that in such cases we cannot assign a probability of being accepted to every proposition, and so we cannot use standard formulas for pragmatic information and other relevant measures. To overcome the problem, I propose that qualitative possibility theory could be used to describe the situation. In such theory, the confidence in a proposition is expressed using a scale. Basic concepts like epistemic states, belief revision, information gain, pragmatic information etc. are discussed in this frame. Finally an application to some specific cases is sketched.

Keywords Anomalystic phenomena · Pragmatic information · Uncertainty representation · Possibility theory · Belief revision

1 Introduction

1.1 Anomalystic Phenomena

With "anomalystic phenomena" (AP) or "Psi phenomena" I mean phenomena like telepathy, precognition, psychokinesis, etc. that seem to contradict the normal physical laws. The term "spontaneous anomalystic phenomena" (SAP) means that

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I will not consider experimental situations, in which the investigators try to produce the phenomena in the laboratory, but cases that have been reported by the general public.

Several collections of such cases can be found in the literature, showing that (1) SAP are not at all rare, (2) they show a consistent set of characteristics, when statistically analyzed (see e.g.: Persinger 1974; Piccinini and Rinaldi 1990; Rhine 1955; Rinaldi and Piccinini 1982; Schouten 1979, 1981a, b; Siccardi 2008; Siccardi et al. 2008, 2009; Steinkamp 2000; Stokes 1997).

It has been proposed (von Lucadou 1995, 1997; von Lucadou and Zahradnik 2004; von Lucadou et al. 2007; Atmanspacher et al. 2002) that Generalized Quantum Theory (GQT) and the Model of Pragmatic Information (MPI) could provide a phenomenological description and a theoretical frame for AP.

In this paper I discuss an application of MPI to the SAP; I will consider more specifically "mental" SAP (MSAP), that is cases in which physical effects are absent or secondary. Applications to SAP with strong physical effects have already been described, see von Lucadou and Zahradnik (2004). My aim is to define a conceptual frame, that could help to grasp a better comprehension of the phenomena. As a consequence, we would be able to lay down new guidelines for the research in the field of SAP, e.g. "ask the correct questions" to the witnesses, etc.

More than present a complete theory, I would like to discuss a number of concepts that I think are relevant to the task at hand. Many of my considerations are to be considered informal, but I hope that they can help to make "a bit less informal" the application of GQT to the SAP and to human interactions in general.

1.2 The Model of Pragmatic Information

The two main propositions of the MPI applied to AP or Psi are (see von Lucadou 1997):

Proposition I *Psi phenomena are non local correlations in psycho-physical systems, that are induced by the pragmatic information produced by organizationally closed systems.*

Proposition II *Every attempt to use non local correlations as signals makes them disappear or change in an unpredictable way.*

In Proposition I, with organizationally closed system we mean a network of interactions of components that recursively generate the network, so that a boundary between internal and external can be defined.

In Fig. 1 we sketch the structure of the interactions in MSAP, adapting a picture devised by von Lucadou and Zahradnik (2004) for cases with strong physical effects: in MSAP we have a main subject S, who experiences the phenomenon (for instance the precognition of some event), and an external observer, who is the scientist, journalist, etc. reporting the case. Sometimes we have a target person P, strongly related to the informative content of the phenomenon (for instance, the precognized event could be the death of the target person). It can also happen that S

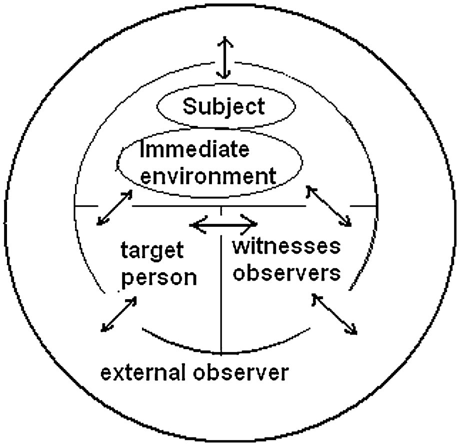

Fig. 1 The structure of a MSAP. The *inner circle* contains the subject and people directly linked with him/her in normal life. The *outer circle* contains the researchers or journalists who published the case. *Arrows* indicate the bidirectional flow of information, of the 3 types described

and P coincide. Quite often, there are also witnesses and observers to whom the case is reported before any external observers.

The interactions are exchanges of information; usually we have three main categories:

– I1: specific information about some event (e.g. the precognition that somebody is going to have an accident)
– I2: "meta" information that is implicitly inferred from the previous (e.g. about the ability of somebody to have precognitions, or of a deceased person to stay in touch with his family, etc.)
– I3: generic information (e.g. beliefs that some unusual facts are bad omens)

The meaning of Proposition II is that the correlations found have nothing to do with precise objects involved, their locations, etc., but with the "meaning" that they convey to the subjects.

In case of MSAP, and in analogy with other phenomena (von Lucadou et al. 2007), we hypothesize that it is not possible to relate some specific kind of manifestation with the occurrence of the phenomena.

In order to illustrate this and other hypotheses in the present paper, we use our database of Italian SAP (Siccardi et al. 2008, 2009). In this database cases are being collected, that regard Italian people, that have been reported by several Italian parapsychologists, and that have been published in newspapers, magazines and books since the beginning of '900. The cases are actually typed versions of the experiences as related by the subjects themselves, with no attempts of further investigation to prove the existence of psi. The aim of the database is to get suggestions and hypotheses about the way psi operates.

To illustrate Proposition II with an example, we consider the subset of "death coincidences". They are anomalous phenomena occurring in coincidence with the death of somebody who is emotionally related to the subject; we choose these cases because are easily identified and follow basically a standard pattern; moreover they are triggered by a single event type: somebody death. One could think that a single event type would correspond to a single manifestation type.

Actually, we have 108 cases in the database, comprising 14 apparitions, 3 anomalous voices, 10 realistic dreams, 11 symbolic dreams, 7 sensations, 31 anomalous noises, 16 broken objects, 3 anomalous wounds, 2 lights, and 22 anomalous movements of objects, some of the cases having more than one manifestation.

These data show that it is the meaning—or the meaning that the subjects attribute to the facts—and not the facts themselves that characterize MSAP. In other words, we cannot find a relationship between the event "death of somebody" and a manifestation type, e.g. "a symbolic dream" or any other specific fact from the list. On the contrary, we have a relationship between the event "death" and the fact that another person notes something anomalous, whatever this anomaly can be (a dream, an apparition, a noise, etc.), and interprets it as a signal of the event.

Going a step further, we can ask if the main psi effect is the manifestation itself or the fact that a subject relates this manifestation to some other event. For instance, should we label "psi" the cause of a noise that would be absolutely inexplicable otherwise? Or does the noise have a natural cause, and psi is to be related to its interpretation by a subject? We suggest that both aspects may be important and that the analysis of pragmatic information could help us to understand why subjects are sometimes more prone to make inferences, considering anomalies as omens of specific events.

1.3 Complementary Variables

The MPI considers system variables Structure S and Function F and the relation between their variations and the minimum quantity i of Pragmatic Information that can be exchanged: $dS \times dF \geq i$.

This expression is a form of complementarity like the position–velocity relation of standard quantum mechanics.

Moreover MPI connects structural variance (dS) with confirmation E and functional variance (dF) with novelty B. Another expression of complementarity is: effect-size of psi phenomenon $\times$ quality of its documentation $<$ Pragmatic Information.

Still another suggestion is that the confidence of the subject in the phenomenon and its actual psi content are complementary.

To find possible couples of complementary variables of this kind, one could look at statistical analyses of SAP collections. For instance, several authors considered the completeness of information contained in psi experiences. The main variables analysed are (see Stokes 1997 for a review): (1) whether the identity of the target person was revealed, (2) whether the nature of the event was revealed, (3) the number of correct details, (4) whether the experience contains abundant but partially incorrect or correct but incomplete information, (5) conviction on the part of the subjects, (6) whether they took some action prior of learning about the event through ordinary means. For instance some author reported that dreams are characterized by a high number of details but low feelings of conviction, whereas intuitive cases follow the reverse pattern. These kinds of relationships may be considered as hints to find complementary variables.

In the following sections, we will follow another way in order to evaluate complementarity in MSAP: namely, instead of delving into statistics, we will look for suitable specifications for PI, B and E that can be applied to new cases.

1.4 Specifications for Pragmatic Information, Novelty and Confirmation

To specify formulas for PI, B and E we start from a characterization of Pragmatic Information in Dynamic Semantics by beim Graben. In beim Graben (2006) one can find formulas to compute the impact (information gain) of a message, pragmatic information, novelty, etc.

However, all the formulas have been computed supposing that a probability of being accepted can be assigned to every proposition. This can be the case in experimental settings, where a probability can be attached to every possible outcome. On the other hand, in SAP one cannot usually assign such a probability, as the knowledge involved is much more uncertain, subjective and non repeatable than in the laboratory. For instance, one cannot assign a probability to a proposition like "somebody who is emotionally tied with you will have some trouble tonight".

So we turn to the formal representations of such kind of vague information, that are available in the literature (see Dubois and Prade 2004, 2009), like imprecise probabilities, belief functions, quantitative and qualitative possibility theory, and find that the latter can be well suited to the information involved in SAP. In the following, we will recall the basic ideas of possibility theory. Then we will discuss some of the formulas available for MPI concepts, to find their counterparts in the new setting. Finally, we will discuss the application of the model to some examples of MSAP.

2 Uncertainty Representations

2.1 Ordinal Approach to Uncertainty

Suppose that an agent expresses her confidence in a sentence or event using a scale like the following: false/impossible (sometimes denoted 0), very unlikely, unlikely, unknown/uncertain, likely, very likely, true/certain (sometimes denoted 1). As we cannot infer any "distance" between two points of the scale, we say that we are using a qualitative or ordinal approach.

On the other hand, if the agent can express her confidence assigning a number from e.g. $0 =$ false/impossible to $10 =$ true/certain, we have an idea of the distance between any two events or sentences, and we say that we are using a quantitative approach. Obviously, in this case, we can always think that the scale range is the interval [0,1].

In both cases, we obtain a relative confidence relation between propositions. Denoting $\geq$ this relation, $A \geq B$ means that the agent has at least the same confidence in the truth of A as in the truth of B. Instead, $A > B$ means that the agent is strictly more confident in A.

2.2 Epistemic States and Possibility Distributions

More formally, let L be a finite propositional language, Ω the set of classical interpretations or worlds obtained assigning a truth value to each of the n propositions of L. If f is a proposition, let [f] be the set of classical models of f, that is the set of interpretations in which f is true. Epistemic states, viewed as sets of beliefs about the real world, are represented as a total pre-order on Ω.

An epistemic state is represented by a possibility distribution π, which is a mapping from Ω to a scale, that can be ordinal or numeric. $\pi(\omega)$ represents the degree of compatibility of ω with the available information about the real world (see for details Benferhat et al. 2002).

Given a possibility distribution we can define two different measures on formulas of the language:

- the possibility degree $\Pi(f) = \max\{\pi(\omega) : \omega \in [f]\}$ which evaluates the extent to which f is consistent with the information expressed by π. In words: we consider all the interpretations in which f is true, and assign the maximum of their possibilities as the possibility of f.
- the necessity degree $N(f) = 1 - \Pi(-f)$, which evaluates the extent to which f is entailed by the available information. In words: we take the most possible of all the interpretations in which f is false, and assign the reverse of its possibility as necessity.

Note that in the ordinal setting, the function $1 - (.)$ is the order-reversing map of the scale. The quantity $1 - \Pi(f)$ is sometime called "degree of potential surprise"; we will later discuss its interpretation in terms of novelty.

The determination of the belief set corresponding to π and denoted by $BS(\pi)$ is obtained considering the formulas that are more plausible than their negation:

$$BS(\pi) = \{f : \Pi(f) > \Pi(-f)\}$$

An epistemic state can also be represented syntactically by possibilistic knowledge bases, that is finite sets of weighted formulas:

$$S = \{(f_i, a_i),\ i = 1, n,\ 0 \leq a_i \leq 1\}$$

This form of representation is interesting for us, because in MSAP research we can ask people to rate their confidence in sentences f_i using a likert scale, and then convert the values in a_i.

Given S, we can generate a possibility distribution π defining for any ω of Ω:

$$\pi(\omega) = \begin{cases} 1 & \text{if } \omega \text{ is a model for every } f_i \text{ of } S \\ 1 - & \max\left(a_i : \omega \text{ is not a model of } f_i\right) \end{cases}.$$

2.3 Belief Revisions

The set X of epistemic states is the set of all possibility distributions. The epistemic state of an agent is not static, and we can interpret input information as an operator mapping epistemic states to other epistemic states (see beim Graben 2006). Belief revision results from the effect of accepting a new piece of information.

When epistemic states are probability distributions, the impact of an input f is computed as a conditionalization, in a way that takes advantage of the numeric nature of the probability.

In an ordinal setting, we can define a “minimum-based” conditioning starting from the possibility distribution $\pi(\omega)$. In case of a totally reliable input f:

$$\pi(\omega|\mathrm{f}) = \begin{cases} 1 & \text{if } \pi(\omega) = \Pi(\mathrm{f}) \text{ and } \omega \text{ is a model of f} \\ \pi(\omega) & \text{if } \pi(\omega) < \Pi(\mathrm{f}) \text{ and } \omega \text{ is a model of f} \\ 0 & \text{if } \omega \text{ does not belong to [f]} \end{cases}$$

In a numerical setting, we define:

$$\pi(\omega|\mathrm{f}) = \begin{cases} \pi(\omega)/\Pi(\mathrm{f}) & \text{if } \omega \text{ is a model of f} \\ 0 & \text{otherwise} \end{cases}$$

If the input f is uncertain with weight a (f, a), limiting ourselves for simplicity to the numerical setting, we define:

$$\pi(\omega|(\mathrm{f},\mathrm{a})) = \begin{cases} \pi(\omega)/\Pi(\mathrm{f}) & \text{if } \omega \text{ is a model of f} \\ (1-a)\pi(\omega)/\Pi(-\mathrm{f}) & \text{otherwise} \end{cases}$$

An important point about revisions is that we should distinguish cases in which generic knowledge is involved in the revision from cases in which only specific knowledge is revised. The revision of epistemic states can be seen in several ways, namely:

– inputs are incomplete but sure information about a case at hand (e.g. medical tests), while the possibility distribution reflects generic knowledge (e.g. medical knowledge in general). In the example, the resulting belief is the patient diagnosis. In MSAP this revisions seem to be mainly related to information about specific events (type I1 in Sect. 1.2).
– the epistemic state is made of uncertain evidence about a specific case, and the new input has the same status of the possibility distribution, and can modify it. As an example consider a criminal case where the guilty person is to be found on the basis of clues etc. In MSAP this revisions seem to be mainly related to meta information about the subjects’ abilities (type I2 in Sect. 1.2).
– even in the case of generic information, like medical knowledge, new evidence often forces the alteration of the possibility distribution. In MSAP this revisions seem to be mainly related to generic information about omens etc. (type I3 in Sect. 1.2).

2.4 Information Measures and Information Gain

There is no standard way to associate an information measure or entropy to the distribution $\pi(\omega)$.

To get some directions, we turn to decision theory, where we have the concept of ordinal preferences, when an agent cannot quantify her uncertainty (van Rooij 2003). In this setting, the agent has to choose an action after evaluating her knowledge. We can identify “actions” with statements of belief, as we are not interested in the course of actions of the agent. We say that a dominating action is one that is preferred to all others in all situations. Even if there is no such an action, we can say that an agent should not perform any action that is dominated by another. We say also that a proposition gives relevant information, if the set of non-dominated actions decreases after learning it. Reasoning in the same way, we can define an order relationship between proposition: A will be more relevant than B if A reduces the set of non-dominated actions more than B.

Using the formulas for conditioning, we can compare the set D of non-dominated actions before and after belief revision. So we have an algorithm to compute the information gain associated with f in terms of reduction of the set D. As this information gain refers to the whole possibility distribution, we can consider it a definition of the pragmatic information of f. Of course, this setting is very basic and does not take into account a lot of points that can be important in pratical situations, e.g. the fact that the agent's confidence in some propositions can change even if set D does not. Moreover it is not easy to find formal definitions for novelty and confirmation.

If the distribution $\pi(\omega)$ is numeric, after receiving the uncertain input (f, a), one can compute $\pi(\omega|(\mathrm{f}, \mathrm{a}))$ and from this the Pragmatic Information in terms of the Kullback–Leibler information:

$$\mathrm{I} = \sum_{\omega\in\Omega} \pi(\omega|(\mathrm{f}, \mathrm{a}))\log\left(\pi(\omega|(\mathrm{f}, \mathrm{a}))/\pi(\omega)\right)$$

Cautions should be taken as some denominators or logarithm arguments could vanish. If f is totally novel or totally confirming, $\pi(\omega|(\mathrm{f}, \mathrm{a})) = \pi(\omega)$ and the Pragmatic Information is 0.

We can write also:

$$\begin{aligned}\mathrm{I} = {} & \Sigma_{\omega\in[\mathrm{f}]}\pi(\omega)/\Pi(\mathrm{f})\log(1/\Pi(\mathrm{f})) \\ & + \Sigma_{\omega-\in[\mathrm{f}]}(1-\mathrm{a})\,\pi(\omega)/\Pi(-\mathrm{f})\log((1-\mathrm{a})/\Pi(-\mathrm{f}))\end{aligned}$$

Using the degree of potential surprise $\mathrm{S(f)} = 1 - \Pi(\mathrm{f})$ and the necessity degree $\mathrm{N(f)} = 1 - \Pi(-\mathrm{f})$, we can write:

$$\begin{aligned}\mathrm{I} = {} & \Sigma_{\omega\in[\mathrm{f}]}\pi(\omega)/(1-\mathrm{S(f)})\log(1/(1-\mathrm{S(f)})) \\ & + \Sigma_{\omega-\in[\mathrm{f}]}(1-\mathrm{a})\pi(\omega)/(1-\mathrm{N(f)})\log((1-\mathrm{a})/(1-\mathrm{N(f)}))\end{aligned}$$

and we get a decomposition of I in a term depending on potential surprise and one depending on necessity.

We don't look for more formal developments of these concept, but try to apply them to some examples.

3 Examples

3.1 Two "Death Coincidence" (DC) Cases

We use as examples two cases from the database of Italian SAP (Siccardi et al. 2008, 2009) we already quoted. Note that both examples are quite typical and that many other cases follow the same patterns.

Example 1 A woman was at home; she was alone. Suddenly she heard somebody knocking at the door, but nobody was there. The door was shut and there was no wind. Some 15 min later, she received a phone call from the hospital. A friend of hers was dead; she was at the hospital for a routine therapy, she wasn't expected to die.

Example 2 A girl was sleeping at night, in her masters' house. She woke up suddenly, as she heard some knocks. Nobody was at the door. It was four o'clock. She thought that something bad had happened to her little brother, as he was ill. Next morning she received the news that her brother died at the hospital of another town, exactly at four o'clock.

A lot of cases of DC are very similar to one of these two examples for what concerns the informational structure and evolution. In the following notes, we don't take into account the specific characteristics of the cases, like the relationships between the involved persons, that have been statistically studied by the authors already quoted. If suitable questions had been asked at the time the cases were recorded, we could deduce possibility distributions and trace belief revisions as follows.

Define propositions p, q and r:

p = [the target person recovers] with target person = the subject's friend in Example 1 and the subject's brother in Example 2.
q = [something bad happens].
r = [the subject hears anomalous knocks].

Suppose that we can ask the subjects for their opinion and that we get the weights shown in Table 1.

The weight assigned to p reflects the greater confidence in the target's recovering in the first example. The last formula reflects the hypothesis that in Example 2 the subject is focused on the health state of her brother. Numerical values are of course specified only to illustrate the possible usage of the concepts.

We have the initial possibility distributions detailed in Table 2.

When the subjects hear the anomalous knocking, we have a first belief revision with the input "r certainly true". We have $\Pi(\mathrm{r}) = \max\{\pi(\omega) : \omega \in [\mathrm{r}]\} = \pi(\mathrm{pqr}) = 1$ in Example 1 and $\Pi(\mathrm{r}) = \max\{\pi(\omega) : \omega \in [\mathrm{r}]\} = \pi(-\mathrm{pqr}) = 0.5$ in Example 2.

Moreover, the degree of surprise is $\mathrm{S}(\mathrm{r}) = 0$ and $\mathrm{S}(\mathrm{r}) = 0.5$ respectively; and the necessity $\mathrm{N}(\mathrm{r}) = 0$ in both cases.

After conditioning we get the possibility distributions of Table 3.

Table 1 The knowledge basis with hypothetical weights for relevant formulas in Examples 1 and 2

Formula	Weight in Example 1	Weight in Example 2
p	0.9	0.5
IF r THEN q	0.5	0.6
IF −p THEN q	1	1
IF q THEN −p	0	0.6

Table 2 The initial possibility distributions in Examples 1 and 2

ω	$\pi(\omega)$	
	Example 1	Example 2
pqr	1	0.4
pq − r	1	0.4
p − qr	0.5	0.4
p − q − r	1	1
−pqr	0.1	0.5
−pq − r	0.1	0.5
−p − qr	0	0
−p − q − r	0	0

Table 3 The possibility distributions in Examples 1 and 2 after the subjects hear the anomalous knocking

ω	$\Pi(\omega\|r)$	
	Example 1	Example 2
pqr	1	4/5
pq − r	0	0
p − qr	0.5	4/5
p − q − r	0	0
−pqr	0.1	1
−pq − r	0	0
−p − qr	0	0
−p − q − r	0	0

We have also:

PI $= 0$ in Example 1 and PI > 0 in Example 2.

When the subjects get the actual news about the targets, we have a second belief revision, with the input "p certainly false". We have $\Pi(-p) = 0.1$ in Example 1 and $\Pi(-p) = 1$ in Example 2; $S(-p) = 0.9$ and $S(-p) = 0$ respectively; $N(-p) = 0$ in Example 1 and $N(-p) = 1/5$ in Example 2.

After conditioning we get the possibility distributions of Table 4 where only one interpretation is possible.

We have also:

PI > 0 in Example 1 and PI $= 0$ in Example 2.

Although very simple, this framework allows us to follow the information flow of the phenomena and to highlight the differences in the two cases.

Here we list some other comments inspired by our previous discussion:

1. In both examples two different kinds of beliefs are involved:
   - a specific and explicitly stated belief about the health of a distant person.
   - a generic and implicit belief about the relationship between anomalous knockings and bad news.

Table 4 The final possibility distributions in Examples 1 and 2

ω	$\Pi(\omega\|r)$	
	Example 1	Example 2
pqr	0	0
pq − r	0	0
p − qr	0	0
p − q − r	0	0
−pqr	1	1
−pq − r	0	0
− p − qr	0	0
−p − q − r	0	0

2. In Example 1 no explicit conjectures are reported by the subject when the anomalous knocking is heard: the event is just kept in memory. A connection with her friend's health only happens when the phone call is received.
3. However, as the case is reported as a death coincidence, also a belief revision (a confirmation) of the belief about anomalous knockings is implied. This point should be more carefully analyzed, as is evidently quite weak: it should be at least compared with a search for cases in which no bad news follow.
4. On the other hand, in Example 2 a conjecture follows the knocking, that has actually the meaning of an input in this case. So the structure and the implications of Examples 1 and 2 are very different, in spite of the fact that the two kinds of events are often put together in the collections of cases.
5. Leaving apart other differences, from a strictly informational although informal point of view, we note that the mix of "novelty" and "confirmation" of the message that might be conveyed by the knocking is different in the two examples.

3.2 A Case Involving Several Subjects

The above examples are very simple, now we will describe a much more complex case, that will enable us to discuss some other features of our theoretical model. The case is described in De Boni (1997).

On March 25, 1928, a 20 year-old man was working as an assistant at a car race when he was hit by a car and died. The following psi experiences have been related to this event:

(a) 1 year before the subject dreamt about his grandfather, died years before, telling him that they would meet shortly; the subject told the dream to his mother, who tried to reassure him.

(b) 3 nights before the event his mother had a nightmare, in which she was hit by a racing car. She thought that the bad omen was about herself, and was scared by cars for some days.

(c) 1 night before, his mother dreamt about a funeral, very similar to the actual one; again she thought that some accident could happen to herself.
(d) The day after the accident, his mother and a few other people in the house heard a mysterious loud noise; a sister and an aunt of the dead man heard noises for several nights after his death.
(e) A week after and for several nights his grandmother saw a light globe.
(f) 20 days later, his 9-year-old sister perceived an apparition of him.
(g) After 1 month his sister was falling into a river when was helped by an invisible hand. She was sure that it was her brother's from heaven.
(h) 1 month later, his grandmother was walking, when a car was about to hit her. Somebody took her by her shoulders and pulled her back: there was nobody there, so she thought that it was her grandson.
(i) 5 months later his grandmother saw him in an apparition;
(j) Meanwhile, the family had sued the organizers of the race in which the young man died. One night his grandmother heard an unexplicable noise and thought that it was the man announcing that they had lost the case. In the morning a wire confirmed her precognition.

We note also that the mother had a materialistic way of thinking, but at the time of the events was in touch with a member of the theosophic society, and was changing her mind. Later she started to communicate with her son's spirit through automatic writing, although she maintained some criticism about her own productions. She told the whole story to De Boni, the parapsychologist who reported the case.

We don't try to follow the information flows, that in this case are very complex, but limit ourselves to a general discussion.

The structure of the relationships between the subjects involved in the case fits quite well those depicted in Fig. 1. In the inner circle, we have several people belonging to the same family, including the young man whose death is the focal event. In the external circle we have the parapsychologist who has been asked for advice, to obtain some explications and confirmation of the phenomena.

The family members started an iterative communication between themselves and about: (1) the possible death of a member of the family (2) the possibility that the dead man could stay in touch with the other members of the family.

As hypothesized in Proposition I, we have a closed system, the family, a consistent flow of information within it, and psi effects are perceived. As hypothesized in Proposition II, these effects, that last for several months, are continuosly changing in an unpredictable way.

At the beginning of the case, the most important content of the information flow is the accident that was going to happen, but later the possibility of communication with the deads becomes the top argument. At this stage very different events are interpreted as meaningful.

The information flow, although more complex, resembles Example 1 above: we have some input information before the event; this input is misinterpreted; after the event we have a belief revision; this revision affects both the specific knowledge about the event and the generic belief in the possibility of precognition, communication with the deads, etc. Subsequent information is interpreted according to the new belief set.

The information gain depends on the stage at which an input is received, not only on the input itself. For instance, we note the difference in the impact of information and belief revision between input b (the dream of the racing car) and input j (an unexplicable noise). Input b involves a racing car and an accident, the target person is going to a car race, but his mother does not report any connection between her dream and her son. On the other hand, input j is much more generic (a noise), but the subject makes a very specific inference (the loss of a case). This suggests that the belief system of the family has changed.

We are again faced with the question whether psi consists mainly in the manifestation, that is in the generation of the message (a strange dream, a noise, etc.) or in the subject's interpretation. If we could ask people involved in the case to rate their beliefs about the survival hypothesis, the possibility of communicating with the deads, etc., and how they evolved with the time, we could probably see the effects of the phenomena in terms of belief revisions, information gain, etc. This could help us to distinguish the importance of the facts from the role of the subjects' beliefs, and to understand their dynamics and relationships in MSAP.

4 Conclusions

We have shown that, even when no exact probabilities are available, it is still possible to model the informational content of SAP. Even if the agents cannot supply but a qualitative, ordinal evaluation of their beliefs, we can model the cases in a clear way.

As it is not possible to forecast the form (dream, apparition, sensation, etc.) in which these pieces of information will be perceived by the subjects, the main point is the evolution of their opinions about both the actual events and their meanings.

In our opinion, the examples above, especially the more detailed one, indicate that psi phenomena are produced in systems rich of pragmatic information. Regular interactions and information exchanges between the components maintain the system identity and assure a high level of pragmatic information. On the other hand, psi phenomena produce new pragmatic information, whose impact stabilizes the system, gives new meaning to specific data and induces a revision of general knowledge shared by its members.

We hypothesize that both aspects are important to have a psi phenomenon, or at least the first psi phenomenon of a series occurring to the same subject. If the subject is not part of a system with enough pragmatic information, a SAP is not likely; but a SAP is not likely also if it cannot produce enough new pragmatic information in a system in which no other psi related phenomena have occurred before.

These considerations suggest that people involved in SAP should be asked to evaluate their beliefs in the most appropriate way they can. Tracing the revisions of their beliefs we could tend to a closer application of MPI and GQT, and hope to derive some falsificable consequences.

For instance, we could derive a more definite model of the information flows and of the belief revisions related to psi phenomena. Maybe we could find some patterns applicable to several types of phenomena. Then we could check these models against new evidence.

Other hypotheses could concern the revision of general beliefs about psi that is always involved when a subjects first experiences a psi phenomenon. We could make predictions about the minimum degree of novelty and confirmation that the psi phenomenon must have for the subject, in order to be noted: if the subject is completely skeptical, and so the novelty associated with the phenomenon is maximal, he would probably discard it, and so we will never be told of the phenomenon. If the subject is a believer in psi, finding no novelty and maximal confirmation in the phenomenon, maybe he will not even feel the necessity to report it to a parapsychologist, and again we will not know about it. Then we can expect some intermediate degree of novelty and confirmation in the reported SAP, that we could try to quantify and to check against new evidence.

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