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21. SCHRIKBEELDEN

Op de omslag van het themanummer een fragment van het stilleven 'Is, was, komt' [2016] van fotograaf Dik Nicolai (c), speciaal voor dit themanummer over SCHRIKBEELDEN gemaakt (bijdrage 19).

THE ELABORATION LIKELIHOOD MODEL REVISITED

A biological explanation and a somatic extension

Cécile R.L. Boot, Maarten C.A. van der Sanden, Martin Klein, Frans J. Meijman

The key elements of the Elaboration Likelihood Model (ELM) are the two different routes for information processing: the central and the peripheral routes to persuasion. To increase the insight in the ELM and to explore the use of the ELM within the context of health communication, we elaborated on the ELM in two ways. First, we searched for a biological explanation for the distinction between the two routes to persuasion, and second, we evaluated the completeness of the model. The scientific literature was searched for publications focussing on the ELM. Next, the authors discussed the ELM to formulate hypotheses regarding explanations for and completeness of the two routes.

No biological explanation for the two routes and no comments regarding the completeness of the ELM were found in the scientific literature. We formulated two hypotheses. First, the distinction between the central and peripheral route of the ELM can be explained within the context of evolutionary biology, in which staying alive and maintaining the species are the primary aims of each organism. Peripheral cues - threats, attractiveness of (others in) the environment - are necessarily processed faster than information or signals requiring a cognitive evaluation of the external environment. Secondly, the ELM is not complete when applying it to health communication specifically. Health complaints or different kinds of disturbing arousal may hinder information processing. Endogenous signals from the internal environment, cannot be classified in the central or peripheral route, since they relate to exogenous information. A third route to persuasion is presented: the endogenous route, which is hypothesised to compete with the peripheral and central routes throughout the process of information processing.

Keywords: communication, human information processing, patients, information theory, health communication, Elaboration Likelihood Model.

INTRODUCTION

Communication about health issues with the public is becoming increasingly important in our society. Not only has the number of options in health and health care increased, patients have become increasingly involved in health care and are stimulated to make their own choices and to take responsibility regarding their own health (Fox & Ward, 2006). Health information is considered the key element of informed decision making. The public is expected to make their own decisions regarding health insurance, health care providers, or medication. Health information has become publicly available through diverse media such as television, magazines, newspapers, or the Internet. The increasing amount of health information accessible for the public may lead to problems regarding finding useful information or at least selecting the passively received information. Health information seekers or receivers may be discouraged

by information overload or lack of specificity of the information. Moreover, as a result of the large number of different presenters of information, it is difficult to assess the reliability of the information. Another actual problem is related to health literacy. Health information on the internet may not be comprehensible for all members of the public, because it was written by and for professionals, or members of the public may lack searching abilities to retrieve the information (Brender, Ammenwerth, Nykanen & Talmon, 2006; Case, 2002; Cashen, Dykes & Gerber, 2004; Cline & Haynes, 2001; Eysenbach & Kohler, 2002).

To ensure that the public is able to process the health information they need, and to understand the public health messages, it is of major importance to gain insight in how the public handles the health information (overload) they face in their lives, and how the health information relates to changes in attitudes and behaviour with respect to health issues. Before attitude change can take place, one needs to be aware of health issues concerning the individual, family or society. The Elaboration Likelihood Model (ELM) proposed two routes to involvement and awareness following exposure to information in any form (Petty & Cacioppo, 1986).

Dual persuasion

The ELM focuses on attitude change in general (Petty & Cacioppo, 1986). The theory behind this model outlines a finite number of ways in which information can have its impact on judgments. Central in this model are the two routes to persuasion: the central and the peripheral route. Central route attitude changes are aimed at scrutinising and uncovering the central merits of the issue, whereas peripheral-route attitude changes are based on a variety of attitude change processes that typically require less cognitive effort. Attitude change can result from high-effort as well as from low-effort scrutiny of the information available, e.g., by examining less information, by examining the information less carefully, or by less resource demanding processes, such as classical conditioning or the use of heuristics. In case of low effort, people are looking for a quick, simple and easy way to judge the merits of the position, rather than examining all of the information carefully. People's considerations and judgements may be based on the first arguments processed, or whether the source is attractive. This peripheral route precedes the information entering by the central route, which generally takes more time because of the cognitive work involved. The ELM is, as are many other social-psychological models, criticised because it describes rather than explains the factors and processes involved in attitude change and information processing. Criticasters accuse the ELM for not exploring the extent of the interrelations, or causalities. Before the ELM can be applied to health communication, insight in the background of the two routes to persuasion will be useful. In addition, an evaluation of the completeness of the model when applied to the context of health information will be valuable as well.

To increase the insight in the ELM and to improve the framework that can help to improve our insight in health communication, the aim of this study was to elaborate on the ELM in two ways:

- Explanation: is there a biological explanation for the ELM theory about two different routes for information uptake, and does this biological explanation provide room for an additional route of information processing?
- Completeness: From these insights into the biological explanation, and the application of the ELM within the context of health information, we ask ourselves: is the ELM complete when applying it to health information?

I. METHODS

Literature review

Scientific books and articles were searched using Pubmed, Web of Science, PsycInfo, EBESCO, and JSTOR in three ways. First, all the above-mentioned databases were searched for other publications by Cacioppo and Petty about the ELM. In addition, we searched for publications about

information processing during illness or in combination with health complaints. Second, these databases were searched using the keyword 'elaboration likelihood model' and 'ELM'. Finally, we used Web of Science to search for articles that had cited the original articles by Cacioppo and Petty. Relevant articles were selected on title and abstract by the first author.

Assessment of face value hypotheses

The results of the literature review, in combination with logical reasoning, were subject to group discussions between the authors. By mirroring the ELM to other psychological models, hypotheses were formulated and used as input for the discussion again.

Results and discussion

In a recent publication about the two routes to persuasion, the authors of the original publication of the ELM, Petty and Cacioppo, did not give an explanation for the distinction in two routes, nor did they discuss the completeness of the ELM (Petty, Cacioppo, Strathman & Priester, 2005).

Explanation of the ELM

No publications about a biological explanation for the distinction between the two routes for persuasion were found in the scientific literature. Publications regarding the ELM focus on the description or the application of the two routes for persuasion, rather than the background of the two routes.

Information uptake in the body: a biological explanation

In the group discussions, a hypothesis was formulated regarding the origin of the existence of the two distinct routes. The authors hypothesise that the differences between the peripheral and central route may be explained within the context of biological evolution. From an evolutionary point of view, an organism needs to stay alive. Besides the maintenance of life, reproduction is necessary for survival of the species. Both tasks require a continuous and fast assessment of the external environment. It was this function that was developed first in the brains of the most primitive species.

II. EVOLUTION OF THE BRAIN

From an evolutionary point of view, the human brain can be divided into three parts in which each part has its own functional characteristics and evolutionary development. The model of the division of the brain in three parts is called the 'triune brain' and is proposed by MacLean (Maclean, 1990). The three sections of the brain are the R-complex, the limbic system and the neocortex.

R-complex: self preservation

The R-complex is the most primitive part of the brain and includes the brainstem and the cerebellum. The R-complex is also known as the reptilian brain, because the brain from reptiles is dominated by the brainstem and cerebellum. From an evolutionary point of view, this complex is the most ancient part of the brain. This part of the brain controls the muscles, balance and autonomic functions (e.g., heart rate, blood pressure) in reaction to direct stimuli. As a result, this part of the brain is responsible for basic survival fight-or-flight responses.

Limbic system: emotions

The limbic system is the intermediate brain and derived from the old mammalian brain, which implies that only mammals have a limbic system. It is the source of emotions and instincts, such as feeding, fleeing, aggression, and sexual behaviour. It consists of the amygdala, hippo-campus, both located in the medial temporal lobe, the hypothalamus, located just above the brain stem, several anterior thalamic nuclei, and the limbic cortex. The amygdala play a role in the processing and memory of emotional reactions and the hippocampus – anatomically speaking a part of the cortex- plays a role in long-term memory and spatial orientation. The hypothalamus controls body temperature, hunger, thirst, fatigue, anger, and day/night rhythms. The limbic system is connected to a

wide variety of brain regions, including the prefrontal cortex, which is responsible for problem solving and initiation of goal-directed behaviour.

Neocortex: cognitive processing, intellectual tasks

During evolution, human brain mass increased beyond that of other species, relative to body mass. This process is most pronounced in the neocortex, the outer layer of the brain involved with so-called higher cognitive functions requiring conscious and effortful information processing. These functions include language comprehension and expression, planning, memory, abstract reasoning, and consciousness. The brain structure of mammals differs from other creatures in the outer parts of the brain, which are more recently developed in evolution. Only mammals have a neocortex. Some cortical brain areas process only visual, olfactory, or auditory information. Other areas are association areas that coordinate signals and relay disparate types of information.

One important association area is the orbitofrontal cortex (OFC). The OFC processes an abundance of information from sensory, emotional, and memory-related brain regions and thus likely serves as an important centre for integration and evaluation. Recent research is revealing that the OFC could be a major site, or is at the very least an essential participant in a network of sites, where sensory and memory-related information is evaluated and transformed into predictions of the future used to guide decisions and actions (Bonelli & Cummings, 2007). The convergence of chemo-sensory, emotion, and memory related inputs within the OFC enables this area to function as a major centre for calculating the value of basic rewards and punishments, and relating them to past and future events and behaviours. In animals performing repetitive experimental tasks, physiological activity in the OFC appears to predict or anticipate future events in the task. The activity of OFC neurons can also reflect the value of anticipated rewards in a context-dependent manner. This means that neural activity in the OFC may change depending on how much of an anticipated food will likely be available or how much the animal desires that food, considering what else is available or what it has already consumed that day. The neurons in the OFC also seem to discriminate between contexts where the same food is available but it will be either easy or hard to obtain.

III. THE ELM AND THE ROLE OF EVOLUTION

When taking into consideration these three parts of the brain, information processing by the peripheral route will take place in the limbic system, and even by the R-complex, whereas the neocortex is needed for central route cognitive processing. Within the context of evolution, it can be hypothesised that the peripheral cues could be processed first, before the human brain evolved into information processing through the central route. It can be imagined that the peripheral cues are processed faster because they have been processed over a longer period of time, compared to the cognitive processing. It can be concluded that the evolutionary development of the brain increases our insight in the origin of the two different routes of persuasion.

Completeness of the ELM: endogenous route

No scientific publication has paid attention to the completeness of the ELM, regarding the two routes (Petty and Briñol, 2015). In health communication, illness or perceived health complaints may play an important role. Previous studies have shown that perceived health complaints, such as pain were negatively associated with information processing capacity (e.g., Grigsby et al. 1995; Taimela, 1990). Previous studies on pain have shown that chronic pain directly affects the speed and capacity of information processing (Grigsby and Rosenberg, 1995). They hypothesise that the threshold for disruption of cognition by pain may vary considerably among individuals. Although it may seem obvious that severe pain affects information processing, earlier studies attributed the cognitive errors to emotional distress, rather than to pain (Dufton, 1989). In another study on chronic pain patients, pain was considered as a major cognitive distractor, but the information deficits were considered to be associated with depression and not pain (Sprock et al., 1983). Taimela et al. (1990, 1993) reported a lower speed of cognitive processing in

persons with low back pain compared to control subjects. Again, the cognitive delay was ascribed to fear of pain, depression or anxiety, rather than the low back pain itself.

Grigsby et al (1994) hypothesise that 'one simply finds it difficult to concentrate because of pain'. This hypothesis is explored by Grigsby et al. (1995) by stating that "pain represents a powerful sensory stimulus that activates nodes in the reticular system, thalamus, limbic system and cortex. As a perceptual stimulus, it demands one's attention and thus represents a competitor for finite attentional resources. (…) Pain, like certain other stimuli, e.g. sensory deprivation, sensory overload, may drive the brain into states with marked differences from its usual mode of processing." It is tempting to speculate that activation of cortical regions with sensory and limbic functions, along with activation of the OFC, reflects an interplay of related networks. Thus, sensory information about internal stimuli might be interpreted at the level of the OFC, which connects with the amygdala in evaluating the motivational value of the stimuli, and labelling the emotional response as unpleasant.
Perceiving health complaints while searching for health information or being passively receptive for it is a realistic situation since many people search for health information to find a diagnosis for their health complaints (Keijser, 2005; Shuyler & Knight, 2003). This implies that they may start searching for health information while they perceive pain, fatigue or other health complaints. The signals they meet in their external environment, consisting of peripheral cues or signals, which require cognitive processing, and enter by the central route will have to compete with signals or information from within the body.

These health complaints can be considered as endogenous signals that need to be processed. They may influence information uptake. A group between the authors discussion led to a hypothesis regarding a third route for information processing: endogenous signals may have to compete with exogenous signals, which are processed by either the central or the peripheral route.

We hypothesise that endogenous signals, which are originating from within a person will severely influence the uptake of external signals. It is easy to imagine that a person suffering from pain, fatigue, hunger or thirst will not, or at least to a lesser extent, be able to process information from the external environment. This will have consequences for the effects of the presented or requested health information.

Parallels with Maslow's hierarchy of human needs

The endogenous route we have now proposed can be put within the perspective of Maslow's hierarchy of human needs (Maslow, 1943). The parallels are visualised in figure 1. Within this hierarchy of needs, it is assumed that the needs, which are below in the pyramid, should be fulfilled first, or at least partially, before the needs that are placed higher in the pyramid will be met. Our endogenous route can be considered parallel to the physiological needs, which appear from within the person (figure 1). Once these needs are met, or these signals are taken care of, the peripheral cues, relating to safety appear. A need for safety can be placed parallel to maintaining one's own life, whereas love or belonging, the next need in Maslow's pyramid can be placed next to maintaining the species through reproduction. Status and self-actualisation refer to the central route, in which cognitive processes play an important role. The higher in the pyramid, the higher the elaboration will be. It can be questioned whether the endogenous route always acts faster than the peripheral route. Future research is needed to explore on this hypothesis.

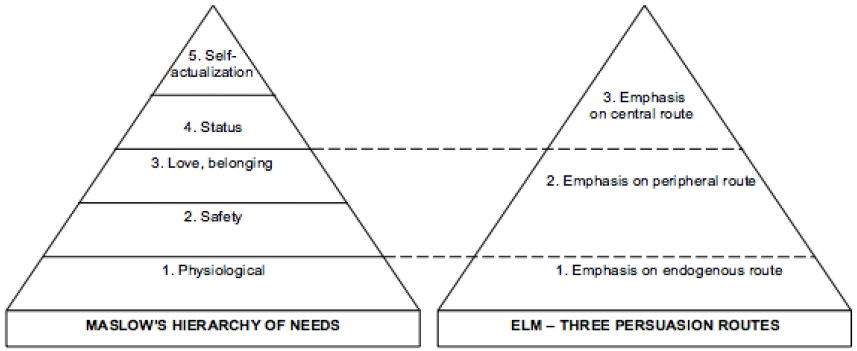


Figure 1: Parallels between Maslow's hierarchy of human needs and the Elaboration Likelihood Model (ELM), extended by the third, endogenous route.

The processing of health information derived from other people or external media can be seen as an activity which is higher in the pyramid. The basic needs, such as hunger and thirst, coping with pain and other physical or mental disabilities, and safety and love, should be met first, before one will be open to exogenous health information processing.

By presenting the parallels with Maslow's theory, we aim to stress that the biological explanation of the distinction between the peripheral and central route, and the extension of the ELM by a third source of crucial information, the endogenous route, appear to be logical supplements to the ELM.

Implications for research and practice

One of the aims of health information is attitude change, with behavioural change as the ultimate goal. Previous research has shown that effects of peripheral cues should not be neglected. In addition to the central route, the peripheral route plays an important role in information processing (Mattila, 1999). This is also true within the context of health information processing (Gollust, Hull & Wilfond, 2002; Hull & Prasad, 2001).

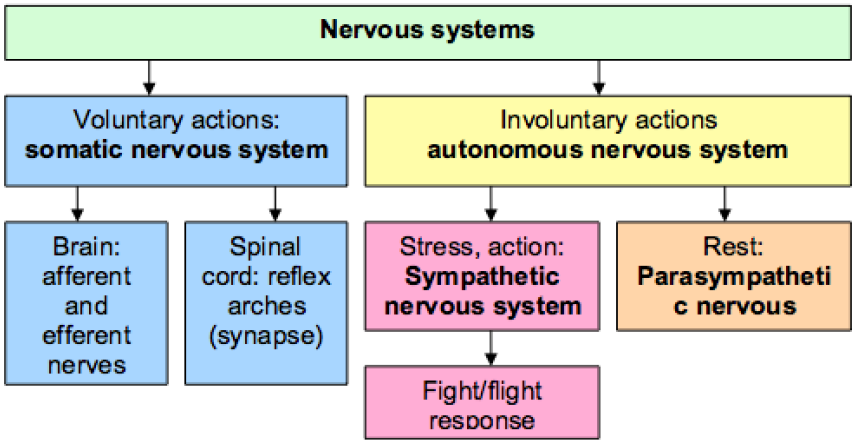
In the process of composing health information, it can easily be imagined that the first impression of health leaflets or health websites needs to be such that people feel safe with it or feel attracted to it before one wants to start with considering the content. This first selection process can be associated with the quicker, peripheral route of the ELM that depends on non-described, emotional and often issue-irrelevant information, images and impressions. However, when we apply the ELM to communication of health information to people with health complaints, the central and peripheral information appear to be preceded, or at least severely influenced by a different route: information from the own body, endogenous information, e.g., health complaints, symptoms, or physiological stimuli, such as hunger, thirst, pain, fatigue, heat or cold. Obviously, three levels of awareness can be distinguished: cognitive, emotional and somatic. All three levels should be taken into account when communicating health information, in public, but also in clinical practice.

Methodological considerations

This paper elaborates on the background and completeness of the ELM within the context of health information. Since we have not found information on both topics in the scientific literature, this paper relies on hypotheses and logical reasoning formulated by all authors. Much work on this topic remains to be done, with the first step being the confirmation or rejection of our hypotheses by experiments.

Regarding the explanation of the two (or three) routes to persuasion, it would have been a major argument in advantage of our evolutionary biological hypothesis when the different routes would be reflected in separated functional anatomical pathways. However, as a result of the nature, the aim and the function of the division into three routes, it would be too simple to translate these routes one to one to the classic anatomic, neurophysiologic classification of the nervous system (frame 1). All three routes make use of parts of the nervous system and will most likely be interconnected through various anatomical structures based on their evolutionary functions.

Frame 1: Overview of nervous systems in the human body



Nervous systems

Several nervous systems are present in humans. A body is in touch with its surroundings by the **somatic nervous system**. The somatic nervous system is the part of the peripheral nervous system associated with the voluntary control of body movements through the action of the skeletal muscles, and with reception of external stimuli, such as touch, hearing and sight. This system includes all neurons connected with muscles, skin and sense organs. Afferent nerves receive sensory information from external sources and transmit them to the brain, and efferent nerves are responsible for receiving brain communication for voluntary muscle contractions.

The **reflex arches** are an exception, since reflexes do not pass directly to the brain, but synapse in the spinal cord without the delay of routing signals to the brain. This enables a quick activation of the spinal neurons, allowing a quick motor response.

Besides the somatic nervous system, the **autonomous nervous system** exists in the body. The autonomic nervous system regulates involuntary movements and processes, such as breathing, heart rate, and digestion. This nervous system consists of the sympathetic and parasympathetic systems. The sympathetic nervous becomes active in times of stress, in which it aims to maintain homeostasis in the body. During stress, the fight-flight response is initiated, in which the body is primed for fighting or fleeing by releasing epinephrine and norepinephrine to enable an acceleration of heart and lung function, and inhibition of gastro-intestinal function, a liberation of nutrients for muscle action, vasodilatation of muscular blood vessels and vasoconstriction of blood vessels in other parts of the body.

CONCLUSION

We have presented two hypotheses regarding the ELM. First, the distinction between the central and peripheral route to persuasion can be explained within a biological evolutionary context. Our second hypothesis is that the ELM is not complete within the context of health information since a third route, the endogenous somatic route should be integrated with the central and peripheral exogenous routes.

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Dutch abstract

ANGSTAANJAGENDE INFORMATIE EN DE VERWERKING ERVAN

'En de draak stond voor de vrouw, die baren zou, opdat hij haar kind zou verslinden, wanneer zij het zou gebaard hebben.' (Openbaringen 12:4). Aan welke informatie geeft de barende vrouw voorrang: de pijn (vanuit haar lichaam) of de angst voor de draak (van buiten haar lichaam)?

Een Engelstalige bespiegeling op een model voor duale informatieverwerking

Cécile R.L. Boot,[1] Maarten C.A. van der Sanden,[2] Martin Klein,[3] Frans J. Meijman[4]

Schrik voor de buitenwereld in de schaduw van de eigen pijn

Petty en Cacioppo formuleerden decennia geleden het Elaboration Likelihood Model (ELM) voor de verwerking van informatie vanuit de buitenwereld, in het bijzonder hoe die informatie aan overreding bij kan dragen. Zij postuleerden twee routes waarlangs de informatie 'binnenkomt' en verwerkt wordt:

- centrale verwerking van informatie (van buiten) met als kenmerken: diepgaand, systematisch, langzaam, vaak verbaal, inhoud van de informatie van belang;
- perifere verwerking van informatie (van buiten) met als kenmerken: oppervlakkig, snel, non-verbaal (beeld/muziek), aspecten van belang die niet gerelateerd zijn aan de inhoud van de boodschap zoals emoties (gevaar, vertrouwdheid, aantrekkelijkheid) en 'sfeer'.

Het ELM wordt als een belangrijk model gehanteerd, ook al ontbreekt volledig empirisch bewijs. Op basis van uitgebreid literatuuronderzoek en onderlinge gedachtewisselingen formuleerden wij vanuit het gezichtspunt van gezondheidscommunicatie twee veronderstellingen: voor een biologische verklaring van het ELM en voor een derde (aanvullende) wijze van informatieverwerking.

- Het onderscheid tussen de centrale en de perifere verwerking van informatie kan worden verklaard vanuit de evolutiebiologie: de verwerking van informatie ten dienste van de overleving van het betrokken individu (gevaar) of het in stand houden van de soort (voortplanting) dient sneller te verlopen dan de cognitieve beoordeling van de buitenwereld.
- In de sfeer van gezondheid en ziekte is de verwerking van informatie vanuit het lichaam zelf (als derde route) van belang naast de twee routes die gericht zijn op de buitenwereld. Het is voor iedereen herkenbaar dat signalen van moeheid, pijn of andere 'aandacht vragende' aard de verwerking van informatie uit de buitenwereld in de weg staan zo niet geheel blokkeren.

Kan de endogene route zelfs dominant zijn ten opzichte van informatie die overwegend via de perifere route wordt verwerkt? Verdwijnt de schrik voor de buitenwereld in de schaduw van de eigen pijn of uitputting?

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