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COMMUNICATION BEYOND WORDS<sup>1</sup>

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One of the fundamentals of our civilization is the efficient and strictly codified system of linguistic messages, called verbal communication. Yet, there is no doubt that beyond this system there is also something like nonverbal communication.

Tokarz, *Argumentacja, perswazja, manipulacja*

INTRODUCTION

It is no accident that we begin this article with a quotation from Marek Tokarz. His article entitled *Komunikacja poza gramatyką* [eng. Communication beyond grammar], which was published in the commemorative book in honor of professor Jerzy Pelc *W świecie znaków: księga pamiątkowa ku czci profesora Jerzego Pelca* (Tokarz 1996), was one of the chief inspirations for *this paper*. In his article, Tokarz studied the possibility of achieving communication without syntax. In what follows, we intend to go one step further and analyze the possibility of achieving communication without verbal means. Let us begin with specifying the term 'nonverbal communication'. According to the common definition, it is a communication which involves giving signs (signals) other than words (Tokarz 2006: 327). Verbal communication is not identified with oral, spoken communication, but with a communication established through words. That is why emitting sounds such as muttering or humming are considered nonverbal messages. On the other hand, sign language and written language are treated as verbal communication.

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A mere confirmation that nonverbal communication exists is by no means a revolutionary thesis. The importance of nonverbal signs for natural communication is a well-known fact in psychology and advertising, as well as, to some extent, in informal logic or communication theories. It would seem that there is no need to restate some of these theses in this article. However, the notion of nonverbal communication is almost entirely unfamiliar to formal approaches (perhaps with the exception of Tokarz who takes into consideration some of these aspects). The communication studied in formal systems either has a verbal character or is reduced to or identified with verbal communication. According to such systems, locutions which are well-formed syntactically are represented by verbal signs (sentences).

Let us imagine an action movie in which criminals kidnap a wealthy man, lock him in a basement and try to make him reveal where he keeps his money. What kind of arguments do we expect them to use? Verbal? If the criminals are truly 'serious', we will probably have a scene where they tie down the victim and torture him. Is it the same argument to say "I'll punch you" and to actually deliver the punch? Does it really make a difference to the criminals whether they perform the verbal or the nonverbal action? Finally, is there a point in distinguishing these two types of messages in the communication model? The aim of this article is to discuss two issues around nonverbal communication. Firstly, we intend to examine if nonverbal signs can be reduced to their verbal equivalents. Secondly, we plan to answer the question of how to shape nonverbal communication.

The article has a three-part structure. In chapter one we will be giving an overview of various theories on nonverbal communication, which can be found in contemporary literature. In chapter two we will proceed to discuss the problem of bringing nonverbal messages down to their verbal equivalents. Finally, in chapter three we will be presenting an example of a formal model of communication, which enables the representation of nonverbal acts of communication.

## **1. CONTEMPORARY RESEARCH IN NONVERBAL COMMUNICATION**

We shall begin by outlining the background for our considerations, that is, by putting together those theories which 'notice' the existence of nonverbal communication. First, we shall discuss two concepts derived from informal logic. The first one is the theory of coalescent argumentation proposed by Michael Gilbert (part 1.1). The acknowledgment of the speakers' attitudes, such as their emotions or intuitions, can be interpreted as an emphasis

on factors which exceed the mere use of words during message exchange. Another interesting idea is the theory of visual argumentation developed by Leo Groarke (part 1.2). In this case, the nonverbal quality is expressed by the use of image as either a premise or a conclusion. Finally, we will discuss certain concepts from psychology and communication theory, which examine such nonverbal symptoms of social interactions as facial expressions, gesticulation or clothing (part 1.3).

### **1.1 COALESCENT ARGUMENTATION (MICHAEL GILBERT)**

In his works (Gilbert 1994, 1995, 1997) Michael Gilbert introduces the concept of coalescent communication. The goal of such communication is to produce effective argumentation, which is not focused on attacking the opponent's arguments, but on establishing agreement by analyzing points of disagreement and consequently, by identifying differences and similarities in the reasoning of the conflicted parties. Coalescent argumentation involves bringing together two disparate claims by uncovering the crucial connection between the content of a message and its sender's position, that is, his beliefs, feelings, emotions, values and needs. On such a basis, dispute partners are able to identify what they share and what differs between them. This knowledge is used to effect coalescence, a merging of divergent positions.

Arguments are often assumed to be claims, that is, messages which convey a certain thesis. This theory, however, assumes that such claims are in fact icons for positions adopted by the participants and that the essence of the argument is much more complex and profound than the content of the message. An argument-claim is like the tip of the iceberg — it points to where the problem lies, but it does not embrace its nature, which usually remains concealed. In order to understand somebody's position, you ought to uncover as many aspects directly or indirectly connected with the thesis as possible. Note that arguments very rarely arise over directly expressed claims. What is more important is where the difference in opinions comes from, why somebody thinks this or that and why they hold a particular view. Therefore, in order for persuasion to be successful, one must impact on somebody's entire position. Attacking only the claim will not produce the

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<sup>2</sup>Informal logic is one of the contemporary approaches focused on analyzing arguments. It aims to develop tools, criteria and procedures for identifying, analyzing and assessing arguments typical for every-day conversations. Informal logic is particularly interested in arguments found in advertising, political debates, court and social commentary in newspapers, television or the Internet.

desired result. If we concentrate only on the content of the message, we will shift the emphasis towards a different aspect of the conflict, but we will not resolve it. We will be efficient only if we go to the heart of the matter and determine the goals and motivations of our dispute partner. What must be also taken into account is the self-awareness of a dispute's participants, i.e. the fact that they can be either aware or unaware of their every motivation. Some factors, such as fear, concern or uncertainty, may be concealed (they may exist at the subconscious level). The more the opinions differ, the more important it is to uncover those hidden components which influence the opponent's and the proponent's positions.

Gilbert draws on a theory according to which arguments have two levels of goals. The macro level is all about cooperation and maintaining the relationship between the participants. These goals, treated as 'face goals,' are the actual goals of an interaction and they involve attention to role, status and power relationships between people. At the micro level 'strategic' goals are found, referred to as 'dark-side goals.' These goals describe the desired outcome, which was the stimulus for the argumentative encounter. For example, when a student asks his professor for a meeting to discuss an essay, his face goal is to improve his knowledge and to establish a working relationship with the professor, while he has as a strategic goal of having his grade raised. The awareness that both parties in a dispute have face and strategic goals is the basic ingredient of coalescent argumentation. It is vital to establish the participants' expectations, which allows for the possibility of satisfying them. Therefore, the main function of the process of argumentation is uncovering and determining the goals and needs of the arguers. Thus, the first stage of coalescent argumentation is to answer the question "Why are we arguing?" If we do not know what our opponent expects, what his beliefs are, what he is feeling, then it is difficult for us to satisfy his needs and consequently, to bring him around to our point of view throughout argumentation. Hence, determining these items is the key to successful argumentative communication.

The second stage of coalescent argumentation is an attempt to answer the question "What are we arguing about?" by exploring the participants' positions. Understanding somebody's position requires far more than simply knowing the content of a message and its immediate supporting reasons. What is crucial is to know why somebody holds that particular position and what he might think or feel. This means that one must not only collect the facts that support the claim, but also establish what values and emotions go along with it. Obviously, uncovering a position is much more difficult than

simply hearing a claim. It includes exploring all aspects of an argumentation, that is, the logical, emotional, visceral (situation) and kisceral (intuition) aspects of a view. Beliefs derive from many sources, only one of which is the logical. In order to go beyond a simple examination of the content of a claim, i.e. to comprehend somebody's entire position, one needs to explore all of these sources and the connections between them. As we already mentioned, arguments may be based on logic, emotions, feelings, physicality or intuition. Logical arguments are those which are grounded in the laws and rules of logic. For example: Henry states "John is in that room." "Why?", Anne asks. "John entered through the door on the right or through that on the left — both lead to that room." "John must be inside then," Anne confirmed. We have just followed a rule based on the formula: if A or B and if A then C and if B then C, therefore C. However, in disputes between humans the arguers' emotions are as important a factor as logical arguments. Let us take a look at the following situation: when talking with Professor Nowak, Susannah is canvassing for a good grade. "If I do not get a good grade, I will not receive a scholarship. I am in a very bad financial situation and unless I get this scholarship I will be forced to drop out," says the teary-eyed student and passes her record book to the professor, her hands shaking. She is hoping to succeed by emphasizing how important it is for her to have the grade raised. She achieves that mainly through body language. Another set of arguments refers to the circumstances of a dispute. Let us consider, as an example, the following: John is making shrimps for dinner and Mary is trying to convince him to add some curry to the dish. John doubts that it will improve the flavor. Mary is not going to use logical or any other verbal arguments to explain why adding curry powder is the right thing to do. Instead, she walks up to the cupboard and starts searching for the spice. It turns out that the spice is on the top shelf, so Mary climbs on a stool and rummages through the cupboard making a lot of noise and fuss. Finally, she passes the curry to John, satisfaction spreading all over her face, and says: "Are you sure you don't need some curry?" "Fine", says John, resigned. The effort that Mary had put into finding the spice convinced John to change his original plan. Mary engaged in a physical activity that ensured her success. Notice that what convinced John was not a verbal description of why it was worth adding curry, but Mary's dedication and involvement. The last set of arguments is connected with intuition. Intuitions play an important role in many argumentations, even though they are often dismissed as silly and illogical. These arguments usually concern religion, spirituality, mysticism etc. The following dialogue may serve as a good illustration for these kinds

of arguments: "Did you buy that house?", Jake asked. "No. When I went to see it, I suddenly felt this strange fear," Sebastian answered. "But it was such a good offer!", said Jake amazed. "So what? It made me feel ill at ease, I wouldn't have the courage to move in there," Sebastian explained. It is hard to account for Jake's behavior by referring to "logic." His fear was unjustified. And yet, he decided not to buy the house despite favorable terms of agreement. In practice, arguments which are based on intuition are often irrational, but very effective nonetheless. Obviously, there is a wide group of nonverbal arguments, which facilitate achieving the desired outcome. They refer to all the factors which affect people's beliefs and behaviors.

The third stage of coalescent argumentation is to find the answer to the question "How can we come to an agreement?" The word 'coalescent' means resulting from a joining of different elements. Obviously, it is difficult to merge conflicting positions into one. For that reason, we should speak of the degree of coalescence, that is, the extent to which disparate views can be reconciled. The degree to which coalescence may be attained is a function of the degree to which we can answer the question "Why are we arguing?" It is obvious that revealing the full position of both arguers, all of their motivations, feelings, beliefs etc. is not always possible. The key is empathy, that is, the ability to put oneself in other people's position. Empathy allows us to predict the goals and needs of a person who holds a particular position and consequently to discover their true motivation. What is also crucial is the empathic awareness that certain beliefs, attitudes, situations and intuitions are common to both dispute partners. That is why some shared knowledge about each position must be established — why it is held, what it means to its holder, how important it is for the person's worldview and which needs it fulfills. It is indeed difficult to attain coalescence when one person finds a particular argument irrelevant or incidental, while for the other person the same argument is fundamental. The move towards coalescence requires the participants to first understand each other's beliefs and needs, and then to satisfy, as much as possible, their needs and desires.

## 1.2 VISUAL ARGUMENTATION

Visual arguments have recently become a hotly debated issue. A theory of such argumentation is developed primarily by Leo Groarke (e.g. 1996a, 1996b, 2002, 2007), as well as by J.A. Blair (1996), D.S. Birdsell (e.g. 1996, 2006), C. Shelley (e.g. 2001, 2003), M. Gilbert (1997) or Ch. Slade (2002).

A visual argument can be defined as a set of premises and a conclusion, which are wholly or partially expressed by visual (nonverbal) means (Groarke

2007: 535). Not all arguments which are accompanied by visual images are considered visual arguments, since an image can perform a different function than leading to conclusions — it can be purely aesthetic or function as a 'visual flag' to attract our attention. Photographs, drawings, logos or documentaries may all be part of visual arguments, but sometimes nonverbal signals may also be accompanied by verbal signs.

In this theory images count as indirect speech acts and their interpretation is based on three principles of visual communication: (1) such images can be understood, (2) such images ought to be interpreted in a way that makes sense of the main (both visual and verbal) elements contained in them, (3) such images should be interpreted appropriately to the social, critical, political or aesthetic context in which they occur (Groarke 2002). Knowing the modes of visual meaning can be helpful when it comes to interpreting visual arguments (Shelley 2003, Birdsell, Groarke 2006): (1) *argument flags* are images which are supposed to attract attention to a message, e.g. a picture of a beautiful woman used to advertise cars, (2) *visual demonstrations* are images used to convey information which can be best presented visually, such as colors, shapes or abstract relations e.g. charts presenting election results, (3) visual metaphors are images used to convey information figuratively, e.g. David Siqueiros's painting *Nuestra imagen actual* (*Our present image*) which presents a man with a rock instead of head, (4) visual symbols are images which function as signs standing for the things they represent, e.g. the image of a skull may represent death, (5) visual archetypes are images whose meaning is generally recognized, e.g. Pinocchio's long nose, which began to symbolize lying.

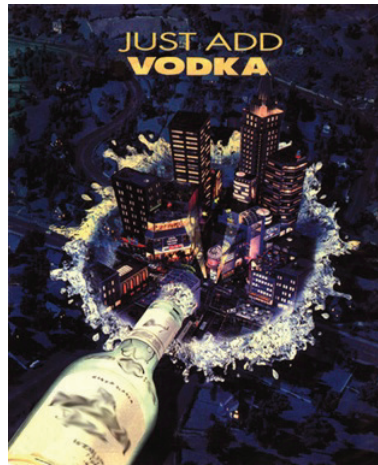


Fig. 1. A vodka advertisement as an instance of a visual argument (Groarke 1996b)

Leo Groarke's primary goal is to advance such a theory of visual argument, which would enable an evaluation of the correctness of such argumentation with the tools offered by informal logic. A vodka advertisement (see Fig. 1) is an example of a visual argument analyzed by Groarke (1996b). It features an oversized bottle of vodka spilling its content onto a motionless city plunged into darkness. But in the part of the picture where the vodka splashes, the city springs to life, bursting with lights and colors. Above the image it says: "Just Add Vodka." The advertisement is a visual metaphor transmitting a message, which, according to Groarke, can be put verbally as follows: "Vodka can transform your sleepy life into one full of cosmopolitan excitement" (Groarke 1996b). A more detailed interpretation of the image shows that the argumentation here is as follows:

*Premise 1:* If you add vodka to your life, your boring life will be transformed into one full of colors and excitement.

*Premise 2 (implicit):* You want your life to be colorful and exciting.

*Conclusion:* You should add vodka to your life (i.e., purchase vodka).

Once nonverbal argumentation is reconstructed, it can be analyzed in the same way that informal logic assesses verbal arguments. For example: premise 1 can be easily questioned by pointing out that the consumption of vodka leads not so much to fun, as to addiction. In addition, the analyzed reasoning can be accused of being a normative variant of 'affirming the consequent' fallacy, since it follows the scheme: "If A, then B" and "B is desirable," therefore "A is desirable." In conclusion, Groarke claims that nonverbal argumentation contained in an image can be treated as an equivalent to



verbal argument, which makes it possible to examine it with the tools developed by informal logic.

### **1.3 NONVERBAL COMMUNICATION (PSYCHOLOGY AND COMMUNICATION THEORY)**

Nonverbal communication, especially the classification of nonverbal signals, is a particularly interesting problem for psychology and communication theory. Let us begin then with the classification proposed by Marek Tokarz (Tokarz 2006, 336-339). Some nonverbal messages are sent in an uncontrolled way, that is, without their sender's will (see Fig. 2). Such signals include a face turning red or trembling hands. However, from the point of view of communication studies, a more important class would be formed by those messages, which are not only controlled by the sender, but ones which are also purposeful, in other words, messages that are intentionally controlled. A criterion for recognizing controlled signs is whether they can be simulated (faked). Since we can pretend to laugh at someone's joke, even though we did not find it funny, the criterion of laughter would count as a controlled signal. However, depending on whether, in a particular communicative situation, laughter acts as an expression of a purposeful or unintentional action, such a controlled message would be put in the subclass of either intentional or spontaneous signs. Intentional messages can be further divided into two more categories. Although nonverbal communication is much less codified than verbal communication, the meaning of several nonverbal signs is determined to some extent by the convention adopted by a given community. Conventional intentional signals are, for example, pointing a direction with the index finger or nodding. In the case of nonverbal communication the convention may be adopted by any group of people, whatever their number, and remain unrecognizable to other participants of communication, who may codify it differently. For example, a Pole would interpret nodding as sending a message of agreement, while a Bulgarian would read it as a sign of disagreement. Similarly, a gesture done by connecting the thumb and the index finger would be perceived in Poland and in the US as a sign of approval ("A-OK"), whereas in France it would mean 'zero' and in Greece it would be considered offensive. Individual intentional signals are behaviors characteristic for a particular person — their interpretation (decoding) is only possible for those who know this person well.

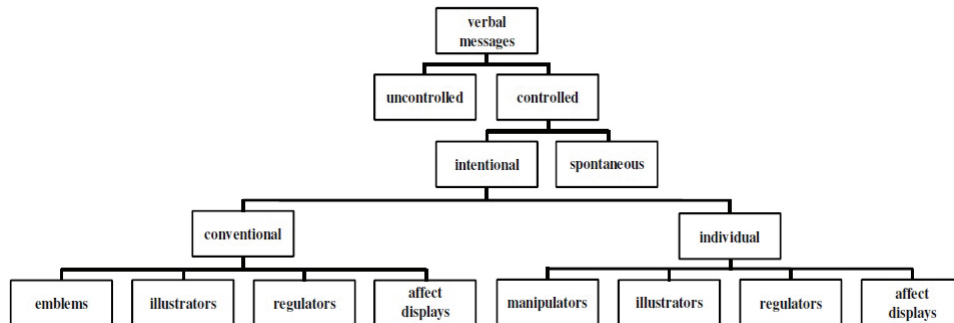


Fig. 2. Classification of nonverbal messages (Tokarz 2006, 339)

Both conventional and individual signals can take the form of illustrators, regulators or affect displays. Illustrators are signals which accompany verbal signals to complement them. When I point my index finger and at the same time say "You should go that way," my pointing of the finger would be an illustrator. Regulators are signals which regulate the whole communicative situation, like the speed of speech or raising intonation. Whereas the function of affect displays is to indicate the current emotional state of the sender, which is usually conveyed by facial, vocal or gestural means. Conventional messages may also take the form of emblems, that is, signals with a specified meaning, which can replace some words or phrases. Nodding would be an example of an emblem. Notice that such a gesture is an emblem only if we do not at the same time express our agreement verbally. Otherwise, that gesture would be classified as an illustrator. Meanwhile, individual messages can take the form of manipulators (or adaptors), that is, movements which increase the comfort of the sender, such as changing one's position in a chair, crossing one's legs, scratching or rearranging objects on the table. Notice that most types of visual signals listed by Groarke (such as visual demonstration, metaphor, symbol and archetype) would often fall into the category of emblems, as he seems to emphasize those communicative situations in which image acts as an autonomous message that constitutes a particular argumentation. Images could also play the role of illustrators, if they were repeating or complementing a message sent simultaneously via a verbal channel or the role of affect displays, if the message was illustrating its sender's emotions. However, it seems that the function referred to by Groarke as the flag argument does not belong to any of the categories mentioned by Tokarz. It results probably from the fact that Tokarz's classification takes into account only what function a certain message performs from the perspective of its sender (whether it replaces a verbal sign or supports it,

whether it regulates the communicative situation or conveys information about emotions), while flag arguments are distinguished in terms of what function they have for the receiver (attracting his attention).

Another interesting and important classification can be found in the work of Necki (1996: 213). He distinguishes the following nonverbal signals: gestures – movements of body parts (e.g. hands, legs or head), body position — the way of sitting or standing, open and closed posture, facial expressions — facial movements and positions (smile, eyebrow position), touch — stroking, hugging, pushing away etc., presence — physical appearance constituted by clothes, hairdo and makeup, parlanguage — sounds other than words (muttering or humming), way of speaking — the speed of uttering words, pauses, intonation, way of looking – direction of the gaze (e.g. looking into the interlocutor's eyes), length of eye contact, distance — physical distance between the interlocutors, arrangement of the setting — furniture, paintings, the way of piling documents etc. Practically all of the above signals can function as emblems or illustrators, but most often we use gestures (e.g. nodding), presence (e.g. military uniform) and setting (e.g. elegant office) to perform these functions. Facial expressions (like smile) and touch (e.g. hugging) usually play the role of affect displays, while the way of speaking is usually a regulator.

According to Knapp and Hall (2007: 12-17), verbal and nonverbal signals can interact in one of the six ways: (1) repeating — a nonverbal message repeats a verbal message in order to reinforce the message, (2) conflicting — the two channels of communication can be sending contradictory messages, for example, when the sender says "I like you a lot" in a sepulchral voice, with his arms crossed and eyes down, (3) complementing — signals can complement each other's meanings, (4) substituting — a nonverbal message is sent independently and replaces its verbal equivalent, (5) regulating — nonverbal behavior can regulate the whole communication, (6) accenting — nonverbal signals can amplify or tone down the meaning of verbal signals, e.g. shaking one's fist may accent verbally expressed anger.

## **2. REDUCIBILITY OF NONVERBAL COMMUNICATIONS TO VERBAL ONES**

Some time ago, a certain remark was made in a review of our article, a remark, which made us doubt for a while whether we understand correctly the specific character of nonverbal messages. In this article, we put forward a model of persuasion which would enable the representation of not only verbal arguments, such as deductive inferences, but also nonverbal arguments like

smiling or threatening with a fist. We used the example of a poker game, in which one player, during a betting round, tosses a pile of money on the table in an attempt to convince the other player that he has a strong hand. The reviewer, however, was skeptical towards that example and argued against this case being a nonverbal argument, since this argument could be brought down to a verbal one. He concluded that there is no point distinguishing nonverbal arguments in the model of persuasion until we find such examples of nonverbal arguments, which could not be reduced to their verbal equivalents. We were perplexed, as it is hard to deny that in this case a player could indeed just say the amount of his bet instead of putting the money on the table. We started wondering if it was possible at all to complete the assignment set by the reviewer. The answer seems negative — after all, every situation can be described through a sentence. So if Anne smiles in the attempt to convince us of something, it can be brought down to a sentence "Anne smiles" and the implication, which is a kind of topos,<sup>3</sup> can be formulated e.g. as follows: "If  $x$  smiles, then  $y$  will likely accept whatever  $x$  claims." In this chapter we intend to accurately define this problem (paragraphs 2.1 and 2.2) and offer a solution to it (paragraph 2.3.).

## 2.1. CONFLICTING PERSPECTIVES

What is the common practice when it comes to constructing models of communication on the ground of logic? The most common approach identifies nonverbal communication with (reduces it to) verbal one. Tokarz's theory of persuasion is an example of that practice (Tokarz 2006: 197). For the purpose of the analysis, the theory holds that a message is always the same message, no matter if it is produced verbally or nonverbally. For that reason, saying the words "Get out of here" and showing somebody the door is denoted here by the same symbol. Another model, which identifies the two types of messages is the theory of visual argument. As we demonstrated in paragraph 1.2., such researchers as Leo Groarke answer affirmatively to the question about the possibility of reducing visual arguments to their verbal equivalents..

But would the creator of the vodka advertisement, which we described in that paragraph, give the same answer? His view must differ from the one given by an informal logician. Otherwise, he would probably prefer

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<sup>3</sup>In rhetoric, topos is an argumentative strategy, which determines the method of choosing premises for a given conclusion (cf. e.g. Budzyńska 2008).

using verbal equivalents reconstructed by Groarke to paying huge sums of money to graphic designers. How to account for such a difference in opinions between a logician and an advertiser? The answer seems obvious after a moment of consideration: a logician is interested in correctness, while an advertiser in the effectiveness of communication. The former evaluates the correctness of the reasoning behind a visual message (if it is formally correct, if the premises are true etc.). The latter is interested only in the effect of the message on the product's sale, no matter if the argumentation used is correct in terms of logic or not. Obviously, the frequency of using images in advertisements suggests that visual arguments are much more effective than their verbal equivalents.

## **2.2 THE EFFECTIVENESS OF A MESSAGE: THE GOAL AND THE RESULT**

The division into verbal and nonverbal messages becomes crucial when we intend to analyze communication in terms of the goal of a message, the possibility of achieving that goal (effectiveness) and the actual result of that message. Particularly important types of goals, which are the main point of sending messages, are persuasive goals. A message has a persuasive function if it is sent with the intention of changing the receiver's beliefs, attitudes or behaviors. Not all messages have that goal. If we are in a hurry and someone at the bus stop asks us for the time, we could say out of politeness that it is, for example, 6 p.m., but we may be completely uninterested in what the receiver does with that message — if he believes us and as a consequence changes his belief (that is, instead of identifying with a sentence "I don't know what time it is," he will begin to identify with "It's 6 p.m.").

The theory of persuasion by Tokarz, mentioned in the previous paragraph, is an interesting attempt to include communication goals in the formal model (Tokarz 2006: 197-218). Messages which are sent with the intention of producing a certain effect are called here persuasive acts. As we mentioned earlier, that model identifies verbal types of messages with nonverbal ones. Therefore, we propose expanding Tokarz's model of persuasion, so that it is possible to express the difference between the two. Let us adopt the following designations:<sup>4</sup>

k — the message,

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<sup>4</sup>The original symbols of Tokarz's theory were changed to ensure uniformity with symbols used throughout this article.

- s — the sender's goal (that is, the situation that the sender intends to provoke),
- ver, nver — the way of conveying the message, where
- ver stands for communicating through sending verbal cues like saying the words "Get out of here,"
- nver stands for communicating through sending nonverbal cues like pointing at the door with a finger,
- p — the situational context in which the message was sent,
- $R(p, k, \delta)$  — the result of sending the message  $k$  in the way  $\delta$  ( $\delta \in \{\text{ver}, \text{nver}\}$ ) in the situation  $p$ ,
- $a = (k, s, \delta)$  — persuasive action performed by sending the message  $k$  in the way  $\delta$  ( $\delta \in \{\text{ver}, \text{nver}\}$ ) with the intention to attain situation  $s$ .

This model allows for the possibility to express the goal of a message and to distinguish it from the actual result ( $R$ ) of that message.<sup>5</sup> Sending a message can only be successful if the actual result overlaps with the intended goal of the message (or if the result exceeds the goal). We say that the persuasion  $a = (k, s, \delta)$  is effective in the initial situation  $p$  when  $s \leq R(p, k, \delta)$ ,  $s_1 \leq s_2$  meaning that the situation  $s_2$  is at least as advantageous to the sender as the situation  $s_1$ . In other words, the action of sending the message  $k$  (e.g. the Vodka advertisement from paragraph 1.2) with the intention of triggering situation  $s$  (achieving an increase in the sales of vodka at rate  $x$ ) in the way  $\delta$  (nonverbally, through an image) is effective when the actual result of that message achieves or exceeds the desired goal (achieves or exceeds value  $x$  – the desired rate of increase in the sales of vodka).

Notice that the same message  $k$  sent in two different ways (ver and nver) may have different results in attaining the goal  $s$ , the success may be full or limited, the goal may be achieved quickly or slowly, at a great or small expense etc. Let us assume that the two persuasive acts  $a_1$  and  $a_2$  differ only in terms of the way in which they achieve the goal  $s$ , that is, in the case of  $a_1$  the message  $k$  is conveyed verbally, while in the case of  $a_2$  – nonverbally. In other words,  $a_1 = (k, s, \text{ver})$  and  $a_2 = (k, s, \text{nver})$ . It may

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<sup>5</sup>Sending every message produces (at least potentially) a certain result. In the theory of speech acts this result is referred to as a perlocutionary act (Austin 1962).

so happen that  $R(p, k, nver) > s$  and  $R(p, k, ver) < s$ . This means that the message sent nonverbally yielded a better result than expected, while the same message sent verbally did not achieve the desired goal. Therefore, even though the content of the message itself does not change, the way in which the message is delivered can change the result of the persuasion. This could be the case of the criminals trying to squeeze out the information of where the wealthy man keeps his money (the situation mentioned in the introduction). Verbal threats could prove ineffective, while nonverbal ones could even be effective beyond their expectations, if the wealthy man revealed where he had hidden not only the money, but also e.g. the jewels. Another concept taken from Tokarz's theory — the notion of the degrees of success — is useful when it comes to expressing such situations. If the hierarchy of the sender's preferences looks as follows:  $s_1 < s_2 < s_3 \leq s_4 < s_5$ , where  $s_3$  is the minimal goal of the sender, then the higher  $R(p, k, \delta)$  ranks in that hierarchy the more effective the persuasion. Nonverbal persuasion ( $k, s_3, nver$ ) will be more effective than the verbal ( $k, s_3, ver$ ), when e.g.  $R(p, k, nver) = s_5$ , while  $R(p, k, ver) = s_4$ .

Certain messages may perform merely an auxiliary function in a persuasion. To illustrate that phenomenon, we shall use the example discussed by Tokarz (2006: 209). A man wants to ask his colleague out for dinner. The woman however is in a bad mood. The man can try out at least two tactics to achieve his primary goal – he can either just say it straight out, or first lay the foundations for his offer. Let  $s_1$  be the initial situation (the moment the two colleagues meet). So in  $s_1$  the man can either say straight away: "Would you like to go to dinner with me today?", or try to lift her mood first by paying her a compliment "You look lovely today." Notice that the goal of the latter message – improving the woman's mood — is merely an auxiliary for the primary goal – asking her out for dinner. Once the man succeeds in achieving the auxiliary goal and changes the situation  $s_1$  (bad mood) into  $s_2$  (good mood), only then can he attempt to ask her out. This tactic is much more likely to pay off than the offer of dinner straight out. Formally, we shall put it as follows:

*Persuasion 1:*

$R(s_1, \text{"Would you like to go to dinner with me?" ver}) = \text{rejection.}$

*Persuasion 2:*

$R(s_1, \text{"You look lovely today." ver}) = s_2.$

$R(s_2, \text{"Would you like to go to dinner with me?" ver}) = \text{acceptance.}$

Thus, the function of the first message in persuasion 2 is to change the situation in which the "proper" message, offering to go dinner together,

is going to be uttered. The offer rejected in situation  $s_1$ , turns out to be successful when it is sent in the situation  $s_2$ . We shall return to the problem of the auxiliary function in relation to nonverbal communications in paragraph 3.3.3.

There are other properties that make the verbal and the nonverbal modes of sending messages different. A message sent through a nonverbal channel can be more effective at times, but usually it is also more costly, not only in the financial sense. Why is it that only 'truly evil' criminals would use rather torture than verbal persuasion? Because torturing a victim entails the risk of a heavy penalty and only 'truly evil' criminals can afford that.

Finally, we should also mention the degree of codification of the rules governing these types of communication. Encoding nonverbal messages relies "heavily on intuition and there is a lot of freedom in that domain" (Tokarz 2006: 328). From the point of view of the sender, it is much easier today to tell a story in modern cinema than it was during the time of silent movies. Encoding a particular content nonverbally took much more creativity. Similarly, from the perspective of the receiver, there is a much higher risk of misunderstanding while decoding nonverbal messages. One of the accusations against the theory of visual argument is the lack of definite rules for interpreting images (i.e. rules that would allow for the transformation of images into their verbal equivalents in an unquestionable way) (Johnson 2005). In his commentary to an example given by Groarke (Groarke 2002), Ralph Johnson demonstrates that Groarke's interpretation of the conclusion is not the only one possible. On the poster, one can see three men (chief administrators) in front of the entrance to the University of Amsterdam. Groarke offers the following reconstruction of the argumentation included in the poster:

*Premise:* The University of Amsterdam's three chief administrators are all men.

*Conclusion:* The University of Amsterdam needs more women.

Johnson proves that the same conclusion could be decoded differently, e.g. "The University in Amsterdam needs more women in administrative positions," "The University wants to hire more women in administrative positions" or even "Woman, do not even try to apply for a job at the University of Amsterdam (because of the barriers imposed by men)."

### 2.3. A POSSIBILITY OF ACCOMMODATING THE PERSPECTIVES

Whether the distinction between verbal and nonverbal messages can



be ignored depends on the aims and the applications of the proposed model of communication. So if a model's function is not to include the influence of messages on their receivers, but only to acknowledge e.g. the correctness of argumentation or the interactions between the content of various messages, then this distinction can indeed be discarded as irrelevant. In those cases, the two communicative activities with the same content, one message being verbal and the other nonverbal, may be reduced to one symbol only, e.g. pointing at the door and saying "Get out of here" may both count as message  $k$ .

However, this distinction starts making sense, when we want to discuss the effectiveness of messages.<sup>6</sup> In other words, when we take into consideration the persuasive function and the parameters of success connected with that function, such as the odds, the cost or the speed of achieving the goal. The parameters may have different values if the message is sent through the verbal, the visual or some other nonverbal channel. It may so happen that the same message  $k$  sent in the same situation  $s$ , but in a different way may produce a different result — e.g. it may be that for saying "Get out of here" and pointing at door

$R(s, \text{get\_out\_of\_here, ver}) = \text{failure}$  and  $R(s, \text{get\_out\_of\_here, nver}) = \text{success}$ .

Notice that using such nonverbal messages as illustrators (or such interactions as repeating or accenting) would be unjustifiable or could be ignored without taking into account the goal and the effectiveness of communication. Let us imagine a scene, in which a girl tells her boyfriend "You hurt me, so. . ." and points at the door with her finger, unable to utter another word. Formally speaking, she sent two messages: "You hurt me" (verbally) and "Go away" (nonverbally), which respectively could be marked with symbols  $P$  and  $W$ . The argumentation was: "P, therefore W." At this point a logician could examine the correctness of such an argumentation — i.e. he could ask if the premise was true or how the conclusion was justified etc. Now imagine that the girl says "You hurt me, so go away" while pointing at the door. Formally speaking, we have here two verbal messages "You hurt me" and "Go away" plus one nonverbal message "Go away" (conveyed through the gesture of pointing at the door). If we were to adopt the same designations as before, her argumentation looks as follows: "P, therefore W and W." Obviously, logic would ignore that doubling of the conclusion. If we are interested in the

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<sup>6</sup>Obviously, modeling communication in terms of effectiveness, not always necessities distinguishing how the message was conveyed. We may be just as well interested in other aspects of a communication's effectiveness, which are unrelated to its verbal or non-verbal character.

interactions between the components of argumentations, such a repetition is indeed meaningless. But if we are interested in a persuasive argumentation, the use of an illustrator cannot be ignored, precisely because its role is to increase our effectiveness in achieving the goal of the message.

It seems that an equally problematic situation, from the formal point of view, is one when a verbal message is sent which comes into conflict with the message conveyed through nonverbal channels. Imagine a situation, where a girl says in a sepulchral voice, with her arms crossed and eyes down: "I'll go to the movies with you today, because I've grown to like you a lot." Her reasoning, expressed verbally, can be represented as "W, because P," where W stands for the sentence "I'll go to the movies with you today" and P for the sentence "I've grown to like you a lot." However, her posture may also be treated as a message that communicates "I don't like you at all." In that case, the argumentation should rather be represented as "W, because P and  $\neg$ P." Although, from the perspective of classical logic, there is a logical consequence (" $p \wedge \neg p \rightarrow q$ " is a tautology of this logic), such a representation of that scene seems peculiar. Interestingly enough, there is a rule in psychology that makes it possible to determine the ratio between the effectiveness of a verbal message and of a nonverbal message in a situation where the two messages are contradictory in terms of meaning. It is the so called Mehrabian's rule (Mehrabian, Ferris 1967; Wiener, Mehrabian 1968), according to which, if a verbal and a nonverbal message are in conflict, then the receiver's conviction about the sender's attitude ( $A_{total}$ ) is a weighted sum of the attitude expressed in words ( $A_{content}$ ) and two attitudes conveyed through a nonverbal channel — through tone of voice ( $A_{tone}$ ) and facial expression ( $A_{face}$ ). Their relation is represented in the following formula:

$$(A_{total}) = 0.07 \cdot (A_{content}) + 0.38 \cdot (A_{tone}) + 0.55 \cdot (A_{face}).$$

To put it more casually, this equation indicates that in the case of conflict, the nonverbal message is much more effective than the verbal one (ratio: 0.93 to 0.07). In other words, in such an instance the sender goes by the information sent through the nonverbal channel.

### 3. THE $AG_n$ LOGIC

As we demonstrated in the previous chapter, formal models of argumentation can perform two types of functions. Some models are built in such a way as to allow the examination of the correctness of an argument. Others make it possible to grasp certain aspects related to the effectiveness

of argumentation. Each of these approaches generates completely different research questions. The  $AG_n$  logic is one of the formalisms focused on analyzing effectiveness. Similarly to Marek Tokarz's approach, it allows for the examination of arguments' results. Moreover, it has a complete axiomatization (Budzyńska, Kacprzak 2008), that is, a set of axioms and rules of inference, on the basis of which there can be constructed formal proofs of the validity of formulas which describe particular properties of a given argumentation. In the following chapter we will present the main ideas behind that logic (paragraph 3.1), as well as its formal syntax and semantics (paragraph 3.2) and finally, we will try to demonstrate how chosen aspects of nonverbal communication, described in those two preceding paragraphs, can be expressed in that logic (paragraph 3.3).

### **3.1. PERSUASION AND NONVERBABILITY**

In the model upon which the semantics of the  $AG_n$  logic is built, the persuasive goal of a communication comes to the forefront. It also emphasizes those aspects which are connected with the nonverbal cues in communication, especially in a communication with a persuasive function. The  $AG_n$  logic was created on the basis of two formalisms: epistemic logic of graded modalities (Hoek 1992) and dynamic logic (Harel, Kozen, Tiuryn 2000). The former inspired the creation of the model for testing what, if any, elements of an effective persuasion are fulfilled in a communication in consideration. The latter became a basis for modeling nonverbality.

#### **3.1.1. GRADES OF BELIEFS**

Before we proceed to formally define the gradation of beliefs, we shall consider the following example. Let us assume that John wants to open a safe. He is in possession of two keys, but he does not know if they match the lock of the safe. He may exchange them for Jake's keys, but is not sure if that bargain is in his favor. To simplify the analysis, let us assume that there are 5 keys in the investigated model (in the beginning John has two and Jake has three keys), but only one of the keys unlocks the safe. John knows that he has the keys numbered 1 and 3. He does not know which key opens the safe, but he suspects it is an odd-numbered key. For that reason, John considers three options as the possible description of his situation, i.e. has three subjective visions of reality. The first one is  $(1, 3 | 2, 4, 5 | 1)$ , the second one  $(1, 3 | 2, 4, 5 | 3)$  and the third  $(1, 3 | 2, 4, 5 | 5)$ , where the two initial numbers refer to John's keys, the following two stand for Jake's keys and the

final number refers to the key which opens the safe. Let us also assume that the key which actually matches the safe is key number 3, so the description of the present situation would be  $(1, 3 | 2, 4, 5 | 3)$ . Both the actual situation and John's vision of it (represented by the so called doxastic relation  $RB_{John}$ ) are illustrated in figure 3. Notice that John holds three separate visions of reality and the fact that key number 3 opens the safe is true only for one of them. Therefore, we would say that John believes with a degree of certainty 1 to 3 ( $1/3$ ) that the key he needs is number 3. Meanwhile, it is true for all of his visions that the safe can be opened by an odd-numbered key, which means that he believes with a degree of certainty 3 to 3 that he needs an odd-numbered key. Since the fraction  $3/3$  equals 1 (which is the maximum possible value), we can say that John is sure that to be able to unlock the safe, he should have an odd-numbered key. We can assess likewise the degree of John's belief in other facts. For example, John is absolutely sure that the safe cannot be opened with the fourth key, because it does not take place in any of his visions of the world. More precisely, his degree of belief is 0 to 3 ( $0/3$ ). Such an instance will be marked as  $M_{John}^{!0.3}$ , (key\_number\_four), where "key\_number\_four" is a formula which describes the advanced thesis.

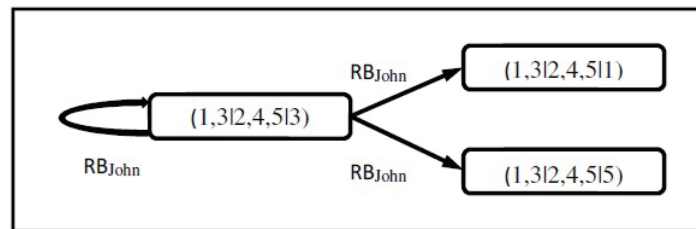


Fig. 3. John's doxastic relation

In a general case, we determine the set of arguers and the set of states (or possible situations). Next, relation RB is assigned to each of the arguers, a relation which specifies what visions are considered by a given person in a particular situation. Once we have added the valuation of propositional variables (examining the truth-value of those elementary propositions belongs to the scope of our consideration), we can assess the degree of the arguers' belief in the truthfulness of analyzed facts. A precise semantics will be given in paragraph 3.2.

There are a few modalities in the  $AG_n$  logic which allow us to infer beliefs. The basic  $M_i^k(T)$  operator expresses that an agent  $i$  considers more than  $k$  visions of reality, in which a thesis  $T$  is true. Dual operator  $B_i^k(T)$  expresses that an agent  $i$  considers  $k$  visions of reality at most, in which a thesis  $T$  is

untrue, which is formally defined as  $B_i^k(T) \leftrightarrow \neg M_i^k(\neg T)$ . Moreover, there is operator  $M_i^k(T)$ , which intuitively means that an agent  $i$  considers precisely  $k$  visions of reality, in which a thesis  $T$  holds, and there is the aforementioned operator  $M_i^{k_1 k_2}(T)$ , which indicates that an agent  $i$  considers precisely  $k_2$  possible visions and in precisely  $k_1$  of them a thesis  $T$  is true. Let us assume that  $T$  means that the key number 3 opens the safe. Then, on the basis of figure 3, we can say that  $M_i^0(T)$  reads: John considers more than zero visions (at least one), in which  $T$  holds,  $B_{John}^2(T)$ : John considers two visions at most, in which  $T$  is false,  $M_{John}^1(T)$ : John considers precisely one vision in which  $T$  holds and  $M_{John}^{1,3}(T)$ : John considers three visions of the world and in only one of them it is true that the key number 3 opens the safe. The final formula is the one we use the most often, as it says not only how many desired visions there are (visions in which a thesis holds), but also how many visions overall a given agent considers. There is an enormous difference between a situation where John accepts one vision out of three in which a thesis holds and where he also accepts one vision in which a thesis holds, but it is at the same time the only vision he is considering. In the former case, we would intuitively say that John is convinced about a thesis  $t$  being true to a degree  $1/3$  (one vision out of three possible fulfills  $T$ ). In the latter case, we would say that John believes in a degree  $1/1$ , which means that he is absolutely certain that a thesis  $T$  is true.

### 3.1.2. ARGUMENTS AS ACTIONS THAT CHANGE THE GRADES OF BELIEFS

Gradation of beliefs is a perfect tool for evaluating the effectiveness of a particular persuasion. Returning to our example, let us assume that Jake wants to exchange the fourth key for John's third key. So he tries to persuade John that such an exchange would work in his favor. He puts forward a verbal argument  $a_i$ : "I've heard that the safe can be unlocked with an even-numbered key and that it is the key number 4. I can give it to you if you give me the key number 3." As a result of that argumentation, John is willing to accept that the fourth key may actually be the desired key, but at the same time he clings to his previous belief that it is an odd-numbered key that opens the safe. Hence, as a consequence of adding argument  $a_1$  John now has four visions of the situation: the former three  $(1, 3 | 2, 4, 5 | 1)$ ,  $(1, 3 | 2, 4, 5 | 3)$ ,  $(1, 3 | 2, 4, 5 | 5)$  and a new one  $(1, 3 | 2, 4, 5 | 4)$ . As a result, the degree of belief in the validity of the thesis  $T$ : "The fourth key opens the safe" is 1 to 4 (it is true in one out of four visions). The degree of belief changed to a higher one from  $0/3$  to  $1/4$ . We can now start evaluating the effectiveness of

argument  $a_1$ . If we are satisfied only when John is absolutely sure about the thesis T, then the argument is not successful. But it may happen that any rise of the degree of belief is desired. In that case we would consider this argumentation a success. Obviously, in our example, the bigger the rise, the better. If there was an argument that could cause a rise in the degree of belief to e.g.  $3/4$ , we would consider it more effective than argument  $a_1$ . Thus, grades of beliefs allow us to both determine and compare the effectiveness of particular arguments

Notice that the aforementioned argument  $a_1$  is a verbal one. Indeed, most models and formalisms only consider argumentative dialogues for argumentations, without taking into account arguments that take forms other than words. In our approach, we went a step further. Obviously, we still accept that an argument can be conveyed verbally, but we do not limit ourselves to such arguments. For that reason we identify arguments with actions undertaken by the arguers. Such an action may change the world (the environment) around an argument or bring about a change of beliefs of one arguer or all of them. A change in the world usually (but not necessarily) entails a change in beliefs. But there may be cases, in which the world itself remains unchanged, while the beliefs do change. In order to illustrate that with an example, let us assume that thesis T means that John has the right key to open the safe. Given that, let us discuss the initial situation once more  $(1, 3 | 2, 4, 5 | 3)$ , a situation in which John considers three visions  $(1, 3 | 2, 4, 5 | 1)$ ,  $(1, 3 | 2, 4, 5 | 3)$  and  $(1, 3 | 2, 4, 5 | 5)$ . Since only in one of the visions the thesis is true, John believes with a degree  $1/3$  that he has the right key. Let us assume now that Jake can perform three actions (give three arguments)  $a_1, a_2, a_3$ . The argument  $a_1$  is the verbal statement: "I've heard that the safe can be unlocked with an even-numbered key." If John believes Jake's words, he will change the considered visions into the following:  $(1, 3 | 2, 4, 5 | 2)$ ,  $(1, 3 | 2, 4, 5 | 4)$  and, consequently, he will believe with the degree  $0/2$  that the thesis T is true (the thesis holds in none of the visions in consideration). Notice that the reality did not change and  $(1, 3 | 2, 4, 5 | 3)$  is still true. The argument  $a_2$  enriches the first argument, as Jake offers John an exchange: "I'll give you the key number 4, if you give me the key number 3, so that you'll have keys 1 and 4, and I've heard that the safe can be unlocked with an even-numbered key." Assuming that accepting this argument means exchanging the keys, then the actual state changes into  $(1, 3 | 2, 4, 5 | 3)$ . John's visions of reality change as well and they now are:  $(1, 3 | 2, 4, 5 | 2)$ ,  $(1, 3 | 2, 4, 5 | 4)$ . Therefore, John believes with a degree  $1/2$  that the thesis T holds (in one of the visions in consideration John has

the key opening the safe). The last argument,  $a_3$ , is an action performed by Jake that involves showing John that the key number 3 opens the safe. Such an argument leads to John's accepting only vision of the world, a vision which coincides with the actual state of affairs, that is,  $(1, 3 | 2, 4, 5 | 3)$ . Notice that the action  $a_1$  is a typical verbal action, which can cause a change of beliefs. The action  $a_2$  combines a verbal argument with a nonverbal activity. Performing that action may lead both to an exchange of keys and, what follows, a change in beliefs. The argument  $a_3$  is conveyed only in a nonverbal way. Giving that the arguments lead to a change in John's beliefs. He now believes with a degree  $1/1$  that he is in possession of the right key (see Fig. 4). We have demonstrated that our approach allows for the evaluating of the effectiveness of arguments conveyed through verbal and nonverbal means or both at the same time. It offers a possibility to infer effectiveness of persuasions within well-developed models, in which the result of persuasion is influenced not only by verbal arguments, but also various other intentional activities.

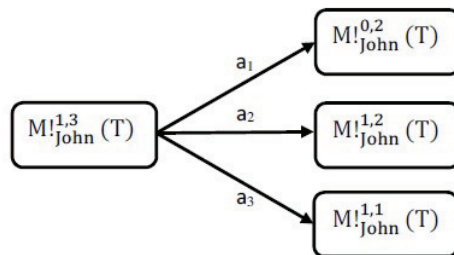


Fig. 4. The result of using arguments  $a_1$ ,  $a_2$ ,  $a_3$

In the  $AG_n$  logic, changes resulting from performed actions are denoted by the existential operator  $\diamond$  which we read as: 'possible'. For example, we intuitively read the formula  $\diamond(a_1:Kuba)M!_{John}^{0,2}(T)$  as follows: When giving the argument  $a_1$ , Jake can make John believe with a degree  $0/2$  that  $T$  is a valid thesis. Similarly, the formula  $\diamond(a_3:Kuba)M!_{John}^{1,1}(T)$  expresses that by performing an action  $a_3$ , Jake can influence John's beliefs and make this become certain that the thesis  $T$  is true.

### 3.2. FORMAL SYNTAX AND SEMANTICS OF THE $AG_n$ LOGIC'S LANGUAGE

In this chapter, we shall present the complete syntax of the language of  $AG_n$  logic, as well as its interpretation in the model of multi-agent systems.

Assume that  $\text{Agt}=\{1,\dots,n\}$  is a set of names of agents (arguers),  $V_0$  is a set of propositional variables and  $\Pi_0$  is a set of program variables (elementary actions). Further, let  $;$  denote the operator of program sequential composition, which allows us to devise programs schemes defined as a finite sequence of elementary actions  $a_1; \dots ; a_k$ . Intuitively, the program  $a_1; a_2$ , where  $a_1, a_2 \in \Pi_0$  means "Perform  $a_1$  and then perform  $a_2$ ." The set of all program schemes is denoted by the symbol  $\Pi$ .

A set of well-formed expressions of the language of  $\text{AG}_n$  logic is described by the following BNF *Backus-Naur form*:

$$\alpha ::= p \mid \neg\alpha \mid \alpha \vee \alpha \mid M_i^d \alpha \mid \diamond(i:P)\alpha,$$

where  $p \in V_0$  is a propositional variable,  $i \in \text{Agt}$  is an agent's name,  $P \in \Pi$  is a program (a sequence of arguments) and  $d \in \mathbb{N}$  is a natural number.

Other boolean connectives are defined in a traditional manner. We also use the following abbreviations:

$$B_i^d \alpha \text{ for } \neg M_i^d (\neg\alpha),$$

$$M_i^d \alpha, \text{ where } M_i^0 \alpha \leftrightarrow \neg M_i^0 \alpha, M_i^d \alpha \leftrightarrow M_i^{d-1} \alpha \wedge \neg M_i^d \alpha, \text{ if } d > 0,$$

$$M_i^{!d_1 d_2} \alpha \text{ for } M_i^{!d_1} \alpha \wedge M_i^{!d_2} (\alpha \vee \neg\alpha).$$

*Definition.* Let  $\text{Agt}$  be a set of agents' names. By a semantic model we mean a Kripke structure  $M = (S, \text{RB}, I, v)$  where:

$S$  is a non-empty set of states,

$\text{RB}$  is a doxastic function, which assigns to every agent a binary relation defined in  $S$ ,  $\text{RB}: \text{Agt} \leftrightarrow 2^{S \times S}$ ,

$I$  is an interpretation of program variables  $I : \Pi_0 \rightarrow (\text{Agt} \rightarrow 2^{S \times S})$ ,

$v$  is a valuation of propositional variables,  $v : S \rightarrow \{0, 1\}^{V_0}$ .

Function  $I$  can be easily extended to interpret any program scheme.

Let  $I_\Pi: \Pi \rightarrow (\text{Agt} \rightarrow 2^{S \times S})$  be a function defined by mutual induction on the structure of the program  $P \in \Pi$  in the following way:  $I_\Pi(a)(i) = I(a)(i)$  for  $a \in \Pi_0$  and  $i \in \text{Agt}$ ,  $I_\Pi(P_1; P_2)(i) = I_\Pi(P_1)(i) \circ I_\Pi(P_2)(i) = (s, s') \in S \times S: (\exists s'' \in S)((s, s'') \in I_\Pi(P_1)(i) \text{ and } (s'', s') \in I_\Pi(P_2)(i))$  for  $P_1, P_2 \in \Pi$  and  $i \in \text{Agt}$ .



The semantics of  $AG_n$  formulas is defined in Kripke's structure  $M$ .

*Definition.* For a particular structure  $M = (S, RB, I, v)$  and a particular state  $s \in S$  the boolean value of formula  $\alpha$  is denoted  $M, s \models \alpha$  and defined inductively as follows:

$M, s \models p$	iff	$v(s)(p)=1$ for $p \in V_0$ ,
$M, s \models \neg\alpha$	iff	it is false, that $M, s \models \alpha$ ,
$M, s \models \alpha \vee \beta$	iff	$M, s \models \alpha$ or $M, s \models \beta$ ,
$M, s \models M_1^d \alpha$	iff	$ \{s' \in S : (s, s') \in RB(i) \text{ and } M, s' \models \alpha\}  > d, d \in \mathbb{N}$ ,
$M, s \models \diamond(i:P)\alpha$	iff	$(\exists s' \in S)((s, s') \in In(P)(i) \text{ and } M, s' \models \alpha)$ .

We say that formula  $\alpha$  is satisfied in model  $M$  and at state  $s$ , if  $M, s \models \alpha$ .

We offer a detailed description of  $AG_n$  semantics and a complete axiomatization of this logic in our other works (Budzyńska, Kacprzak, Rembelski 2008a; Budzyńska, Kacprzak 2008).

### 3.3. APPLICATIONS OF THE $AG_n$ LOGIC

The afore proposed formalism is a perfect tool for inferring the persuasive function of communication. It also allows us to differentiate between a verbal and a nonverbal medium. In this chapter we will describe its role in modeling, studying, analyzing and testing the meaning of nonverbal arguments in the process of persuasion.

#### 3.3.1. MODELING ELEMENTS OF COALSCENCE

The  $AG_n$  logic is a perfect tool for inferring coalescent argumentation. It allows us to embrace all characteristic features of the process of convincing. In coalescent argumentation a great emphasis is put on including arguments which refer not only to logic, but also to emotions, feelings, intuition and the entire position held by both arguers.  $AG_n$  allows us to model all those aspects.

We shall begin with emotions. In the model of  $AG_n$  logic, performing an action, or giving an argument, results in going from one system's state (call it  $s_1$ ) to another (call it  $s_2$ ). And sometimes we assume that an argument does not change anything, so  $s_1 = s_2$ . A state can be characterized in various ways. Especially, if we assume that it is the emotional state of one or both arguers. Then, performing an argument which involves smiling and making

a kind face by the proponent, leads to a change from a state describing sadness to one describing joy and contentment. A similar effect can be brought about by such a nonverbal action as a tender hug, touch or kiss. Although that action has no impact on the beliefs of the person who is being convinced, it significantly changes his feelings and it is these feelings that influence both beliefs and behaviors. A state of a system can determine such emotions as fear, worry or insecurity, but it can also define intuitions. Looking around the house that we intend to buy may result in going from an euphoric state caused by having found an amazing bargain to a state of anxiety triggered by an intuitive sense that there must be a catch somewhere, if somebody is willing to sell such an impressive house for such a low price. The discomfort can also stem from an imprecise fear instilled in us by the house we were visiting. Even though such an argument can hardly be called convincing, it will probably change considerably our attitude towards this seemingly attractive offer. Similarly, we can model someone's entire position, as well as its transformation, which happens in the process of communication. An important element of coalescent argumentation is the situation in which communication occurs. If the same process takes place in different circumstances, it can have different results. Moreover, a change of environment can significantly influence the success of an argumentation. Let us recall the example in which Jake tries to convince John that key number 3 opens the safe. Assume that Jake performs a series of verbal actions, i.e. "I've heard that the safe can be unlocked with the third key," "I've seen Peter open the safe with key number 3," "I'm sure that the safe can be opened with the third key" etc. Such words would probably have a poor effect. But there is one argument with which John cannot argue. It is precisely the action performed by Jake of taking key number 3 and opening the safe with it. In the  $AG_n$  model we would describe that situation as follows. At state  $s_1$  John believes with a degree  $1/3$  that key number 3 opens the safe. After having performed the action involving the opening of the safe, we go to state  $s_2$ , in which John believes in the advanced thesis with a degree  $1/1$ . Notice that the nonverbal argument did not refer directly to John's beliefs. It only brought about a change of situation: in state  $s_1$  the safe is locked, in state  $s_2$  the safe is open and John sees that it has been opened with the third key. A revision of beliefs was a result of the environment's modification. Jake did not say a word, instead, he nonverbally introduced a change to the environment; you could not dream of a better result. Apparently, environmental arguments (situational arguments) have a considerable impact on succeeding in argumentation, and the extent of those

changes can be formally modeled with the use of Kripke's possible-world semantics.

### 3.3.2. ANALYZING RELATIONS BETWEEN THE GOAL AND THE RESULT OF AN ARGUMENT

In our previous works, we used the  $AG_n$  logic to verify properties of argumentative systems, especially multi-agent ones. For that purpose, we would build a model for the already existing system, a model consistent with the one we described in paragraph 3.2. Then, we would use formulas of the  $AG_n$  logic to describe the properties of our interest and to test their validity. This can be done in two ways. One is a syntactic proof which makes use of the complete axiomatic system for  $AG_n$  (Budzyńska, Kacprzak 2008). The other is based on a semantic model of verification and allows us to automatically study the satisfiability of formulas, which the  $AG_n$  logic can do with a tool called Perseus (Budzyńska, Kacprzak, Rembelski 2008b). The questions we posed for the studied systems mainly concerned such issues as: "Is a given argumentation effective?", "What result would a particular argument bring?", "Is there any argument that would be more successful?" Therefore, we focused on succeeding in argumentation, or more precisely, we wanted to answer the question whether success can be achieved and to what degree. We analyzed systems in terms of which arguments are successful, but we left out why they achieve the desired effect. Thus, it was enough to limit our interpretation of an action to determining the state in which it can be performed and the state it attained once the action is performed. Now, assume that, just like in the extended proposal by Marek Tokarz from paragraph 2.2., a persuasive action is characterized by three elements ( $k$ ,  $\alpha$ ,  $\delta$ ) that determine message  $k$ , conveyed through action, medium  $\delta$  and goal  $\alpha$ . Formally, we are now able to define the set of elementary actions as follows:

$$\Pi_0 = \{(k, \alpha, \delta) : k \in K, \alpha \in F, \delta \in \Delta\},$$

where  $k$  is a non-empty set of messages,  $F$  a set of formulas of the  $AG_n$  logic,  $\Delta = \{\text{ver}, \text{nver}\}$  is a set of possible media (verbal and nonverbal). Notice that depending on the needs and applications of a designed model, the set  $\Delta$  can be freely expanded. For example: if we want to examine visual arguments, the possibility of sending messages by means of images ought to be added to that set and denoted by the symbol  $\text{vis}$ . An even more detailed distinction can be added, if we use e.g. Nęcki's classification

discussed in paragraph 1.3. The set  $\Delta$  would thus be extended by such means of conveying messages as facial expression, gestures, appearance etc. Thanks to such extensions, we will also be able to infer the relations between performed arguments and examine why one argument is effective, while another is not.

We assume that the goal of an action is described in the  $AG_n$  language as bringing about the desired belief or behavior of the opponent. For example, Mary may be aiming to convince John that adding curry to a shrimp dish will improve the taste of the meal. Formally, the goal  $\alpha$  is  $M_{John}^{3,3}$  (a\_dish\_with\_curry\_in-it-is\_better), that is, John considers three visions of reality and in each one the meal with curry is better. Mary may also want to make John add curry, without caring if he is convinced that it is right to do so. Formally,  $\diamond(\text{adding\_curry} : \text{John}) \text{ true}$  – perhaps John will perform the action of "adding\_curry." We say that the goal of an action is attained, if after that action the system is in a state in which the formula describing that goal is satisfied. For example, consider the argument  $a = (k, \alpha, \delta)$  used by Mary. The goal  $\alpha$  will be realized if, after having performed that persuasive action, Mary achieves a situation  $s$ , in which  $s \models \alpha$ . Here lies the crucial difference between the  $AG_n$  logic and the theory by Tokarz. In Tokarz's approach, the goal of a persuasive action is a specific situation; we say that such a situation was a success if, after it is completed, the attained situation is desirable or better than the previous. In the  $AG_n$  logic we assume that a goal is a language formula and that an action is successful if its result satisfies that formula. Thus, any situation is successful in which a property defined by formula  $\alpha$  is true. Such an approach allows us to concentrate on what is most vital to the proponent and to leave out less important elements. For example, if Mary aims to make John add curry to the dish, it may matter to her whether he does it with a happy face or with visible resignation and resentment. Both situations are desired from Mary's point of view, because in both cases it is true that John adds curry. Any other situation is also successful in which John serves shrimps with curry, no matter the circumstances of that occurrence. In Tokarz's approach, one should either describe a successful situation in detail, including all its elements, or present other situations which would be more desirable.

If we treat an action as a triple  $(k, \alpha, \delta)$ , we can accurately identify differences between the effectiveness of the same message depending on how it was conveyed. Assuming that Mary's goal is to have the dish spiced with curry, the message she wants to send concerns adding curry to the shrimps. She may send that message verbally: "I've eaten shrimps many

times. They taste better with curry. Could you add some of that spice?” or, as we described earlier, she can convey it nonverbally, performing a number of actions, such as bustling about the kitchen in search of curry in order to show how important it is for her to have the spice added. The verbal argument may have a poor result, if any — John will ignore Mary’s request, still convinced that curry would spoil the taste of the dish. While the nonverbal argument may produce the desired outcome: John, impressed by Mary’s efforts, will take up her suggestion. Formally, the difference lies in the degree of John’s belief that it is good to add curry, which depends on the medium (see Fig. 5). Likewise, we may analyze how different messages influence attaining the same goal. Describing arguments by identifying their message, their medium and their goal would make it much easier to establish what contributes the most to the success of an argumentation.

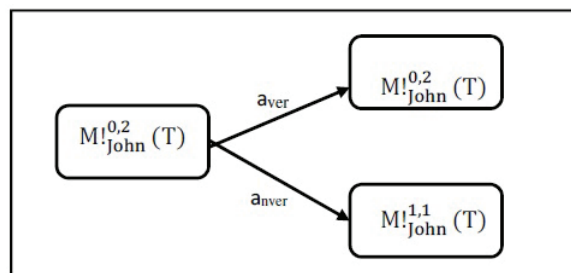


Fig. 5. A comparison of performing a verbal and nonverbal action containing the same message

### 3.3.3. EXPLORING THE AUXILIARY FUNCTION OF ARGUMENTS

In paragraph 2.2 about Marek Tokarz’s model and its extension, we mentioned that some messages sent during persuasion perform merely an auxiliary function. Notice that this is the role of numerous types of nonverbal messages, e.g. facial expression, touch, presence. A smile, a hug or a mini skirt rarely are autonomous means of persuasion in their own right. They are rather used to create favorable conditions for the realization of the proper persuasive actions such as asking somebody out on a date, asking for a loan etc.

Let us restate the example discussed in paragraph 2.2, so that it takes into account nonverbal communication and is adapted to the  $AG_n$  logic. Let  $a_1$  be an action which consists in John making a proposal: “Would you like to go to dinner together?”, while  $a_2$  is an action consisting in smiling. State

$s_1$  shall be the initial situation of the persuasion in which the receiver of the communication (Mary) is in a bad mood,  $s_2$  — a situation in which Mary is in a good mood,  $s_3$  — Mary rejecting the offer and  $s_4$  — Mary accepting the offer. Now consider the two persuasions:  $P_1 = (a_1)$  and  $P_2 = (a_2; a_1)$ . In our model the result of performing action  $a$  in state  $s'$  is determined by the function of an interpretation  $I_n$ . According to the definition from paragraph 3.2, we say that the state  $s$  is a result of having performed the persuasion  $P$  at the state  $s'$  by agent  $i$ , if  $(s, s') \in I_{\Pi}(P)(i)$ . Notice that here, unlike in the approach described by Tokarz, the result of a persuasive action in the situation  $s$  depends not only on the message we want to send, but also on how it is performed, on who sends the message, as well as on its goal. Assume that the result of action  $a_1, a_2$  in the abovementioned persuasions is as follows:

*Persuasion 1:*

$(s_1, s_3) \in I_{\Pi}(a_1)(\text{John})$  — John performing the action  $a_1$  in the state  $s_1$  leads us to the state  $s_3$ ,

*Persuasion 2:*

$(s_1, s_2) \in I_{\Pi}(a_2)(\text{John})$  — John performing the action  $a_2$  in the state  $s_1$  leads us to the state  $s_2$ ,  $(s_2, s_4) \in I_{\Pi}(a_1)(\text{John})$  — John performing the action  $a_1$  in the state  $s_2$  leads us to the state  $s_4$ ,

so  $(s_1, s_4) \in I_{\Pi}(P_2)(\text{John})$  — John the persuasion  $P_2 = (a_2; a_1)$  in the state  $s_1$  leads us to the state  $s_4$  (see Fig. 6).

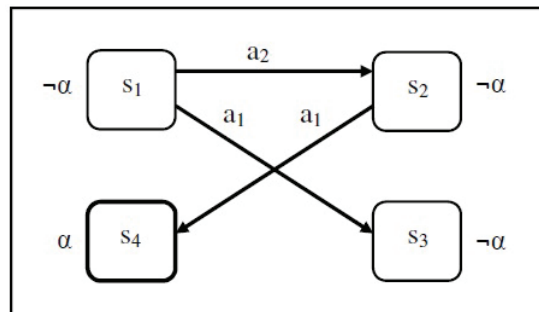


Fig. 6. The interpretation of actions  $a_1$  and  $a_2$

Now assume that the formula  $\alpha$  ("Mary accepts John's offer of dinner") is the goal of persuasion and that the only state which fulfils  $\alpha$  is state  $s_4$ . Formally,  $s_1 \models \neg\alpha, s_2 \models \neg\alpha, s_3 \models \neg\alpha, s_4 \models \alpha$ . We can see that giving merely the argument  $a_1$  will not produce the desired result. But when it is preceded by the argument

$a_2$ , the situation changes radically. Thus, we shall say that the action  $a_2$  was used by the agent  $i$  in the state  $s$  as auxiliary to the action  $a_1$ , where there exists no such state  $s'$  that  $(s, s') \in I_{\Pi}(a_1)(i)$  and  $s' \models \alpha$ , and there exists such a state  $s''$  that  $(s, s'') \in I_{\Pi}(a_2, a_1)(i)$  and  $s'' \models \alpha$ .

## CONCLUSION

At the beginning of this article we raised two questions: can nonverbal signs be reduced to their verbal equivalents and how can we formally model nonverbal communication. In the literature on the subject, one may often come across the opinion that those two types of messages can be reduced to one another, because from the formal point of view information is always the same message, no matter if it was conveyed verbally or nonverbally (no matter if I say "yes" or nod my head). Hence, both messages should be denoted by the same symbol. Secondly, it is claimed that a formal model with nonverbal arguments would only be interesting if anyone was able to enumerate nonverbal arguments which cannot be reduced to verbal ones. The problem is that in fact there are no such arguments (if we understand 'reducibility' as the possibility to replace the activity, e.g. nodding, with speaking the words, e.g. "yes").

We offered a solution to that controversy. We demonstrated that it does make sense to distinguish nonverbal and verbal messages, when a model describes communication in terms of its one specific function. Namely, a model whose functions or applications include describing the effectiveness of communication. Obviously, a model of communication can fulfil other functions: it may serve e.g. to verify correctness of the arguments contained in a message. In such a case, distinguishing between the verbal and the nonverbal is unnecessary, because what is important here, are the relations between pieces of information and not the way they are conveyed. In informal logic bringing visual arguments down to their verbal equivalents is completely justifiable (which does not mean that one cannot have some reservations over other specific solutions offered in that model), because the aim of that model is to analyze visual arguments in terms of their correctness and not the effectiveness of the message. A vodka advertisement assessed in terms of correctness may score poorly, but highly in terms of effectiveness. In social practice these two criteria often have little in common. That is why an advertising agency which based its marketing strategies on informal logic, would probably go belly up pretty fast.

Formal systems, such as propositional or predicate logic, which are concerned only with the aspects of communication related to its correctness,

may ignore the nonverbal character of some messages. For example, the fact that one piece of information is structured 'A  $\rightarrow$  B', the other is A, no matter how these were distributed, allows us to establish that the conclusion B has been inferred correctly, because the produced reasoning falls under the *modus ponens* form of a deductive argument. A different research situation is generated by questions which concern differences in the effectiveness of messages depending on the means of its transmission. In this paper, we presented the example of a logic which formalizes a communication model fulfilling that task and in which it is possible to express the nonverbal character of messages. It is the multi-modal logic of graded beliefs and actions  $AG_n$ . In that logic arguments are represented as actions, hence they are not predetermined to be verbal by nature. Only a further specification allows us to establish whether we are dealing with a verbal or a nonverbal action. Referring to Marek Tokarz's ideas, we demonstrated how to distinguish different types of arguments and how to tie up their effectiveness with the means of conveying the message. Assume that some criminals are considering two ways of extracting the desired information from the hostage. In each case they have the same goal in mind ( $\alpha$  — to gain information about where the money is hidden) and they send the same message ( $k$  — a threat), but one argument consists in speaking the words "I'll punch you" in a menacing voice (*ver*), while the other is actually beating the hostage (*nver*). In our model, the arguments are not considered identical, even though they contain the same message, thanks to allowing for the parameter *ver-nver*. In other words, these arguments will be denoted by two different symbols, but they will be sharing some properties ( $k$  and  $\alpha$ ). This allows us to establish in the model that the two arguments produce different results. It gives us the possibility to express the difference in the effectiveness of both arguments, e.g. uttering a threat may not achieve the intended goal (the hostage will remain silent), while bringing the threat into action may lead to the criminals' success and to retrieving the desired information.

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