The cognitive error in decision making

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ABSTRACT

This issue deals with the partial data of a research in progress on focalization, pseudodiagnosticity and framing-effect in decision making, followed by the most important results of some experiments about the emotional aspects of the choice, and ends by stressing the potential contribution of the artificial neural networks to the medical diagnosis.

Introduction

First of all, I will connect to my article "Decision making", published in this Journal some years ago[1]. In that issue I pointed out some aspects, among them focalization, pseudodiagnosticity and framing-effect, which, according to some research works, significantly influence decision making. Focalization, and pseudodiagnosticity are two inter-related ways of information processing: the first one concerns the tendency to consider only some elements of a situation and to leave out all the others; the second one consists of leaving out important aspects for a diagnosis (diagnosis widely considered, beyond the medical sphere). Focalization and pseudodiagnosticity imply that, in decision making, the subjects are satisfied with an incomplete research of the possible alternatives[2]. Focalization and pseudodiagnosticity are explained by "Mental Models Theory" (MMT), stating that "…we are unconsciously satisfied with simplified models of reality and … such models guide our thinking and behaviour"[2].
As for framing-effect, it is the conditioning of the decision by the verbal formulation modalities of the alternatives.

First data of a research on focalization, pseudodiagnosticity and framing-effect

I will explain now the concepts of focalization, pseudodiagnosticity and framing-effect by the provisional data of a research work on decision making I am carrying out on undergraduate students. This research requires a yes/no answer, with possible addition of observations, to the following four questions:

• Question No. 1
In your city, in the last month, an Indian holy man healed 15 people. A famous physician, who is interested in the same pathology, healed 4 people. Would you recommend an examination by the Indian holy man to a friend of yours, who suffers from the problems treated by both the holy man and the physician?

• Question No. 2
Imagine that you have just graduated and you receive a job offer from an important multinational company. You are offered an interesting job and a €5,000 initial monthly salary. You are also required to make an immediate decision. Would you accept the offer?

• Question No. 3A
During a party, in a newlywed's couple's home, you meet some nice boys and girls, who invite you to ride their car and spend the rest of the night in a club in an area you like very much. Would you accept?

• Question No. 3B
During a family party you make friends with some boys and girls, who invite you to ride their car and spend the rest of the night in a club in an area you like very much. Would you accept?

TAB. 1
Answers to the questions (%).

		Questions			
		No. 1	No. 2*	No. 3A	No. 3B
Answers	Yes	32	84	36	62
	No	68	12	64	38

* No answer: 4%.

Questions 3A and 3B are parallel and convey the same information, but there are some formal differences among them, aiming to elicit more confidence in reading question 3A than in reading question 3B (e.g., "the newlywed's couple's home" of question 3A becomes "family" in question 3B) and so promoting the framing-effect.

Question 3A was put to a subgroup of subjects, question 3B to the other subgroup.
Table1 shows the results obtained so far.
In my opinion, the most interesting information in Table 1 concern the answers to question No. 2 and the comparison between the answers to question No. 3A and the ones to question No. 3B.
In regards to the data of question No. 2, they are probably referable to the focalization on the interaction between the promised high pay and the prospect of an interesting job; nearly all the boys accept the job offer without mentioning, in the comments' space, what the demands of the multinational company may be (e.g. one can wonder about the job site location and how frequently homecoming is possible, what are the risks involved in the job even if it's interesting, etc.) and show a clear pseudodiagnosticity.
The comparison between answers 3A and 3B can be interpreted in the light of the framing-effect: the few formal changes in question 3B have been enough to obtain the overturning of the percentages of answers.
Finally, I think we can easily admit that focalization and pseudodiagnosticity explain the not insignificant percentage of subjects who answered "yes" to question No. 1. These ones didn't realize that the data are incomplete, since the number of people who respectively consulted the holy man and the physician isn't stated: the holy man could have by chance healed 15 people over dozens of them, while the "famous" physician, particularly engaged in scientific activities, could have healed 4 over 5 patients examined in the last month.
If the focalization and the pseudodiagnosticity may be largely ascribed to a simplification process, that can be linked to people's modest cognitive resources, process that allows to deal with otherwise unmanageable problems and decisional situations[3] (Simon, 1982), non-cognitive variables are crucial on other mistakes, which we make over decision making.

Emotions and decision

Several experimental works emphasized the frequent indecision and inconsistency of people's preferences[4], preferences influenced by personality aspects, above all by emotional aspects[5].
The results of many psychological researches, beginning from Zajonic's early researches of the second half of last century up to more recent works, pointed out the inadequacy of an explanation of many decisions exclusively based on rational foundations and the importance of the approach to the *decision making*, considering the emotional elements.
Some studies on people suffering from anxiety dis-

TAB. 2
Equidistribution test of the yes/no answers to questions 3A and 3B.

	3A	3B	Tot.	χ^2
Yes	4	9	13	6.09*
No	7	5	12	
Tot.	11	14	25	

No. = 25; Chi-square test with Yates' correction for continuity; Df = 1; *p < 0.05.

orders showed their outstanding tendency to consider that adverse events are very likely to happen and to perceive themselves in a risk situation[6,7].
Affective states experimentally caused in non anxious people also allowed to observe that, as a consequence of unpleasant emotional states, the perception of the risk rises, causing a significant spin-off on the performances and on the consideration of one's choices[8,9].
According to Bower & Cohen[10], affective states may act as a filter and the prevailing emotional state causes only certain aspects of the decisional context, and no others, to be selected. Possible consequences are decisions highly conditioned by the prevailing momentary emotion.
In an experimental work, Wright & Bower[11] caused subjects of the experimental group to be in a pleasant emotional state, by asking them to recall a situation in which they had been particularly happy, or an unpleasant emotional state, by asking them to recall a particularly unhappy situation.
Afterwards the same subjects, in hypnotic state, had to consider the probability a series of events to happen, where in half cases they were protagonists; the results of the events would have been positive or negative. In comparison with the control group, without any caused emotional state, the subjects who had recalled happy situations tended to overestimate the probability of positive events and to underestimate the risk of negative events, whereas the subjects who had recalled unhappy situations behaved in the opposite way.
The neurosciences also emphasized the affective aspects of decision making. E.g., Damasio[12] observed the impossibility of rational decisions, in spite of the completeness of the intellectual faculties, in patients showing lesions of the frontal cortex, unable to set links between the effects of their action and the related emotions.
On the basis of the obtained outcomes, Damasio[12] states that the emotional experience guides the decision.
Certainly, in the next few years the technological strategies will be improved, to support decision making, strategies which the cognitive science gave a significant contribution to. This area includes researches about the neural networks.

Neural networks and decision making processes

Officially, the "Cognitive Science" was born in 1977, year in which the journal *Cognitive Science* was founded; its two paradigms were modularism and connectionism. Connectionism had more followers, while Fodor's modularism, by hypothesizing a modular cognitive architecture, above all claimed neuropsychologists'attention.
The connectionist approach imposed itself also because of the substantial inadequacy of the previous computational models to simulate the functioning of the human mind; it is characterized by "brain style" models which are artificial "neural networks"; these networks simulate biological neural networks and, so, the nervous system.
In fact, the computer can carry out tasks which are very complex for the individual, as mathematic calculi, solution of logical problems, memorization of lots of data, but it cannot reproduce the tasks that our mind perform very easily on a daily basis as recognizing one object among others from few characteristics, recognizing words written by different handwritings or upturned letters, making decisions based on few information. In short, computers, unlike the human mind, cannot work with imprecise or incomplete data.
Some important differences between the nervous system and a serial system of information processing are as follows[13]:

- Parallel processing of the information, while the traditional computers processing of each datum is individual and serial; that explains a greater velocity of the brain in executing tasks, as visual recognition of the objects, which requires simultaneous processing of a lot of data.
- In the nervous system many neurons execute the same task; the processing is therefore distributed among many elements, as the intracellular registration or cerebral activity visualisation techniques show. In addition, each neuron can participate in different types of elaboration both simultaneously and serially.
- Unlike computers, which access to each memorized information through a numerical address, the human brain accesses to its memory through the content of the information.
- The nervous system performs tasks without being programmed and automatically learns from experience or with an expert teacher's help.

Although the artificial neural networks operate quite differently from the serial computers, it's possible to simulate an artificial neural network on any type of computer.
An Artificial Neural Network (ANN) is a model which simulates the biological neural networks. It is composed of aggregations (or *nets*) of simple elements, named *artificial neurons* or *unities* or *knots*

Saper mangiare per vivere e invecchiare bene

Principi basilari per una corretta alimentazione

Novità 2010

Negli ultimi 40.000 anni i nostri geni sono cambiati poco. Erano stati disegnati per adattare l'uomo a vivere nelle caverne, a cibarsi di prodotti vegetali presenti in natura e a mangiare la carne solo quando riusciva a cacciare.
Oggi invece la vita è cambiata moltissimo e il progresso è riuscito ad agevolare in maniera determinante le attività dell'uomo, facendo però insorgere malattie in passato sconosciute.
Infatti la **riduzione dell'attività fisica e l'aumentato apporto di alimenti ricchi di calorie** e poveri di fibre hanno favorito l'insorgenza di malattie come l'obesità, l'arteriosclerosi, l'ipertensione arteriosa e il diabete. Senza ombra di dubbio una corretta alimentazione nella prima infanzia riesce a prevenire gran parte delle malattie.
È importante che le persone, soprattutto coloro che hanno il compito di educare i bambini (genitori, nonni, insegnanti), abbiano ben chiari i concetti sulla **nutrizione umana** e quali siano i **comportamenti alimentari da seguire**.
Il volume vuole essere un concreto aiuto per tutti coloro che vogliono capire meglio quanto sia **importante il fattore alimentare**, per vivere bene e prevenire eventuali malattie.

Giuseppe Murabito
Medico chirurgo
Specialista in Igiene
e in Odontoiatria

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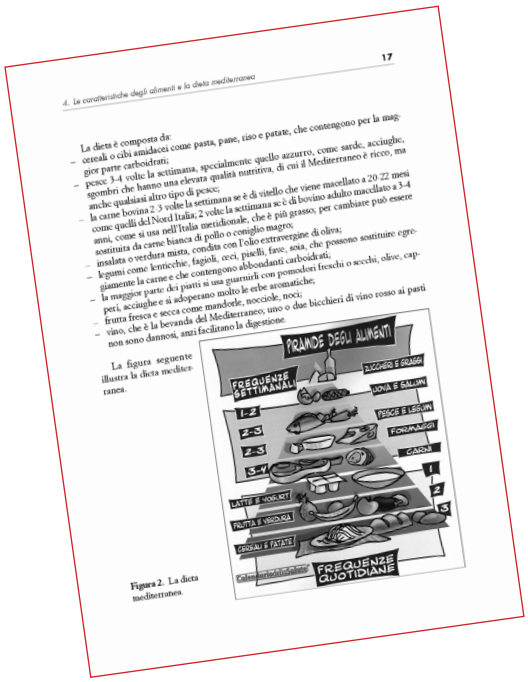
4. Le caratteristiche degli alimenti e la dieta mediterranea 17

La dieta è composta da:
– cereali o cibi amidacei come pasta, pane, riso e patate, che contengono per la maggior parte carboidrati;
– pesce 3-4 volte la settimana, specialmente quello azzurro, come sarde, acciughe, sgombri che hanno una elevata qualità nutritiva, di cui il Mediterraneo è ricco, ma anche qualsiasi altro tipo di pesce;
– la carne bovina 2-3 volte la settimana se è di vitello che viene macellato a 20-22 mesi come quelli del Nord Italia; 2 volte la settimana se è di bovino adulto macellato a 3-4 anni, come si usa nell'Italia meridionale, che è più grasso; per cambiare può essere sostituita da carne bianca di pollo o coniglio magro;
– insalata o verdura mista, condita con l'olio extravergine di oliva;
– legumi come lenticchie, fagioli, ceci, piselli, fave, soia, che possono sostituire egregiamente la carne e che contengono abbondanti carboidrati;
– la maggior parte dei piatti si usa guarnirli con pomodori freschi o secchi, olive, capperi, acciughe e si adoperano molto le erbe aromatiche;
– frutta fresca e secca come mandorle, nocciole, noci;
– vino, che è la bevanda del Mediterraneo; uno o due bicchieri di vino rosso ai pasti non sono dannosi, anzi facilitano la digestione.

La figura seguente illustra la dieta mediterranea.

Figura 2. La dieta mediterranea.

Piano dell'Opera

Gli alimenti e la loro origine • Gli alimenti sono il combustibile biologico che fa funzionare la nostra macchina • Gli elementi chimici che costituiscono gli alimenti e il metabolismo • Le chilocalorie • La digestione, l'assorbimento, il catabolismo e l'anabolismo • Le caratteristiche degli alimenti e la dieta mediterranea • Tutti gli elementi chimici che costituiscono gli alimenti • Determinazione della razione alimentare giornaliera o dieta • Come vedere se il nostro peso è nella norma • La dieta normale • Il sovrappeso e l'obesità • Diete speciali • Come ritardare l'invecchiamento • Danni provocati al nostro organismo dall'uso eccessivo di carboidrati e di sale • Attività fisica sportiva e ginnastica • Alimenti naturali e diete macrobiotiche • La conservazione degli alimenti • Le alterazioni degli alimenti e gli agenti chimici, fisici e biologici che possono determinarle • Le varie tecniche di conservazione degli alimenti • Nozioni circa l'uso degli alimenti conservati • Come cuocere e preparare gli alimenti • I diversi modi di cuocere i cibi • Appendici

Novità 2010

Scores
Clinici in Medicina d'Urgenza

Collana "Decidere in Medicina"

La medicina d'emergenza e urgenza è una nuova specialità che si affaccia alla ribalta nel mondo sempre più diversificato dell'assistenza.
È necessario avere medici d'emergenza e urgenza sempre più preparati, che si possano confrontare alla pari con i colleghi specialisti cardiologi, rianimatori, chirurghi o traumatologi.
Le difficoltà dello specialista in emergenza e urgenza sono tante, perché di fondo si confronta con tutte le patologie acute e quindi mantenere una competenza ed una conoscenza approfondita sulle tematiche delle emergenze richiede tempo, passione e studio. Passare da un possibile caso di addome acuto ad un dolore toracico è per il medico una quotidianità e richiede una straordinaria capacità di focalizzare diagnosi e terapie.
Sapendo che il rischio di una mancata diagnosi può essere fatale per il paziente e conoscendo quali sono gli errori più comuni dei medici d'urgenza, **gli autori hanno pensato di raccogliere una serie di score che possano aiutare la valutazione clinica, sia per sostenere la probabilità diagnostica che per stratificare la prognosi**.
La maggior parte degli score riportati sono validati nella letteratura da ampi studi clinici che consentono la scelta della dimissione piuttosto che del ricovero e della relativa strategia terapeutica.
Questo tascabile è un sintetico, concreto e valido aiuto per tutti i medici che operano nel settore.

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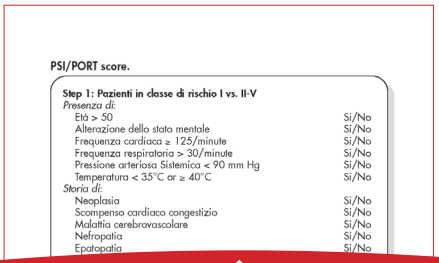
PSI/PORT score.

Step 1: Pazienti in classe di rischio I vs. II-V

Presenza di:	
Età > 50	Si/No
Alterazione dello stato mentale	Si/No
Frequenza cardiaca ≥ 125/minute	Si/No
Frequenza respiratoria > 30/minute	Si/No
Pressione arteriosa Sistemica < 90 mm Hg	Si/No
Temperatura < 35°C or ≥ 40°C	Si/No
Storia di:	
Neoplasia	Si/No
Scompenso cardiaco congestizio	Si/No
Malattia cerebrovascolare	Si/No
Nefropatia	Si/No
Epatopatia	Si/No


Capitolo 7
TRAUMATOLOGIA

Uso della radiografia del rachide cervicale nei pazienti con trauma: criteri di basso rischio "NEXUS" e Canadian C-Spine Rule

Due scores sono stati sviluppati indipendentemente negli Stati Uniti (NEXUS Low Risk Criterial) e in Canada (Canadian C-Spine Rule) per identificare i pazienti con trauma del rachide cervicale, vigili ed in condizioni non critiche, che necessitano o non necessitano di radiografia.
Si sottolinea che la radiografia del rachide cervicale va chiesta nelle tre proiezioni (anteriore, laterale, trans-orale) e che deve visualizzare anche il passaggio cervico-dorsale.
Gli score sono stati elaborati per evitare inutili e dannose esposizioni a radiazioni ionizzanti.

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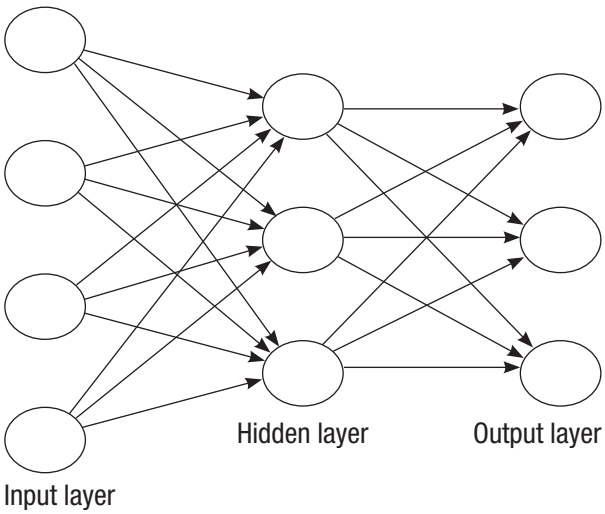

Fig. 1 - An example of a tree layers neural network.

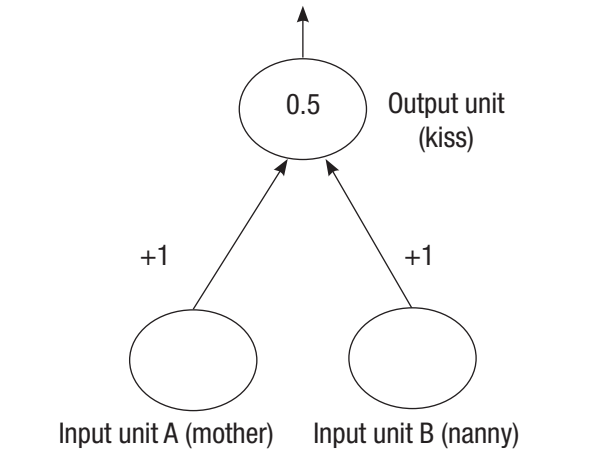

Fig. 2 - Representation of an inclusive disjunction.

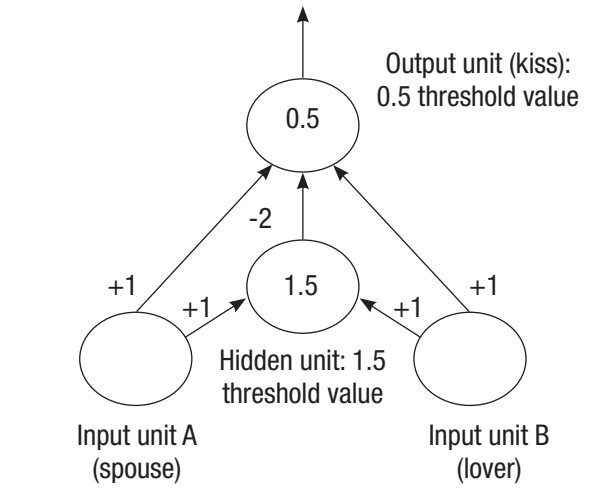

Fig. 3 - Representation of an exclusive disjunction.

or *processors*[13]; the transmission of the signal from one knot to another one is modulated by synapses, which can amplify the signal or reduce it.

In a neural network there are at least two types of unities: the *input units* and the *output units*. Nevertheless multilayer neural networks are required for complicated tasks. The intermediate knots are called hidden units, since they are not in contact with the external and don't produce directly a response.

The various types of neural networks may be simply divided into supervised and unsupervised networks. The first ones, unlike the second ones, are trained to respond to the inputs, to be processed by outputs which lean gradually to the expected outputs. A particularly used training method is the error back-propagation algorithm*, by which the weights of the connections among the knots of the network are progressively modified.

As for the unsupervised networks, they are based on training algorithms, which modify the weights of the network by using only the input data. Among them, Kohonen's networks (SOM: Self-Organizing Maps), are well-known to the specialists in the field and feature many applications. E.g., a SOM can map the input data and cluster them by a certain criterion.

The following is a simple example, derived from Johson Laird (1993) and adapted by Anolli & Legrenzi (op. cit.). I think that it can give some useful explanation of the connectionist networks (Figures 2 and 3).

The network represented in Figure 2 symbolizes an *inclusive disjunction* (A or B or both); suppose that two input units, A (mother) and B (nanny), produce an affective stimulation, which reaches force 1; the child gives a response as output (e.g., blowing a kiss) if he/she is encouraged by his/her mother or by his/her nanny or by both of them, as A and B's encouragement, and even more so A and B's joint encouragement exceeds 0.5 threshold value. The child doesn't blow a kiss only if he/she is not stimulated.

The network represented in Figure 3 symbolizes an *exclusive disjunction* (A or B, not both); in this case we hypothesize a man, who kisses their spouse or their lover, not both at the same time. Inhibitory

* The word "algorithm" derives from the name of the Persian mathematician Al-Khuwarizmi (9th century); it indicates a systematic problem solving procedure by a finite number of steps. E.g., the softwares are algorithms consisting of logical and algebraic operations, written in a language which can be understood by computers.

hidden unit, whose threshold value is 1.5 explains this condition: if the man is in front of their spouse or their lover (inhibitory hidden unit will not put itself in action, for its threshold value is 1.5) will express themselves with a kiss; if the same man is in front of both of them, inhibitory hidden unit will put itself in action, for it will receive a stimulation whose value is 2, that is more than its threshold value, and will send to the *output unit* a stimulation equal and opposite to the sum of the activations from A and from B. That situation will inhibit the response of the output unit and the man's kiss.

Granted that medical diagnosis is a complex process, the artificial neural networks, according to the experts of this area, can be a great help for both the diagnosis of the pathologies and the subsequent prognosis. A neural network can operate on images (X-ray plates), as well as on symbolic data, which represent symptoms and data[13]. It's well known the Anderson's so-called "instant physician"**, that is a neural network for diagnosis and patients' treatment.

I think that the chance to produce a "neural network-artificial physician" in future cannot be "a priori" excluded; such a network could gather the experience of the best physicians in the world counterbalancing the fact that a physician who quits his/her activity deprives the community from his/her experience.

However it goes, it's presumable that an "artificial opinion" may be helpful to the clinician's decision process.

** Attributed by Hecht-Nielsen[16].

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