

68 nods. But not only of agreement

Isabella Poggi, Francesca D'Errico, Laura Vincze

*Department of Education Sciences
Roma Tre University*

poggi@uniroma3.it; fderrico@uniroma3.it; laura.vincze@gmail.com

key words: head movement, nodding, agreement, social signals

Abstract

The work analyses the head nod as a polysemic signal, that may have different meanings sharing some common semantic elements. Speaker's, Interlocutor's and Third Listener's nods are distinguished with their subtypes (agreement, approval, backchannel, emphasis, ironic agreement, self-agreement and others), and for each the common and different aspects of meaning are singled out, and the cues in other modalities are specified that distinguish the types from one another. Finally a procedure is presented for the automatic recognition and comprehension of nods in conversation.

1. Introduction

In this work we investigate the communicative functions of nodding and its use in debates. Generally people think that a nod means you agree; but we will show that expressing agreement is not the only meaning that a nod may convey, by singling out the various meanings of the nods, the perceivable aspects that distinguish different nod types, and the communicative context that surround the nod, providing cues for its interpretation. We finally propose a procedure for the recognition of these different types of nod, that might lead to systems for automatic nod detection and recognition apt to capture some of the subtle nuances of this social signal.

2. The richness of head movements

Head movements have been studied in a marginal way compared to facial expression and gestures (Heylen, 2005), although they have lots of semantic, narrative and discursive functions in the process of communication. McClave (2000) analyzed head movements in relation to the lateral movement and to the orientation, recognizing, for the former, functions of intensification, inclusion and representation of uncertainty, and for the latter one of locating referents in abstract space. According to Kendon (2002) the head shake is anticipated or postponed to negation, for rhetorical purposes. Dittmann (1968), Hadar (1983) and Cerrato (2005) focused on the interpersonal function represented by the "synchrony" voice-nod, that corresponds to the wish of the listener to speak or the wish of the speaker for feedback (Dittman, 1968; Cerrato, 2005), and measured the duration of the nod in relation to the speech rate, while Boholm and Allwood considered the functions of head nod and head shake repetition. Heylen (2005) and Cerrato (2005; 2007) consider the nod as a backchannel signal that indicates acceptance, agreement and submission; maybe for this reason, in the context of power and gender communication, it is more frequent for women than men and for low than high status people (Hegen-Larsen et al., 2004). Cerrato (2005) pointed out the most frequent head nod functions (giving continuation, giving agreement, request feedback and focus) and showed that a nod of "giving continuation" (0.40 msec) is briefer than one "giving acceptance" (0.60msec), while Hadar et al. (1983) classified the "synchrony" movements as having low amplitude and short duration vs. "anticipation" movement with low frequency and large amplitude. Next to these studies which analyze the head nod from the point of view of the signal, recent research emphasizes the effects of nodding in increasing agreement (Wells and Petty, 1980) and changing attitude. Briñol and Petty (2003) demonstrated that nodding while speaking can affect attitude change in the Speaker more than shaking head,

since the nod is seen as an external cue of agreement or approval, and this increases confidence in oneself, becoming an internal cue to the validity of one's thoughts (*self-validation hypothesis*).

3. Nodding: a polysemic holophrastic social signal

We define a nod as a vertical head movement in which the head, after a slight tilt up, bends downward and then goes back to its starting point.

This head movement is a holophrastic communicative signal, that is, a signal that conveys the meaning not of a single word but of a whole communicative act, including both a propositional content and a performative (Poggi, 2007; 2008). In fact, a nod can be paraphrased, depending on the context, as "I confirm", or "I agree", or "I thank you", and so forth.

As is clear from these possible paraphrases, and shown by the works above, a nod is a polysemic signal. Polysemy is typical of signals in any modality. It is a type of ambiguity defined as the fact that a signal (a perceivable stimulus produced by a Sender to convey some meaning) may correspond to two or more meanings; and yet these meanings are not completely unrelated to each other, but all share some common semantic element. E.g., the word *ring*, in both its meanings of a circular object to put on a finger, and of a place for boxing matches, contains the same semantic core, the image of a closed boundary around some place or object (Poggi, 2007).

Like any kind of ambiguity (figure-ground ambiguity in perception, or syntactic ambiguity of sentences), the polysemy of a signal – for instance, the polysemy of a word in a language – is generally overcome by taking a wider context into account: if I utter the word *ring*, it may be either the place for a boxing match or the round jewel, depending on whether we are talking of either sport or millionaires. In polysemy there is some semantic element that is shared by all the meanings of a signal, while additional semantic elements that distinguishes them are added by the various possible contexts.

This is generally how things go with polysemy in verbal languages, where a word must be uttered or written in precisely that way to be that word (i.e., to have that meaning). But for signals in other modalities, a gesture or a head movement is generally combined with signals in other modalities, and this makes a difference; e.g., in backchannel it is not the same if I nod while smiling or not (Bevacqua 2009). Moreover, body signals can be produced in a number of ways, depending on whether the movement is relaxed or tense, single or repeated; in the gesture "come here" (hand palm down with fingers flapping downward), it is not the same if I make it with a soft fluid movement or with hectic jerks (Poggi & Pelachaud, 2008).

Thus, what counts as context for words is something coming before or after the word itself, while for a smile or a nod, which are generally produced simultaneously with other signals, what counts as context may be also the signals in other modalities. Consequently, if we want to disentangle the rich polysemy of the nod but at the same time to understand what is common and what is different in them, we must:

1. find out all the possible meanings of the nod,
2. analyze a number of cases for each meaning;
3. for all cases of each possible meaning, see what, in the preceding (mainly linguistic) and/or simultaneous (multimodal) context, is recurrent or shared with other cases in which the nod assumes the same meaning; and
4. for each possible meaning, single out the "constellation" of preceding or simultaneous signals that cooperate to convey that particular complex meaning.

In this paper we outline a typology of nods by specifying, for each type, how its meaning differs from the others, and how this difference is revealed by subtle cues in other modalities.

4. Speaker's, Interlocutor's, and Third Listener's nods

An important distinction among types of nods during debates is whether they are produced by one who is speaking or one who is listening; and within the Listeners it is relevant to distinguish the actual Addressee of the present Speaker (let's call it Interlocutor) from a simple bystander who is also hearing but not the one to whom the present speaker is addressing (a Third Listener). This is important for the nods of agreement, because while an agreement from your direct interlocutor may be motivated by politeness, be not always sincere, or be a "partial agreement" prefacing to subsequent disagreement (see Ogden, 2006), a nod of agreement by a third Listener may be more spontaneous, because it is not specifically called for by the Speaker; moreover, while the Interlocutor's nod may often be simply one of backchannel, not of true agreement, from a Third Listener you don't expect backchannel signals, then his nods really mean he agrees.

In Sections 8. and 9. we report the typology resulting from our study by first presenting the Interlocutor's nods, then the Third Listener's, and finally the Speaker's nods. But before illustrating the Interlocutor's nods, let us consider another holophrastic communicative act which is fairly comparable to the nod, and shares a great part of its polysemy: saying "Yes".

5. Yes and nod

Saying "yes" is in many cases analogous to nodding. A nod, in fact, often accompanies not only affirmative sentences like *This is just so*, but also the interjection *yes*, and it can be often paraphrased as *yes*. First, also *yes* is a holophrastic item. Second, *yes* and the *head nod* partly share the same range of polysemy. I can both answer "yes" and *nod* to a yes/no question, and if so they both mean: "I confirm that the hypothesis mentioned in your interrogative sentence is, also for me, true". Yet, if used to answer a request for permission, like: "*May I open the window?*", both *yes* and a *nod* mean: "I allow you to do what you asked". Then, if produced after an assessment (Ogden, 2006) both *yes* and *nod* may mean "I agree with your assessment".

The *nod* is again homologous to *yes* in its frequent function as a backchannel: if I *nod* while you are talking, it may mean I agree with what you are saying, but it also may simply tell you I am following and understanding: just like for *yes*.

In some cases, though, the nod cannot be paraphrased by a *yes*. Sometimes we *nod* while talking, to give emphasis to what we are saying; or, even without words, to greet or to thank someone.

5.1. Confirm

Before coming to the cases in which *yes* and *nod* are not homologous, let us focus on the cases of their semantic overlapping. For the three cases above both *yes* and *nod* are polysemic in their own right, since each of them has three different meanings, but these have something in common.

Let us see what is specific and what is shared by the three types of communicative act conveyed by both *yes* and the *nod*: confirmation, expression of agreement and permission.

That an Interlocutor I confirms some belief B mentioned by Speaker S means that I communicates to S that I has the same belief B, so that S may come to attribute a higher level of certainty to B (Castelfranchi & Poggi, 1998).

People are in search for knowledge because beliefs about the world, oneself and others are necessary to pursue and achieve goals; but to this end beliefs must be true (an adequate representation of the world) and certain (reliable for effective use in goal pursuit). As one is not certain of some belief, for instance because one has it only as a hypothesis, a way to have it confirmed is to ask others, because according to the laws of human communication – the Cooperation principle (Grice, 1975), and the principle of reciprocal altruism of knowledge (Castelfranchi & Poggi, 1998) – we believe a belief is more certain if it comes from different sources. So, as one puts a question he is in fact mentioning a belief by treating it as a hypothesis, and asks the other whether she confirms it (*yes*) or disconfirms it (*no*) (Poggi et al., 1982; Pope, 1977). An answer "yes" means: "I also have the same belief that you put as a hypothesis", and this counts as "I confirm what you say".

5.2. Agree

Coming to the notion of agreement, what can we agree about? We can say "*I agree*" after a sentence like "*I think that Napoleon was a great man*" or "*I propose that the home assignment is about Napoleon*", but not after a question like "*Did Napoleon died in 1821?*" or after a statement like "*Napoleon died in 1821*", unless someone challenges this as not a factual belief but simply a questionable belief. In sum, one may not agree about a factual belief, that is about simply informative speech acts or communicative acts, but only about communicative acts that imply values and/or goals, like for instance, a proposal or an opinion. That I agree with you means that I have the same opinion as you.

5.3. Permit

Finally, let us come to the meaning of *yes* as giving permission. If S asks I if S may do action A, a *yes* by I means: "I allow you to do A".

So, what is common in these three meanings of *yes* is a notion of "sameness" of a belief. "*I confirm*" means "I also have the *same* belief as you", "*I agree*" means "I also have the *same* opinion as you", while "*I allow you to do this*" means: "I also have the *same* opinion as you, that

it is right for you to do A”. In both *yes* and the *nod*, the polysemic signal provides a single piece of meaning: that someone has the same belief as another person, and hence confirms the other’s belief. So, like with other polysemic signals, for both *yes* and *nod* the context – the preceding sentence – adds another piece of meaning: whether the belief confirmed concerns some factual information, or some opinion, or the willingness of B to let A do some action.

6. Types of nod. An observational study

In this work we present an observational study on the meanings of the head nod. The aim of our study is to disentangle the polysemy of the nod, that is, to provide a typology of nods that allows, on the one side, to find out the common semantic elements of different types of nod, on the other side to establish which aspects of the verbal and nonverbal context add meaning to the common semantic core, allowing to distinguish each specific nod type. To do so we need to analyze each nod while taking into account both its verbal and its multimodal context, that is, the preceding speech acts and the parallel signals in other modalities.

6.1. Method

To single out a typology of nods, we analyzed 68 cases of nods taken from “Canal 9”, a corpus of political debates collected by IDIAP of Martigny (Switzerland), and available on the portal of the European Network of Excellence SSPNet (Social Signal Processing Network). The corpus contains 72 debates held in 2004, 2005 and 2006 at Canal 9, a TV Broadcaster in the Canton of Valais, where two or four persons, facing each other and representing opposite positions concerning political, cultural or social issues, discuss in the presence of a Moderator. To single out the nods to be analyzed, we considered two different methodological choices. One was to view the debates in video and audio, then, based on the transcription of the verbal message, find out passages in which the participants are agreeing, and finally analyze the nods simultaneous with those passages. But this would have confined the analysis only to nods of agreement. As shown by previous research, people sometimes use nonverbal signals only in a repetitive way, i.e., to convey the same meaning of words also in another modality; but often signals in other modalities have an additive, substitutive, or contradictory function: they convey information that may be congruent but additional, or replace words, or convey an opposite meaning (Poggi, 2007). And also when a gesture or head signal have the same meaning as a parallel word, the very fact they are performed simultaneously is meaningful per se: it means the Sender considers that content so important as to need multiple expression. One more problem with this approach is that a nod does not mean solely agreement, but it is often simply a backchannel: a signal produced by the Interlocutor – one who is not presently speaking – to reassure the present Speaker about one’s listening and understanding (Yngve, 1970; Allwood et al., 1995; Cerrato, 2005; 2007). Not to interrupt or overlap with the Speaker’s turn, backchannel needs to be unobtrusive, and therefore typically the Interlocutor produces only a nod, not even a “*yes*” or “*I see*”. For these reasons, we considered that selecting only the nods produced by a Speaker concomitant to his/her verbal expressions of agreement would have artificially constrained research, being in the end misleading. Instead we opted for a different methodological choice: we first viewed the debates in a mute condition, without hearing the audio, and only later did we take the full audio-video recording into account, we transcribed it, and analyzed it as the context of the nod.

The nods were analyzed in terms of the annotation scheme in Table 1.

Table 1. An annotation scheme to analyze nods

1. <i>n.</i>	2. <i>Time</i>	3. <i>S</i>	4. <i>Verbal</i>	5. <i>Nod description</i>	6. <i>Gaze</i>	7. <i>Goal or Meaning</i>	8. <i>Type</i>
5	3.41 - 3.42	SR Sp	SR: <i>Strictement, rien du tout</i> = strictly, nothing at all	Moves head forward-downward	Gaze fixed to Interlocutor	I want to stress this	Emphasis
10	6.52	HR I	M: <i>les mesures d'économie qui sont proposées</i>	Lowers head fast and briefly three times	Looks down	I see what you mean	Backchannel “I’m following”

			= the economic manoeuvres that are proposed				
--	--	--	---	--	--	--	--

Sp = Speaker; I = Interlocutor; M = Moderator

The first two columns contain the fragment number and its time in the video, Column 3 states who is the Sender of the nod, named with the initials of his/her name, and his/her role as Speaker, Interlocutor, Third Listener or Moderator. Col. 4 contains the verbal behaviour simultaneous to the nod, whether performed by the nod Sender or not; 5 contains the description of how precisely the nod is performed, mentioning also its expressivity parameters like amplitude, velocity, fluidity and repetition (Hartmann et al., 2002); 6 mentions the concomitant gaze behaviour; 7, the goal or meaning attributed to the nod by the researcher. We speak of “meaning” when the nod has the goal of communicating some belief – for instance, “I confirm that what you hypothesize is true” for the nod of “requested confirmation”, (see Table 2, type 1.A1) – and simply of a goal when the nod in itself is not aimed at communicating anything, but simply has a practical function – for example, helping to maintain the sentence rhythm, as for the batonic nod (Table 4., type 3.2). Col.8 finally states the resulting type of nod, classified in terms of the goal of meaning written in Col.7.

For example: in case n.5, (Col.1), at time 3.41 – 3.42 (Col.2), the one who performs the nod is participant SR, who is at the time also speaking (Sp, Col. 3); he is saying “*Strictement, rien du tout*” (= strictly, **nothing** at all), with the word *rien* stressed (Col.4). At the same time he produces a head nod by moving his head not only downward but also slightly forward (Col.5), with gaze fixed to Interlocutor (Col. 6). The meaning we attribute to this nod is that the Speaker wants to stress what he is saying (Col. 7), which is classified as Emphasis (Col. 8).

In case n.10, (Col.1), at time 6.52 (Col.2), the nod is performed by participant HR, who is at the time the Interlocutor (Col. 3); he is listening to the Moderator (Col.4) who is saying “*Les mesures d’économie que sont proposé*” (= the economic manoeuvres that are proposed). While listening, HR moves his head downward three times with high velocity and low amplitude (fast and brief) (Col.5), his eyes looking down (Col. 6). This is interpreted as a nod of backchannel (Col. 8), specifically one signalling contact and perception (Allwood et al., 1995; Bevacqua, 2009), that we paraphrase in Col. 7 as “I see what you mean”.

6.2. Interlocutor’s and Third Listener’s nods

To illustrate our typology we start from the Interlocutor’s nods (Table 2): the most “prototypical” types, but also the most articulated into subtypes, since we must distinguish those produced after the previous Speaker has finished talking (cases A in Table 2.) from those while s/he is talking (cases B). The latter are the nods of backchannel, while for the former the meaning of the nod depends on the linguistic context, i.e., the type of speech act performed by the Speaker in the previous turn. So, like for *yes*, a *nod* following a *yes/no* question is a confirmation of the Speaker’s hypothesis, one following an assessment or a proposal conveys agreement or approval.

The Interlocutor’s nods include both ones corresponding to a *yes* and the other types. In Table 2., lines contain the nod types; as to columns, column 1. mentions the type of speech act produced by the Speaker before the nod, col. 2 the type name, 3, its goal or meaning. Col. 4 contains, for cases in which we found them recurrently in our corpus, a description of the most characterizing features of the signal of the nod at issue, including, beside the classical parameters, head inclination and direction of movement, as well as the parameters of expressivity (fluidity, amplitude, velocity, repetition, see Hartmann et al., 2002), and often the concomitant gaze behaviour. Cases in which col. 4 is empty are those in which no typical signal features have been found yet.

Table 2. Interlocutor’s nods

	1. Previous turn	2. Type	3. Goal or meaning	4. Signal features
Speaker finished	Yes/no question	1.A1. Requested Confirmation	I confirm that what you hypothesize is true	Single nod, head first goes upward and then downward
	Information	1.A2. Spontaneous Confirmation	I confirm that what you say is true	Head movement downward
	Assessment	1.A3. Agreement	I agree with your judgement	Single nod downward, with head movement of

				high amplitude and tension. Gaze generally directed to Speaker, sometimes with a slow closing of the eyelids
	Proposal	1.A4. Approval	I approve	Nod downward single or repeated, with head movement of high amplitude. Gaze possibly directed to Speaker, often with eyebrow frowning
	Permission request	1.A5. Permission	I allow you to do this, I confirm that you may do this	
	Dominant request	1.A6 Submission	Yes, sir, I submit to you	
	Prosocial (communicative) action	1.A7. Greeting	I bow to you	Slow, generally with smile and closing eyes
		1.A8. Thanking	I thank you	Generally accompanied by a smile
Speaker continued	Backchannel	1.B1. Backchannel "I understand"	I confirm I am following you	Brief fast repeated downward movement
		1.B2. Backchannel "I take note"	I record your communicative act and consider it relevant for our social relationship	short, repeated nods, gaze to speaker
		1.B3. Backchannel "I agree"	I confirm I agree	Brief fast repeated downward movement, frowning and gazing to Speaker, possibly smile
	Disagreement	1.B4. Ironic backchannel	I do not agree at all	Possibly asymmetrical (i.e. ironic) smile
	Self-agreement	1.B5. Back-agreement	I agree with you (but just) because you are repeating my previous statements. Do you acknowledge I was right?	Possibly ironic smile, sometimes a sigh. Gaze to Speaker
		1.B6. Processing Nod	I am reasoning about what the Speaker means and is aiming at; Or I am planning my response and I approve of my reasoning	Repeated brief and slow downward movement, generally with a frowning and possibly a smile. No gaze at Speaker

If the preceding speech act is a *yes/no* question or an informative sentence concerning factual beliefs, the nod conveys a *requested confirmation* (1.A1.) or a *spontaneous confirmation* (1.A2.), respectively. Actually, it is not the same to confirm something you were requested to or not. A confirmation following a bare information – not a question – is, so to speak, non-required, spontaneous. As one asks a *yes/no* question he is putting forward a hypothesis and asks you to confirm or disconfirm it. But when you utter an informative sentence, it is not a hypothesis for you, it is a belief you are quite certain of, and you may expect an acknowledgement of it, but you don't ask the other to confirm it. So a non-requested confirmation shows somewhat more of a commitment than one you are bound to give. Yet, in both cases the nod means "I have the same belief as you mentioned", whether it was mentioned in a question or a statement.

Instead, if the Speaker's speech act is an assessment, that is, a sentence or discourse with an evaluative import (Col.1), a nod means "I agree" (Col.3), i.e. "I have the same opinion as you mentioned", that is, "I agree with your judgement": a case of *agreement* (1.A3). The agreement nod (Col.4) is usually a bit slower and more ample than that of confirmation, and sometimes it is accompanied by a soft closing of the eyelids: a gaze signal that counts as an extenuated *yes*, but with a nuance of haughtiness, of showing that one graciously consents, while still feeling superior.

After a proposal, the nod may be an *approval* (1.A4). A proposal is an action request, that is, one in which one asks others to pursue sole goal, characterized by two features: 1. that the proposed goal is not only one of the Speaker, but it may be a goal of the Addressee too; 2. that the proposer, in asking to pursue that goal, does not make an appeal to his power over the Addressee: the Addressee is free to choose, and accepting implies that he approves the proposal, i.e. he also agrees it is good for his goals too. In sum, a proposal is a cooperative and symmetrical request for action, that entails some acceptance, approval or agreement with the other's goals or evaluations.

In some cases, the positions of the conversationalists are asymmetrical. In case the Interlocutor has power over the Speaker, and the Speaker's speech act is a request for permission, the Interlocutor's nod counts as giving a *permission* (1.A5). To the opposite, sometimes one asks you to do something you would rather not to do, but you are bound to that action request because it comes from someone who has power over you. If produced as a response to a peremptory order, the nod is one of *submission* (1.A6), and it maintains its ethological meaning "I submit to you", "I'll do what you want"(Col. 3).

Finally, among the *nods* that are not synonyms of *yes*, after a pro-social action of politeness or benevolence, like a greeting, an offer or a favour, the *nod* is almost a bow, aimed at *greeting* (1.A7) or *thanking* (1.A8): either you are bowing or you acknowledge you are indebted to the other, hence in both cases temporarily submitted to him/her.

We now come to nods performed by the Interlocutor during the Speaker's turn. Four types of them are backchannel signals. The first one, produced while the present Speaker is conveying factual information, is a backchannel of confirmation ("I confirm I am following", 1.B1). The second, often corresponding to an acknowledgement by the present Speaker, is something like "taking note" (1.B2): the Interlocutor is somehow acknowledging that this communicative act may change one's relationship with the other: so this nod is something more than simply confirming comprehension, but something less than expressing agreement. The third backchannel nod, performed during acts of evaluation, opinion, proposal, communicates agreement ("I have the same opinion as you", 1.B3).

In the *backchannel nod of confirmation*, 1.B1, the first nod may be ample, but then two or more nods follow short and rhythmically repeated, like in case n.10 of Table 1.

(Inv., HR, 6.52)

The Moderator prepares to put HR a question: « *Tout d'abord les mesures, on va s'occuper d'abord du premier chapitre, les mesures d'économie qui sont proposées...* », (First of all the measures, we will discuss the first chapter, the economic measures which are proposed). HR first lowers his head almost downward to his chest, while looking downward, and then repeats the movement twice, with lower amplitude. The first nod seems as if induced by a first sudden insight of the topic introduced by the Moderator; then, after grasping the concept, he goes on by confirming he is following, but with faster and shorter nods.

The *backchannel nods of agreement*, instead, are generally single, ample and stressed, possibly accompanied by eyebrow frowning, gaze to the Speaker and smile. In some cases though, when the Interlocutor ironically smiles while nodding at the present Speaker, he is providing an ironical backchannel of agreement, that is, actually, showing strong disagreement (1.B4), like in this example.

(Economie, BZ, 23.52)

TG is saying : *Vous venez de dire ça. Vous venez de dire ça.*

(You've just said that. You've just said that).

BZ moves head downwards, slightly nods three times while gazing downwards and raising one lip corner. This is an ironic smile, hence BZ is implying "Yes, this is so indeed....", resulting in a backchannel of disagreement.

Finally there are two types of nods through which the Interlocutor signals confirmation or agreement to oneself. Sometimes, we nod to the Speaker only because s/he is saying something we had previously said or thought, so we are nodding not just to him but to ourselves (*back-agreement*, 1.B5); in this case the nod may be accompanied by a smile or a sigh, as if saying: "Well, you finally see I was right!".

A curious nod that might belong to this type is what we may call the "Oliver Hardy's nod". Sometimes Oliver, when angry at someone, makes a very jerky single nod, while pressing his lips and gazing at the addressee of the nod. This is a nod of "*revenge*", which expresses the gloating of someone who, after receiving a misdeed, gets a revenge on the offender. During a discussion,

when others do not share our opinions we feel upset, but when finally they say just what we had said before, we obtain this revenge because it is finally clear we were right.
Here is a case of back-agreement.

(Libre C., OF, 5.05)

While LB says: *Et puis vous dites 'on peut pas se faire une idée aujourd'hui de l'impacte de la libre circulation parce que c'est trop récent'*.

(And then you say that today we cannot have an idea of the impact of the free circulation [of people] because it's still too early).

OF bends head downward once in a rapid nod and then again in a more ample nod. The second nod is accompanied by gaze to LB, eyebrows raising and a gesture of the right hand in oblique position, and it means: "This is precisely so, it is obvious that I am right!"

Sometimes, finally, nodding is like saying *yes* to ourselves while reasoning on the other's turn or planning our response, or while confirming to ourselves that we understood what the Speaker really means (*processing nod*, 1.B6). This nod is repeated and accompanied by a frowning of concentration, and it differs from the *back-agreement* nod above because in this case gaze is not directed to the Speaker, but possibly downward.

6.3. The Third Listener's nods

Also the Third Listener's nods (Table 3.) may convey *confirmation* (2.1., after an information), *agreement* (2.2., after evaluative opinion), *acknowledgement* or *thanks* (2.3., after a prosocial act), and finally be *back-agreement* (2.4) or *processing* nods (2.5).

Table 3. Third Listener's nods

1. Speaker's Turn	2. Type	3. Goal or meaning	4. Signal features
Information	2.1. Confirmation	I confirm the belief you mentioned	Not emphatic, often done in extenuated form by simply closing eyelids
Assessment	2.2. Agreement	I agree with you	
Prosocial (communicative) action	2.3. Acknowledgment Or Thanks	I am grateful	Gaze downward
Self-Agreement	2.4. Back-agreement	I agree with you (but just) because you are repeating my previous statements	
	2.5. Processing nod	I am reasoning about what the Speaker means and is aiming at; Or I am planning my response and I approve of my reasoning	Repeated brief and slow downward movement, generally with a frowning and possibly a smile. No gaze at Speaker

Here is a case of Third Listener's *agreement* nod (2.2).

(Inv., HR, 10.58)

SR is listing a set of worrying events : « *Les entreprises, l'économie et le pouvoir public aussi se sont désengagés* ».

(Enterprises, economy and public power have disengaged too).

HR looks at SR, with his chin slightly raised and eyelids half-closed, and moves his head down and up twice rapidly and with low amplitude, like if approving: "This is true, you're right".

SR's sentence does not simply concern a factual belief, but is the last of a whole list of worrying event: hence its mention implies an expression of worry. HR, who is on the same side of SR in the

debate, physically and, therefore, as to his ideological position, is therefore not simply confirming that what SR says is true, but agreeing about his feeling and point of view.

6.4. The Speaker's nods

Within the Speaker's nods (Table 4) we may distinguish two broad families: in the former the semantic core is one of importance, in the latter a request for confirmation.

Emphasis, baton and listing. Nods of importance.

A first case in which we nod while holding the turn is when we want to emphasize what we are saying (3.1., *emphasis*). As to the signal side (col.3), a such nod is characterized by the fact that head does not only go up and down but slightly forward: the typical movement of an emphatic nod is forward-downward in correspondence with a stressed syllable, with gaze toward the Interlocutor. The meaning is: "this part of my sentence or discourse is particularly important". Here we do not distinguish between "focus" and "emphasis", like does Cerrato (2007), because focusing can be seen as a way to emphasize a word or part of discourse. A person nodding to stress his words is like a charging bull: head goes forward, and gaze is directed to Interlocutor, as if ready to fight (after all, in arguing you are fighting for your ideas!).

(Inv., d, 3.16).

To the first question by the Moderator, SR answers « *Je crois que si on voulait non pas fragiliser mais renforcer le système, le Parlement aurait pris les bonnes décisions* »

(I think that if one wanted not to make the system fragile but to make it stronger, the Parliament would have taken the right decisions).

While uttering « *bonnes* » (good), he lowers his head with a short and fast movement, to communicate how good are the decisions he is talking about.

A particular case of emphasis is when we nod in correspondence of all the stressed syllables of our sentence (3.2, *baton*): here the head nod can be compared (Cerrato, 2005) to batonic gestures (Ekman & Friesen, 1969), which impress to or accompany the rhythm of our words. This might be seen as a non-communicative movement, simply used to help ourselves to maintain the right rhythm. But rhythm itself, i.e., the choice of which syllables to stress, is determined by the choice of which words to select as important. Thus, if this nod is not strictly speaking communicative per se – we cannot say it "means" "this syllable is important" –, it is anyway functional to our communicative goals.

(Inv., FD, 4.21)

While saying: *Je crois que vraiment aujourd'hui on s'axe de plus en plus vers la réinsertion.*

(I think that **really today** people move **more** and more towards the re-insertion), FD moves his head downward – forward three times in correspondence with the stressed syllables.

A special case of this nod is used to highlight the items in a list (3.3, *list*), where it generally accompanies the metadiscursive gestures (Poggi, 2007) produced to enumerate. In this case the nod parallels the downward movement of the hand, and by doing so directs attention to it. But it may also accompany syntactic parallelism.

Inv., MC, 13.20.

MC says:

« *Soit effectivement on s'attaque uniquement au financement, ce qui est la volonté de la Gauche, obsession, donc il faut augmenter les recettes. Soit on dit quand même : il y a au sein de l'Assurance Invalidité des possibilités d'économie sur ces fameux 12 milliards* ».

(We either approach solely the issue of funding, which is the Left party's desire, and consequently the revenues must be increased; or we admit, however, that it is possible to save money within the Invalidity Insurance in order to reduce the famous debt of 12 milliards).

MC's head scans the parallelism set by the words "soit... soit" (either... or). In the nod corresponding to the second "soit", the upward movement preceding downward movement is somewhat more salient.

This stressing movement too has a core meaning "this is important". But what is important in a list? A list is a set of items all subsumed to a general category, and all at the same level of generality. Stressing some words through the nod is a way to signal which items have the same importance, hence being at the same level of generality.

Nods of request for confirmation

Other nods of the Speaker are connected to the concept of confirmation. A nod while looking at the Interlocutor and frowning, or with oblique head, slightly tilted sidewise (3.4., *interrogative nod*) is a request for confirmation, as is saying “yes?” with an interrogative intonation.

Inv., M, 7.47

The Moderator puts a yes/no question to HR : « *Mais la réalité des neuf milliards de dettes, ça on ont pas? ça vous y convenez aussi?* »

(What about the 9 milliards debt, do you agree with that as well ?).

In correspondence of the stressed syllables she lowers her head obliquely three times.

This interrogative nod can also be used as a rhetorical question (3.5. *Rhetorical interrogative nod*), when you want the other to definitely confirm instead of asking if he confirms or not.

Sometimes, finally, nodding with an interrogative expression is a request for backchannel (3.6. *backchannel request*): you want the other to confirm or not if he is following and understanding.

Table 4. Speaker’s nods

1. Type	2. Goal or meaning	3. Signal features
3.1. Emphasis	This (part of my) sentence (discourse) is important	Head moves forward-downward over stressed syllables Gaze toward Interlocutor
3.2. Batonic	I stress syllables to help myself keeping rhythm	
3.3. List	This (part of my) sentence (discourse) is important because here starts an item of my list	Stresses the items in a list, often parallel with enumerating gestures
3.4. Interrogative nod	I ask you if you confirm my hypothesis or not	Gazes at Int. with oblique head, slightly tilted sideway. Or Eyebrow frowning like in interrogative sentences
3.5. Rhetorical interrogative nod	Isn’t it so? I want you to confirm	Often with eyebrow raising
3.6. Backchannel request	I ask you to if you confirm or not that you understand what I mean	(sometimes) accompanied by open hand palm up gesture

7. A procedure for nod recognition and comprehension

Based on the typology presented we propose a flow chart (Fig. 1): a possible procedure for nod detection that might lead, if not to comprehension of the nods, at least to more sophisticated semantic recognition than permitted by existing systems. This is but a sketch of such a procedure, to be improved in later works.

We imagine a system with two detection modules, acoustic and visual, that switches from one to another or uses both, as evidenced in Fig. 1 by rhombi in white (acoustic) or grey (visual). Our hypothesis also entails a working memory and a language processor (dotted rhombi) to retrieve and analyze preceding speech acts.

Suppose the visual module detects a downward movement of the head. The first question is: “Is the nod Sender presently speaking?”. Answer “no” leads to the nods of a Listener (whether Interlocutor’s or Third Listener’s), while “yes” results in the Speaker’s nods. If the visual module detects a raising of the eyebrows or inclined head, or the acoustic one detects a raising intonation, since these are both cues to an interrogative speech act, the nod is interpreted as an *interrogative* one. Then, if the visual and acoustic modules together detect correspondence of the nod with various stressed syllables in the concomitant sentence, a *batonic* nod is recognized. If in correspondence of gestures with a number in their handshape – for instance raised thumb or little finger – the nod is interpreted as scanning a *list*; if not, a nod of *emphasis* results.

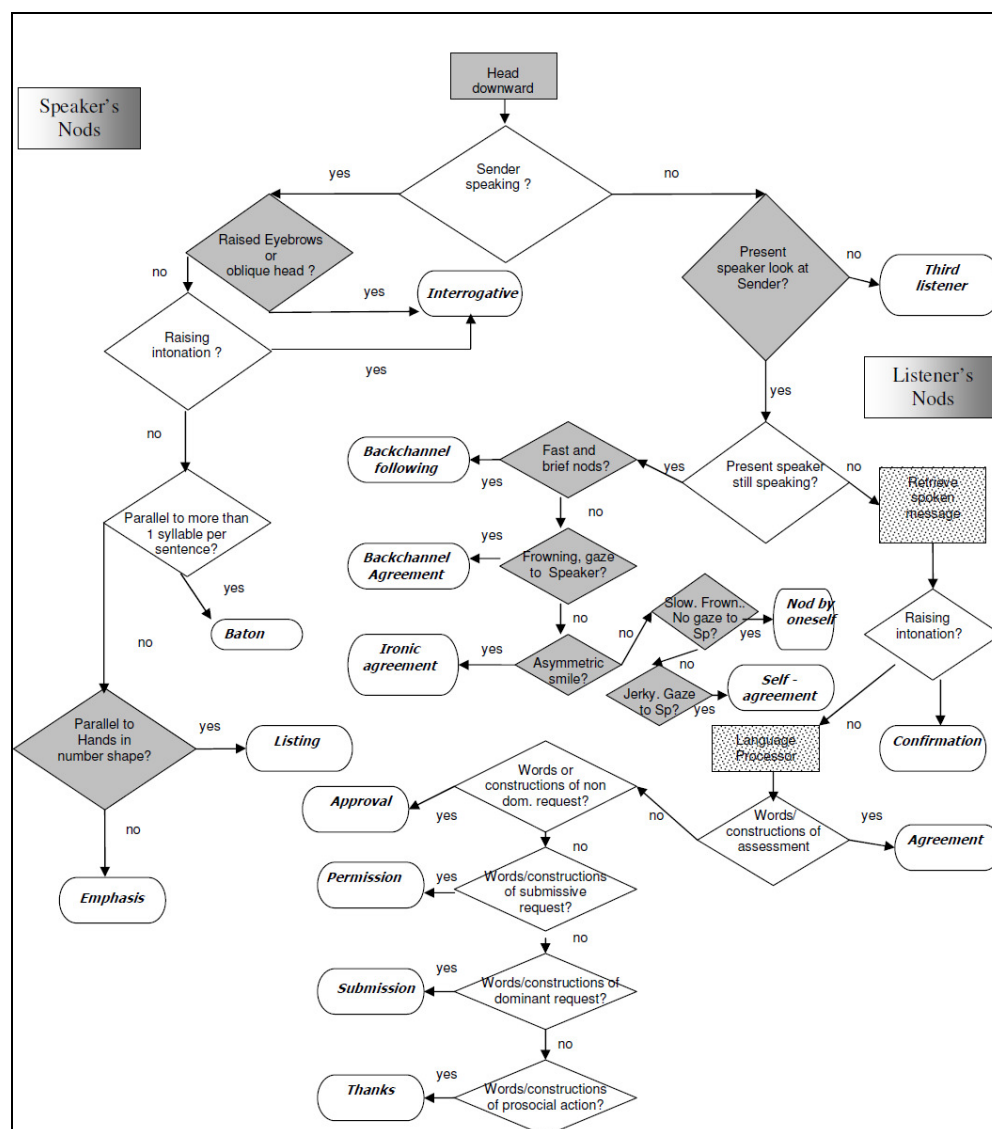
Coming to the Listener’s nods on the right, if the nod Sender is not speaking, to decide between Interlocutor and Third Listener, the visual module must detect if the one who is presently speaking

is gazing at the nod Sender. “No” leads to a Third Listener’s nod. If the present Speaker is still speaking, and the head movement is fast and short, a *backchannel* “I’m following” is recognized, while if he is at the same time gazing at Speaker and frowning, it will be a *backchannel of agreement*. If the nod is accompanied by an ironic smile (asymmetrical raised lip corner), the nod is an *ironic agreement* – then in fact disagreement; if it is repeated and with a frowning, it may be a *nod by oneself*, or *processing nod*, while if jerky and with gaze to Speaker, it is a *back-agreement* (or “*self-agreement*”). Coming back to the case in which the Speaker has finished speaking, the Working Memory module retrieves the spoken message just delivered: if it contains a rising intonation, the nod is an answer to yes/no question (*confirmation*). If not, the Language Processor is triggered to perform a semantic analysis of the preceding speech act. If, through sentiment analysis techniques, it finds words or constructions of assessment or evaluation, like *smart*, *bad*, *one should*, it concludes for a nod of *agreement*. If not, it searches the preceding speech act for performative verbs (like *propose*) or performative formulas or syntactic constructions (like *let us*) that convey a proposal, and upon finding them, concludes for an *approval* nod. If not, it looks for words or syntactic markers of a submissive kind, like *may I*, or *please, I ask you*, then issuing a *permission* nod; or, if finding instead markers of a dominant request, like *I order you* or imperative mode, it recognizes a *submission* nod. If finally it finds words or constructions conveying a prosocial action on the part of the present Speaker, like *I offer you*, or *please accept*, it concludes for a *thanking* or *greeting* nod.

8. Conclusion

The nod is a polysemic social signal used in conversation by both Speaker and Listener. When performed by the Speaker, the nod conveys importance – hence a request for attention – and request for confirmation. When produced by the Listener, be it the Interlocutor of the present Speaker, or a Third Listener, nodding communicates openness to interaction, by confirming the other’s claims and accepting his opinion and goals. From this point of view, nodding still maintains its original ethological meaning, in which lowering your head in front of another, that makes you prone to his power over you, becomes a communicative act of submission, through the device of ritualization (Posner, 2003).

Figure 1. Flow Chart for the semantic recognition of head nods



Acknowledgements

This research is supported by the Seventh Framework Program, European Network of Excellence SSPNet (Social Signal Processing Network), Grant Agreement Number 231287.

The paper is dedicated to Roland Posner and to his seminal rigorous work about body signs. On occasion of his 68th birthday, the numbers 6, 8 and 68 are recurrent throughout the paper. It is divided into 8 Sections, 68 nods have been annotated, 8 examples are described in detail, Table 1 includes 8 columns, and the types of nods the Speaker may perform are 6.

References

- Allwood, J., Nivre, J., & Ahlsén, E. (1992) On the semantics and pragmatics of linguistic feedback. *Journal of Semantics* 9, pp.1-26
- Bevacqua, E. (2009) *Computational model of listener behavior for Embodied Conversational Agents*. Unpub. Phd thesis, IUT, Université Paris 8.
- Boholm M. and Allwood J. (2010) Repeated head movements, their function and relation to speech. In *Proceedings of the LREC 2010*, Malta, May 18, 2010.

- Briñol P. and Petty R.E. (2003) Overt head movement and persuasion: a Self-Validation Analysis. *Journal of personality and social psychology* 84(6), pp.1123-1139.
- Castelfranchi, C., & Poggi I. (1998) *Bugie, finzioni, sotterfugi. Per una scienza dell'inganno*. Carocci: Roma.
- Cerrato, L. (2005) Linguistic functions of head nods. In Allwood, J. & Dorriots, B. (Eds.), *Gothenburg papers in Theoretical Linguistics 92: Proc. from The Second Nordic Conference on Multi-modal Communication*, Gothenburg University, Sweden: 137-152.
- Cerrato, L. (2007). *Investigating Communicative Feedback Phenomena across Languages and Modalities*, Unpub. Phd thesis, KTH, Stockholm.
- Dittmann, A. T. and Llewellyn, L.G. (1968) Relationship Between Vocalizations And Head Nods As Listener Responses. *Journal of Personality and Social Psychology*. Vol 9(1), May 1968, 79-84.
- Collett, P., Contarello, A.(1984) Gesti di assenso e di dissenso, In P.E. Ricci Bitti (ed.) *Comunicazione e gestualità*, Angeli: Milano, pp. 69-85
- Ekman, P., Friesen, W. (1969). The repertoire of nonverbal Behavior: Categories, origins, usage and coding. *Semiotica* 1, 1, 49-98.
- Grice, P. (1975) Logic and conversation. In *Syntax and Semantics*, Accademic Press, New York, (3) 41-58
- Hadar, U. (1991) Body movement during speech: Period analysis of upper arms and head movement. In *Human Movement Science* 10 (1991) 419-446, North Holland
- Hadar, U. Steiner, T.J., Grant, E.C., & Clifford Rose, F. (1983) Kinematics of head movements accompanying speech during conversation. *Human Movement Science*, 2, 35-46.
- Hadar, U., Steiner, T., Rose, C.F.: (1985). Head movement during listening turns in conversation. *Journal of Nonverbal Behavior*, 9, 214–228
- Hartmann, B., Mancini, M., & Pelachaud, C. (2002) Formational Parameters and Adaptive Prototype Instantiation for MPEG-4 Compliant Gesture Synthesis. *Computer Animation* 2002, 111-119.
- Hegen-Larsen M., Cunningham S.J., Carrico A., Pergram A.M. (2004) To Nod Or Not To Nod: An Observational Study Of Nonverbal Communication And Status In Female And Male College Students, *Psychology of Women Quarterly*, 28, 358–361.
- Heylen, D. (2005). Challenges Ahead. Head movements and other social acts in conversations. In *Proceedings of the 5th International Conference on Interactive Virtual Agents*. Kos, Greece, 2005.
- Kendon, A. (2002). Some uses of the head shake. *Gesture*, 2, 2, 147-182.
- McClave, E.Z. (2000). Linguistic functions of head movements in the context of speech. *Journal of Pragmatics*, 32, 855-878. Oxford University Press, 298-311.
- Ogden, R (2006) Phonetics and social action in agreements and disagreements. *Journal of Pragmatics* 38, 1752–1775.
- Poggi I. (2007). *Mind, hands, face and body. A Goal and belief view of multimodal communication*. Berlin: Weidler.
- Poggi I. (2008) The Language of Interjections. In Esposito A., Hussain A., Marinaro M., Martone R. (ed.), *Multimodal signals: Cognitive and algorithmic issues*. COST action 2102 and euCognition international school. Berlin: Springer, pp.170-186.
- Poggi, I., Castelfranchi, C., & Parisi, D. (1982). Answers, Replies and Reactions. In H.Parret, M.Sbisà & J.Verschueren (Eds.) *Possibilities and Limitations of Pragmatics*. Asterdam: John Benjamins, pp.569-591.
- Poggi I., D'Errico F., Vincze L. (2009) Fare sì con il capo. Polisemia di un segnale sociale. In *Atti del Convegno Aisc*. Associazione Italiana Scienze Cognitive, 25-26 Novembre Napoli.
- Poggi, I., & Pelachaud, C. (2008). Persuasive gestures and the expressivity of e-cas. In I. Wachsmuth, M. Lenzen, G. Knoblich (Ed.), *Embodied communication in humans and machines*. Oxford: Oxford University Press.

Posner, R. (2003). Everyday gestures as a result of ritualization. In M.Rector, I.Poggi & N.Trigo (Eds.), *Gestures. Meaning and Use*. Porto: Edicoes Universidade Fernando Pessoa.

Wells, G. L., & Petty, R. E. (1980). The effects of overt head movements on persuasion: Compatibility and incompatibility of responses. *Basic and Applied Social Psychology*, 1, 219–230.

Yngve, V.H. (1970). On getting a word in edgewise. In *Papers from the Sixth Regional Meeting*, Chicago Linguistic Society, Chicago, IL., pp. 567-578.