THE VOICE OF DECEPTION: VOCAL STRATEGIES OF NAIVE AND ABLE LIARS

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ABSTRACT: The aim of this research was to analyze the main vocal cues and strategies used by a liar. 31 male university students were asked to raise doubts in an expert in law about a picture. The subjects were required to describe the picture in three experimental conditions: telling the truth (T) and lying to a speaker when acquiescent (L1) and when suspicious (L2). The utterances were then subjected to a digitized acoustic analysis in order to measure nonverbal vocal variables. Verbal variables were also analyzed (number of words, eloquency and disfluency index). Results showed that deception provoked an increment in F_0, a greater number of pauses and words, and higher eloquency and fluency indexes. The F_0 related to the two types of lie—prepared and unprepared—identified three classes of liars: good liars, tense liars (more numerous in L1), and overcontrolled liars (more numerous in L2). It is argued that these differences are correlated to the complex task of lying and the need to control one's emotions during deception. The liar's effort to control his/her voice, however, can lead to his/her tone being overcontrolled or totally lacking in control (leakage). Finally, the research forwards an explanation on the strategies used by the good liar and in particular treats the self-deception hypothesis.

A semantic analysis of the word "lie" defines this term as a precise mode of deceit, perpetrated when "communicating to someone something believed to be false." In fact, the basic components of a lie are: (a) the *falsehood* of the utterance's contents; (b) the *awareness* of such falsehood; and (c) *the intention to deceive* the receiver (Coleman & Kay, 1981). However, the main element constituting a lie is "the intention to lie," whereas the "falsification of facts" merely constitutes the condition necessary for its fulfillment (Sweetser, 1987).

In its various forms, telling a lie, according to the Intention Hierarchy model (Anolli, Balconi, & Ciceri, 1994), is an *interpersonal and deliberate*

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act of communication characterized by *two levels of communicative intention*: (1a) *hidden intention*: S (Speaker) intends to deceive H (Hearer) by manipulating the information x; (2a) *manifest intention*: S intends to communicate x to H. This implies that S has two co-existing attitudes towards Searle's Sincerity Rule (1979), whereby S commits himself to believe in the truth of the expressed proposition. Thus, at the second level: (1b) *hidden intention*: S breaks the Sincerity Rule; (2b) *manifest intention*: S wants H to believe that S has respected the Sincerity Rule.

In this perspective, lying becomes a *highly demanding and articulated cognitive task* which requires precise and constant control over the conflict and mental discrepancy between the hidden and the manifest intentions. The *able liar* must, on the one hand, be able to manipulate information so that it appears truthful to the hearer, and on the other, must control his/her verbal behavior so as not to reveal the fact that the Rule of Sincerity has been broken (McCornack, 1992; Reboul, 1994).

This cognitive complexity demands a high degree of intellectual effort from the liar whose *articulated mental planning* may be realized through different types of *communicative strategies*. On the verbal level, according to some authors (Buller, Burgoon, Guerrero, Afifi, & Feldman, 1996), this manipulation of information would seem to be represented by utterances characterized by reticence, non-immediacy, withdrawal (about the amount of information), ambiguity (Bavelas, Black, Chovin, & Mullet, 1990), uncertainty and vagueness, equivocation (about the directness of messages; Ebesu & Miller, 1994), and disassociation (about the personalization of responsibility). Other authors (Kuiken, 1981; Vrij, 1995) have pointed out strategies based upon synthetic and concise utterances.

At the same time, when telling a lie the subject has *to keep a check on his/her emotional reactions*. In fact, by our cultural standards, the violation of the Sincerity Rule—object of disapproval and of moral and legal sanction—is accompanied by more or less emotional arousal linked to the fear of being found out, the shame, the guilt and the risk of losing face. When a *naive liar* or an inexperienced one can't efficiently cope with lying the main leakage cues are nonverbal signs such as increased pupil dilation (O'Hair, Cody, & McLoughlin, 1981), frequent emblems (Ekman & Friesen, 1974), and more frequent blinking (Ekman, Friesen, O'Sullivan, & Scherer, 1980; Riggio & Friedman, 1983). In the same way, the presence of too long or too frequent a pause, or the appearance of filled pauses, or else of numerous repetitions, speech errors, or interruptions reveal S's lack of preparation and his/her weakness in coping with his/her own emotional reactions (Cody, Marston, & Foster, 1984; DeTurck & Miller, 1985). This

evidently raises H's suspicions (Cody et al., 1984). In contrast, Vrij (1995) has observed that the demanding effort involved in coping with the emotional arousal can reduce drastically the types of nonverbal signs such as arm, finger, head, trunk, foot, and leg movements. It can also cause a softening of the smile, of the tone of voice, and of the direction of the gaze as well as a drop in speech errors. He explains this as a consequence of the liar's stepped up control over his/her utterances. The ability to control oneself in the act of lying appears fundamental both at the cognitive level (the strategic planning of the manipulation of information) and at the emotional level (simulation and dissimulation of the emotional arousal). Such an ability allows the S, at an interpersonal level, to elaborate strategies whose choice and functionality will suit the different attitudes of the H (Buller & Burgoon, 1994; Buller, Burgoon, White, & Ebesu, 1994). In fact, it is one thing to lie to a compliant and passive hearer, and another to lie to an unmasker, a suspicious and inquiring hearer (Ciceri, 1995; Anolli & Balconi, in press).

The aim of this research is to inquire about the act of lying in different relational conditions, by analyzing the variations in the strategies and in the vocal leakage cues imparted by the liar. The choice to focus on vocal parameters is justified by three reasons: (a) the act of lying is eminently a vocal act; (b) it is through the voice that the able liar enacts the most effective strategies of manipulation (Buller et al., 1996) and the naive liar reveals the most blatant leakage cues (Ekman, Friesen, & Scherer, 1976); and (c) despite earlier research, this is a scientific domain that still requires much investigation.

A pioneer study in this field is that by Ekman et al. (1976). From an analysis of utterances, it was found that there is a significant rise and variability of the fundamental frequency of the voice when telling a lie as opposed to the truth. These are, in fact, vocal characteristics common to conditions of stress and fear (Zuckerman, DePaulo, & Rosenthal, 1981; Scherer, Feldstein, Bond, & Rosenthal, 1985; Scherer, Wallbott, Tolkmitt, & Bergman, 1985). The fact that in the liar's voice the F_0 rises has already been confirmed (see Streeter, Krauss, Geller, & Olson, 1977; Scherer, 1981; Ekman, 1985; Ekman, O'Sullivan, Friesen, & Scherer, 1991), and Ekman has even advanced a hypothesis whereby this variation in the tone of voice might depend upon the emotion of fear felt by the liar, or upon the state of tension connected to this experience. Along with this interpretation, Scherer et al. (1985) believe that the higher frequency and the increase in variability might also be caused by the heightened cognitive complexity involved in imparting a false utterance intended to convince the interlocutor.

In order to investigate the nonverbal vocal parameters in lie detection, Scherer et al. (1985) tested a series of deliberately true and false utterances with different techniques of masking (electronic filters, inversion of tone, tape played backwards, random cutting and re-editing). The intent was to isolate the various vocal parameters. These masked phrases were then examined by a representative sample of judges who had to decide about their level of honesty, along with other characteristics (pleasantness and clearness). The results revealed that the examiners deemed an utterance false especially when they perceived in it an alteration in the speaker's voice quality. These results underline the necessity to explore other vocal characteristics besides the level and variation of the fundamental frequency.

In our opinion, the data gathered from research carried out up until now has certain limits. Firstly, it would seem that by focusing only on single and isolated parameters of vocal aspects only a partial and restricted conclusion of this phenomenon under examination can be reached. Secondly, it would seem that up until now only the vocal cues that detect the "naive liar" have been described, while those vocal strategies making the "able liar" credible seem to have been neglected. Moreover, vocal research so far has ignored the influence that H's attitude may have on the liar's choice of strategies, on his/her control, on his/her emotions, and on the complex task of lying.

The main objective of this research is not to analyze single and isolated vocal parameters, but rather to analyze a configuration of vocal profiles pertaining to the act of lying. In this way both the informational aspects (verbal argument and structure) and the nonverbal vocal features (mean and variations of the F_o, energy, and time) of the false utterances can be considered. Being based on more parameters this analysis aims to describe both the communicative strategies of the able liar and the vocal cues of the naive liar according to the changing attitudes assumed by H.

More precisely, the hypotheses of the research are the following: (1) When H is compliant, (a) S is led to exert excessive control over his/her vocal production with a decreased level and variation of the F_o; and (b) S tends to use a greater number of words (an increased eloquency index). (2) When H is the unmasker, (a) S has to cope with emotional arousal, with a following increase in the F_o level; and (b) S tends to interrupt and repeat words more frequently (an increase in the disfluency index). (3) In telling lies there are liars who are able to control their vocal production (there are no differences when they tell the truth and lie; the so-called "good liars"), and liars unable to control their vocal production in the two conditions (differences appear in the F_o parameters; the so-called "bad liars").

Method

Procedure

The experiment consisted of four phases representing the four moments that mark the experience of telling a lie: the creation of the conditions motivating the lie, the elaboration of the strategies to communicate the lie, the actual telling of the lie, and the evaluation of this communicative act.

In the *first phase*, the experimenter's (E) collaborator (C) telephoned a number of fourth-year law students attending the State University of Milan inviting them to take part in an experiment in psychology of law and, more precisely, on the influence that oratory and rhetorical skills can have in changing the interlocutor's evaluation of perceptive images. The collaborator also pointed out that for the occasion an expert in psychology of law from the juvenile court would be coming and that the students would be expected to arrive punctually. He did not, however, give any information about the tasks and procedures of the experiment.

In the *second phase*, prior to the actual experiment, subject (S) was asked by C to describe a black and white picture of a man looking thoughtful and dressed in a suit (image-stimulus). The picture was intentionally ambiguous as regards hair color (brown vs. black) and age (young vs. middle-aged). The image-stimulus was, in fact, chosen following two criteria: its *neutral content* at an emotional level and its *ambiguity*. The ambiguous nature of the stimulus is, in fact, the condition that essentially permits subjects to falsify the contents of their utterances when both the speaker and interlocutor know about the fact, event, or object falsified (Bavelas et al., 1990). In fact, the intrinsic validity of the stimulus for these characteristics (moderate emotional value and ambiguity) was ascertained in a pre-test on a sample of 20 judges, who on a scale of 1–10 gave the stimulus an average mark of 9.24 for emotional value and 9.17 for ambiguity.

S was given the image-stimulus by C and was asked to describe, as spontaneously as possible, the man in the picture's hair color and age choosing between the alternatives (hair color brown vs. black, and young vs. middle-aged). C asked S if he/she was sure about his/her perception (reinforcement of his/her evaluation of the picture). Then every S, using six copies of the same image-stimulus, was asked to describe the picture six times to the experimenter (E); four out of the six describing his/her actual perception of the picture (in concordance with his/her naive perception; *true condition*) and twice describing another version of his/her perception

of the picture (in discordance with his/her spontaneous perception; *lie condition*). Never did C use the term "lie," nor did C tell S to lie to E. We did not follow the Ekman et al. (1976) paradigm which invites Ss to tell lies to other people. S's aim was to show his/her rhetorical and oratory ability by raising doubts and uncertainties in E's perception of the image-stimulus. In fact, the purported and apparent (to S) purpose of the experiment was to study S's ability to influence and modify E's perception of the stimulus provided, and consequently to analyze E's reactions to S's contradictory utterances. The rationale for this cover story was to induce in S the personal intention to tell lies to E.

During the explanation of the experiment, S was told to describe the age and hair color of the man in the picture using the phrases (*standard phrases*): "I can see a young man with black hair" or "I can see a middle-aged man with brown hair" in their four possible combinations. However, no information was given to S on the order in which he/she could choose to supply the utterances, nor was information given on lying strategies to use. Lastly, S was allowed 5 minutes to think out the most effective strategies to influence E and obtain his/her goal. During these five minutes every S decided and chose freely the order in which to alternate the four descriptions in concordance with the naive perception (*true condition*) and the two descriptions discordant with the naive perception (*lie condition*). C secretly told E S's choice before the actual interview.

In the *third phase* (the actual *experiment*) S and E sat at a desk facing each other, both in front of their own unidirectional standing microphone each connected to its own track of the open reel tape recorder (a four-track Akay 630 G dx). High speed tapes were used (Maxwell 19cm/sec). A camera was placed next to S and directed towards E, since the purported object of the experiment was to evaluate E's reactions. S was given by E six copies of the same picture one after the other, and each time he/she was invited to describe it. S followed the order he/she freely chose before. The first false assertion provoked no reaction in E: E's attitude to this was, in fact, indifferent and compliant, thus preserving a moderate emotional arousal in S. In effect, at this point of E and S's exchange there appeared to be no signs that might threaten S's sense of security and feeling credible. S was able to tell the lie as he/she had planned it in advance without any obstacle (*E without suspicion; prepared condition; Lie 1*).

In contrast, the second false statement did, however, cause E to doubt S's utterance suddenly and led to the questions: "Are you really sure? What can you actually see here?", inviting S to repeat and to justify the description. In this case E's inquiring, suspicious, and unmasking attitude—typical of one who wishes to test the reliability of an interlocutor's statement—

could provoke in S the threat of being detected as a liar and an intensification of his/her emotional arousal. Nevertheless S had to answer E's unexpected questions immediately without any mental planning (*E with suspicion; unprepared condition; Lie 2*).

In the *fourth phase* (*post experiment*), after the interview with E, S was asked to fill in a questionnaire in which, as well as evaluating his/her ability to influence E, S had to assess his/her degree of intention to lie, choosing from a scale of 0 to 5 (maximum). S also reported the order in which he/she freely alternated true and false statements.

Subjects

The original number of subjects was 35, all male, with an average age of 24.4 (fourth-year law students at the State University of Milan). However, only 31 of these 35 subjects really represent the sample upon which the results of the experiment are based. Four subjects were considered unusable because they declared that they had had no intention to lie during the experiment. Thus, since—as was underlined in the first part of this paper—the intention to lie constitutes the principal element of deception, the recordings of these subjects who had had no intention to lie could not be taken into account for the research.

Standard Phrase

As already mentioned, the standard phrases that C suggested S should use when describing the stimulus were the following: "I can see a young man with black hair" or "I can see a middle-aged man with brown hair" in the four possible combinations. The choice of employing standard phrases is motivated by the need to avoid, where possible, the introduction of segmental phonemic differences between the true and false expressions, allowing the acoustic analysis to be based solely on the varying parameters of the suprasegmental features. These short standard phrases have also the advantage of comprising a high number of vowels (a characteristic which provides an opportunity for extensive measurement of speech parameters in voiced segments) and a balanced number of consonants to articulate. Moreover, albeit short, these standard phrases are made up of two distinct segments (hair color and age), a fact that introduces an ulterior feature of examination into this analysis: the manner in which these segments are connected (presence/absence of filled or unfilled pauses; presence/absence of one of the two arguments). Finally, the use of a standard "official" phrase is a reliable way of testing S's introduction of verbal variations ("modified"

standard phrases) during the false statement. In fact, changes in the standard phrase are important verbal cues for the examination of the strategies involved in deception and these will be seen in detail later on.

Measuring the Vocal Variables

Nonverbal vocal variables. From among the six standard phrases recorded for each subject, three were extracted. These were (a) a *true utterance* (this "true statement" was chosen when it followed another true statement in order to assure greater distance from the false utterance and avoid influences from the effects connected with the false expression); (b) a false utterance, *Lie 1* (with a compliant interlocutor); and (c) a second false utterance, *Lie 2* (where the subject had to repeat his/her false utterance immediately after it had been questioned by E; *unprepared condition*). The phrases were then subjected to a digitized acoustic analysis using Kay Elemetrics Corps's Speech Lab Computer (SLC) 4000 with its up-grades MDVP and ASL.

With reference to the *dimension of time*, the following dependent variables were considered: (a) the *length* (of the entire standard phrase, of the spoken segments only and of the pauses), and (b) the *tempo* (taken as the rate of speech and the language speed) measured in milliseconds by the SLC. Where the phrase was inserted into a phonemic chain, the length of the phrase was calculated starting from the first phoneme to the last. Where, instead, the phrase was preceded and/or followed by a pause, this segment was also taken into consideration.

Since not all the phrases pronounced by the subjects were made up of the same number of syllables, another phonetic unit of measure was adopted together with the unit of measure in milliseconds: the *syllable.*

As to the *pauses,* following the criteria normally adopted in past literature, it was agreed that all silent periods lasting 0.1 seconds or longer—visible in the spectrum as absences of sound energy—should be taken into account. All types of filled pauses were also taken into consideration such as vocalizations, inspirations and expirations, tongue noises, laughs and giggles, and hiccoughs.

The *tempo* is the temporal regulation of the production and articulation of the phrase (fast/slow, interrupted by frequent/rare pauses). Thus, for each statement the rate of speech (the relationship between the number of syllables in the statement and its overall duration) and the rate of articulation (based on the length of the speech excluding filled and unfilled pauses) were calculated.

The *fundamental frequency* (F_o) was extracted using the spectral clip-

ping method and zero crossing analysis (with the appropriate parameters relative to the amplitude of segments and to the length of the windows). Once extracted, the mean, the range (F_0+ maximum–F_0− minimum), and the standard deviation (as a measure of the F_0 variability) were calculated. In order to check the reliability of these F_0 values, it was first necessary to work out the mean F_0 of each subject's voice in normal conditions in order to pinpoint the baseline values of reference. Moreover, to avoid systematic interference and shifts from this F_0 mean caused by fricative and sibilant consonants (areas of noise), the utterances were synthesized by the ASL voice synthesizer program which eliminates even one single F_0 value.

Amplitude or energy were measured in decibels. Once again, the mean, the range and the standard deviation were calculated.

Verbal vocal variables. The verbal structure of the standard phrases was also analyzed (van Dijk, 1985) and in particular the following microstructural indexes: (1) the *number of arguments* (1 = hair; 2 = age); (2) the *total number of words*; (3) the *eloquency index* (given by the ratio between number of words and number of arguments); and (4) the *disfluency index* (given by the sum of interrupted and repeated words).

Furthermore, the following variations of arguments in the standard phrase were also examined: (1) *the absence of variations* (when S's verbalizations of the standard phrases were identical to those indicated by C at the beginning of the experiment); (2) *the presence of modifications* (when verbs or adverbs were added to the standard phrase as, for instance, "surely young, quite young, a little younger, very young, etc."). According to their semantic function these modifications were then divided into: (a) *emphasizing modifications*, when they semantically strengthened the description (for example, "very young, definitely middle aged"); (b) *softening modifications*, when they semantically attenuated and weakened the description (for example, "quite young, perhaps a little younger"). (3) *The presence of semantic equivalents* (when the standard terms "young/middle aged" and "brown/black" were substituted for semantic equivalents such as "dark" instead of "black," "fair" instead of "brown," "elderly" instead of "middle aged," etc.). Here too, depending on their semantic function, the equivalents were separated into: (a) *emphasizing semantic equivalents*, when they semantically strengthened the description (for example, "elderly" for "middle aged," "fair" for "brown"); and (b) *softening semantic equivalents*, when these semantically attenuated the description (for example, "a little more mature" for "middle aged," "light streaks in his hair" for "brown"). (4) *The presence of argument replacements* (when one of the two arguments in the standard phrases—hair, age—was exchanged for an-

other *ambiguous or equivocal* term or expression, which was not classifiable as either true or false (for instance, if the truth was "black" hair, a subject might have lied using the term "grizzled" or might have said "a man full of energy" instead of "a young man").

Results

Analysis of Acoustic Differences

Repeated measures analysis of variance was used to analyze the data. Seventeen vocal indicators dealing with time (duration and tempo), fundamental frequency (F_o), and amplitude (energy) were considered as dependent variables and individually analyzed, as reported in Table 1.

TABLE 1

Mean Values for Acoustic Variables (*df* = 2,29)

	Mean value		
Variable	T	L1	L2
Energy (in db)	56.65	55.91	57.01
St. dev.of intensity	6.72	6.88	6.55
−Range of intensity	37.89	37.52	39.42
+Range of intensity	67.09	67.60	68.22
F_o (in hz)	118.97	116.26	128.47
St. dev. of F_o	14.17	14.10	18.67
$-F_o$ range	80.48	81.26	88.74
$+F_o$ range	157.65	153.90	172.35
Number of pauses (in sec)	1.97	2.94	1.81
Pauses length	3.08	4.78	2.18
Filled pauses length	1.09	0.97	0.77
Unfilled pauses length	1.99	3.81	1.41
Duration of speech	3.38	3.98	3.16
Duration of phrase	6.46	8.76	5.34
Number of syllables	20.13	24.00	19.40
Rate of speech	4.30	4.11	4.36
Rate of articulation	6.43	6.42	6.28

Note. St. dev. = standard deviation.

In particular, the results show that there was no statistically significant variation in the *energy* measures among the average values for the three levels of this experiment. In fact, the average energy level was about 56db for Truth (T), Lie 1 (L1), and Lie 2 (L2). On the other hand, as far as the F_0 is concerned, significant differences were recorded for all F_0 measures analyzed. In fact, significant differences were found for the F_0 mean ($F = 7.12$; $p < .003$), the standard deviation ($F = 3.56$; $p < 0.041$), the $-Fo$ range ($F = 4.20$; $p < .025$), and the $+$ Fo range ($F = 5.05$; $p < .013$). The values of L2 especially differed from those of T and L1, whose values, on the other hand, were quite similar.

Similarly for the variable of *time*, repeated measures analysis of variance revealed significant differences for the number of pauses ($F = 4.67$; $p < .012$) and the number of syllables ($F = 5.69$; $p < .01$): for both these variables an increase in the values of L1 as opposed to T and L2 was evident. On the contrary, mean pause duration (considering filled and unfilled pauses separately), mean phrases and speech duration, and mean rate of articulation and language speed showed no significant overall effect.

For a better picture of the results obtained, it was decided to further the analysis on the F_0, the number of pauses, and the number of syllables by carrying out a contrast analysis. In Table 2, for every F_0 measure considered, significant differences between T and L1, T and L2, L1 and L2 statements can be seen.

These differences seem to point in the same direction: in L2 there is a significant rise in the mean F_0 of the voice, a greater variability, and a shift towards sharper values in the range. In contrast, T and L1 are both quite homogenous in their values. Regarding the number of pauses and the number of syllables, there is, on the contrary, a rise in L1 compared with T and L2. Furthermore, since there does not seem to be a significant difference in the average duration of all the pauses at all the three levels of experiment, the results show that the pauses segmenting the L1 expression not only were more frequent, but also more brief.

Analysis of Microstructural Verbal Indexes

Having presented the overall results of the acoustic variables, the next step will be to lay out the results regarding the microstructural verbal indexes examined. Repeated measures analysis of variance showed that the principal effect of the number of arguments ($F = 3.53$; $p < .043$), the number of words ($F = 5.51$; $p < .009$), eloquency index ($F = 3.56$; $p < .041$), and disfluency index ($F = 4.57$; $p < .019$) was significant.

TABLE 2

Analysis of Variance of Contrast of F_o and Time Variables (*df* = 1,30)

	SS	error	MS	error	*F*	*p*
F_o mean						
T–L1	227.99	4710.7	227.99	157.02	1.45	n.s.
T–L2	2799.8	7280.6	2799.8	242.69	11.54	<.002
L1–L2	4625.8	10064	4625.8	335.46	13.79	<.001
$+F_o$ range						
T–L1	434.06	25476	434.06	849.20	0.51	n.s.
T–L2	6707.6	45120	6707.6	1504	4.46	<.043
L1–L2	10554	30456	10554	1015.2	10.40	<.003
$-F_o$ range						
T–L1	18.58	9821.4	18.58	327.38	0.06	n.s.
T–L2	2114.1	8481.9	2114.1	282.73	7.48	<.010
L1–L2	1736.3	10138	1736.3	337.92	5.14	<.031
St. dev.of F_o						
T–L1	0.16	2017.80	0.16	67.26	0.00	n.s.
T–L2	626.40	3256.3	626.40	108.54	5.77	<.023
L1–L2	646.43	2968.9	646.43	98.96	6.53	<.016
Number of pauses						
T–L1	29.03	150.97	29.03	5.03	5.77	<.023
T–L2	0.81	132.19	0.81	4.41	0.18	n.s.
L1–L2	39.52	135.48	39.52	4.52	8.75	<.006
Number of syllables						
T–L1	456.81	2708.2	456.81	90.27	5.06	<.032
T–L2	18.58	2161.4	18.58	72.05	0.26	n.s.
L1–L2	659.65	3017.4	659.65	100.58	0.56	<.015

As can be seen in Table 3, the contrast analysis shows that subjects in L2 tended to remember fewer arguments in comparison to T and L1. Moreover in the same L2 condition there is a significant increase in the disfluency index: here subjects produced a greater number of interrupted and

TABLE 3

Mean Values and Analysis of Variance of Contrast for Microstructural Indexes (*df* = 1,30)

	Mean value									
					SS	error	MS	error	*F*	*p*
Variable	T	L1	L2							
Number of arguments	1.97	1.9	1.65	T–L1	0.13	1.87	0.13	0.06	2.07	n.s.
				T–L2	3.22	8.77	3.22	0.29	11.03	<.002
				L1–L2	2.06	5.93	2.06	0.20	10.43	<.003
Number of words	10.1	12.3	9.87	T–L1	144.8	828.2	144.8	27.61	5.25	<.029
				T–L2	2.61	612.4	2.61	20.41	0.13	n.s.
				L1–L2	186.3	851.7	186.3	28.39	6.56	<.016
Eloquency index	5.24	6.65	5.95	T–L1	61.04	248.2	61.04	8.27	7.38	<.011
				T–L2	15.61	262.9	15.61	8.76	1.78	n.s.
				L1–L2	14.91	273.3	14.91	9.11	1.64	n.s.
Disfluency index	0.39	0.58	0.97	T–L1	1.16	32.84	1.16	1.09	1.06	n.s.
				T–L2	10.45	33.55	10.45	1.12	9.35	<.005
				L1–L2	4.64	51.35	4.64	1.71	2.71	n.s.

repeated words as opposed to the T statements, where this number was definitely lower. It is also worth noting that for both these variables there were no remarkable differences between T and L1, i.e., when S lied spontaneously following his/her strategies of verbal planning without E's inquiring questions.

However, in producing their utterances, subjects seemed to supply a significantly greater number of words in L1 as opposed to T and L2. As far as the eloquency index is concerned, subjects' statements in L1 compared with T only, manifesting a significantly stronger link between the total number of words and the arguments.

On the whole, therefore, these microstructural indexes seem to hold an interesting discriminating power that distinguishes the Truth from Lie 1 and from Lie 2. In fact, certain verbal phenomena (longer utterances and higher eloquency index level) appear more strictly linked to the L1 condition, while others (omission of arguments and higher fluency level) are related more to the L2 condition.

Analysis of Standard Phrase Variations

The last series of variables are the variations that subjects brought upon the "official" standard phrase. These variations are represented by emphasizing or softening "modifications" introduced into the standard phrase by semantic equivalents, or even by new verbalizations of the phrase.

In Table 4, which reports in percentages the values of the different kinds of variations, it is possible to see that the T utterances respect the

TABLE 4

Values in Percentages of Standard Phrase Variations

Variable	T	L1	L2
Standard phrase	73.77	45.00	44.44
Emphasizing modifications	13.11	8.34	11.12
Softening modifications	4.91	16.66	12.96
Emphasizing semantic equivalents	4.91	8.34	12.96
Softening semantic equivalents	3.30	16.66	11.12
Substitutions	0.00	5.00	7.40
Total	100%	100%	100%

Note. N = 31

standard phrase more and with greater regularity (73.77%) than L1 (45.00%) and L2 (44.44%) ones, where adherence to the official phrase, provided by C at the beginning of the experiment, is definitely less strict. The categorical data analysis of variance shows a significant principal effect of the experimental factor on the level of responses (chi-square = 24.01; $p < .001$).

This greater and more systematic variability of the standard phrase during deception is generally expressed by the subjects' inclination to attenuate the description of the arguments in L1 (33.33% summing the softening modifications and the softening semantic equivalents) rather than emphasize them (16.68% adding the emphasizing modifications and the emphasizing semantic equivalents). In fact, the categorical data analysis of variance shows that for the softening modifications (chi-square = 6.06; $p < .048$) and for the softening semantic equivalents (chi-square = 9.46; $p < .009$) alone, there is a significant difference in the level of the three responses linked to the three experimental conditions. The analysis of weighted least squares estimates points out that such differences regard the opposition between truth and lie (softening modification: chi-square = 4.91; $p < .026$; softening equivalent: chi-square = 8.15; $p < .004$), and between the two lies (softening modification: chi-square = 4.17; $p < .041$; softening equivalent: chi-square = 6.08; $p < .013$). This indicates that subjects were, therefore, inclined to stray from the standard phrase and enacted linguistic changes upon it during deception.

Furthermore, it must be noted that abstaining from telling the truth or from telling a lie using ambiguous and equivocal locutions, which are not pertinent to the stimuli to be described and which are neither true nor false, emerged only in L1 and L2 conditions. And yet, when subjects told the truth they kept to the standard phrases much more (73.77%) and, whenever they modified them, they tended to emphasize their arguments (18.02%) rather than attenuate them (8.21%). For the false statements this tendency was reversed.

Analysis of the Different Communicative Styles of Deception

In order to ascertain the quality of the different communicative styles involved in deception, further analysis was carried out on the differences in F_0 variation among subjects. Thus a systematic *subject by subject* comparison of the differences in the values obtained from subjects in the various acoustic parameters of the three experimental conditions was performed. This was done by using the F_0 *baseline values* just as Ekman et al. (1991) had done earlier. It consisted of considering the true expression as the standpoint from which the subsequent distances of the false statements

were measured. This verified for each subject the size and direction of the false statements from the baseline true statement and annulled the average leveled out differences.

The *baseline values* were established taking into consideration two criteria: (1) the differences between the mean F_0 values for true and false, resulting significant in the statistical analysis (mentioned above); (2) the values supplied by the acoustic analysis, as a scale of measures for the differential thresholds of sound perception (Ferrero, 1986; Fry, 1986). Hence, the baseline values were: −10 Hz for mean F_0 variations; −20 Hz for F_0 maximum and F_0 minimum and F_0 range; and −5 Hz for the standard deviation as a measure of F_0 variability. Furthermore, differences in voice performance were calculated between T and L1 utterances and between T and L2 utterances. Table 5 shows the typological classification of subjects according to the differences obtained from the comparison between the mean values of T and L1 and the comparison between the mean values of T and L2.

In considering the size and direction (positive versus negative) of these differences, *three classes* of voice performance have been defined: Subjects who did not manifest differences in the mean F_0 values between true and false statements, subjects who in the L1 condition manifested an increase in differences, and subjects who manifested a decrease in differences. The Stuart-Maxwell test (Maxwell, 1961) shows a significant difference in the

TABLE 5

Typological Classification of Subjects According to Good Liars

Variable	Mean	St. dev.	% Subjects
	Good Liars		
T–L1	0.65	−1.18	64.05%
T–L2	1.31	0.28	43.38%
	Bad Tense Liars		
T–L1	23.83	12.43	9.70%
T–L2	24.49	15.11	41.94%
	Bad Overcontrolled Liars		
T–L1	−17.82	−9.05	25.80%
T–L2	−14.13	−9.42	9.68%

Note. $N = 31$; Stuart - Maxwell test d.f. 2; Chi-squared = 9,84; $p < 0.001$. St. dev. = standard deviation.

way these groups were distributed according to the experimental conditions examined ($df = 2$; chi-square = 9.84; $p < .01$).

More specifically, there is the class of differences whose values are below the baseline level in both comparisons—between T and L1 and between T and L2—for the F_0 variables considered. In fact, the average differences among the mean F_0 in both comparisons is much lower than 10 Hz (precisely 0.65 Hz in the T and L1 comparison and 1.31 Hz in the T and L2 comparison). Similarly the average differences among the standard deviations in both comparisons are inferior to the fixed baseline value of 5 Hz (−1.18 between T and L1; 0.28 Hz between T and L2). The voice performances that fit into this class[1], had similar traits in all three experimental conditions. Subjects, in fact, had the same voice while telling the truth and while lying to the compliant hearer (H) (Lie 1), and the inquiring H (Lie 2). These were particularly able subjects defined as *good liars* whose variations in tone of voice did not disclose distinctions between false and true statements. Moreover, from Table 5 it can be discerned that, as expected, the "good liars" appear more numerous in the comparison between T and L1 (64.05%) than in the comparison between T and L2 (43.38%).

The second class includes the differences that have positive above-baseline values. In effect, the average differences in the comparison between T and L1 and between T and L2 greatly surpass the baseline values indicated both for the F_0 mean (+23.83 Hz between T and L1; +24.49 Hz between T and L2) and for the F_0 variance (+12.43 Hz in the standard deviation between T and L1; +15.11 Hz in the standard deviation between T and L2). Subjects belonging to this category have thus been defined as *bad tense liars*. Owing to the greater activation and tension of their vocal chords, in fact, these subjects' voices became an important and clear cue that revealed their intention to lie. These subjects, however, were "naive" because when lying they could control and regulate their emotions and mental plans. It is also worth pointing out that within this category the "bad tense liars" are more numerous in the L2 condition (41.94%) than in the L1 (9.70%). Evidently the H's inquiring attitude makes it harder for the speaker to control his/her voice during deception. This therefore explains why his/her voice becomes sharper and more modulated. Alternatively, in the condition of L1, where the H appears compliant, the subject less easily becomes tense and thus has the opportunity to deceive following his/her pre-established strategies.

Lastly, the third class contains the subjects that have negative above-baseline values. In fact, the average differences between T and L1 and between T and L2 surpass the fixed baseline values both for the F_0 mean

(−17.82 between T and L1; −14.13 between T and L2) and for the F_o variance (−9.05 in the standard deviation between T and L1; −9.42 in the standard deviation between T and L2). Subjects pertaining to this class have been defined as *bad overcontrolled liars,* because the decrease in the F_o level and the fewer F_o variations indicate an excessive voice control by subjects when telling lies. This statement is also supported by the different way in which subjects are distributed within this category. In fact, the highest percentage of these *bad overcontrolled liars* belongs to L1 (25.80%) where the H is acquiescent and where subjects become overcontrolled because they can lie following their pre-established strategy. This percentage, nonetheless, is far lower in L2 (9.68%) where the inquiring H makes voice control a more difficult task. The results, in fact, show that only three subjects have an overcontrolled voice in the condition of L2.

In sum, this *subject by subject* analysis of the differences regarding F_o indexes in the three experimental conditions permits the separation of the "good liars" (32% of subjects who from truth to falsehood do not manifest variation differences in mean F_o values) from the "bad liars" (who from truth to falsehood do manifest differences in the F_o values). Furthermore, this analysis distinguishes among the "bad liars" two different communicative styles of deception: for the tense liar a higher tone of voice which has more variations; for the overcontrolled liar an average deeper tone of voice, strictly controlled, and without variations. The frequency of these two different communicative styles depends on the nature of the false condition. In the L2 condition, when lying is more difficult, the voice more frequently becomes tenser, whereas in the L1 condition, when subjects lie to a compliant H, the voice is more controlled than usual.

Discussion

The results confirm the validity and heuristic value of the *intention hierarchy model* of telling lies explained in the introduction, and show how lying involves various and diverse psychic functions ranging from the cognitive and emotional through to the social and relational. Firstly, telling a lie requires considerable *cognitive complexity* seeing that falsifying information (or concealing it) necessitates careful mental planning. The complexity of the cognitive task lies in the discrepancy between private knowledge and public statement: the liar (L) *knows the truth* (which he/she does not tell), but publicly *tells a lie* (which he/she does not believe, but has to make the H think that he/she does believe it).

The cognitive conflict between the knowledge of truth and the en-

coded message denying (or concealing) it, as well as the need "to disguise" one's true beliefs, imply a saturation of the L's mental capacities making the task of deception all the more complex. This complexity, in fact, came to light in the research through the results of the experiment in the L1 condition especially. These showed a rise in the number of shorter and more recurrent pauses which, as prior studies have already demonstrated, signal a rather strenuous cognitive task which involves the subject's mental management of various alternatives (Schachter, Christenfeld, Ravina, & Bilous, 1991).

Research carried out by Goldman-Eisler (1968) and Rochester (1973) have also revealed that frequent interruptions in the utterance by filled or unfilled pauses are the sign of a complex task during which the subject is continually having to make choices in order to finish his/her phrase: the temporary interruption provides the subject with the time necessary to select the right words. In the same way studies by Berger and Jordan (1992) on the relationship between planning difficulties and verbal fluency highlight a noteworthy correlation between the number of pauses and the level of difficulty in generating a plan that will fulfill one's aim, like telling a lie. More pauses are recorded when the planning needed to win one's objective is more demanding and difficult (for example, the planning may require the ability to multiply the points of view to consider such as in persuasion and in deception) and when the objective is neither habitual nor familiar.

The cognitive complexity involved during deception is also confirmed by the subjects' longer and more eloquent utterances in the L1 condition especially, where compared with the L2 condition, the subjects' emotional involvement is moderate and allows for greater concentration and mental planning of the lie. The higher eloquency index highlights, in fact, the L's linguistic effort in trying to produce persuasive and credible statements. As studies have already demonstrated (Zuckerman et al., 1981; Zuckerman & Driver, 1985; Buller & Burgoon, 1994), the L does not succinctly state what is false for fear that he/she might be found out, but rather "artfully" states it so that it is credible.

Furthermore, the L's cognitive complexity consists in choosing his/her own *communicative strategies* which not only allow him/her to be understood and appear truthful, but also make him/her seem credible and trustworthy during deception. In fact, the L "must" appear natural and spontaneous just as if he/she were telling the truth, because only in this way can the false message appear true and be accepted as such by the H. In other words, only by following these criteria has the L a good chance of "convincing" the H.

After all, the lie (its moral lawfulness aside), just like other forms of persuasion, constitutes a recurrent "strategic" means of communication used to persuade and influence others in order to obtain from them goods and services. It is also a useful tool for handling positive social relations (Ekman, 1985; Buller & Burgoon, 1994). It is a strategic communicative act because it is intentional, deliberate, normally motivated, enacted according to a codified plan, and directed towards achieving a certain result.

In order to realize this strategic communicative act and in the effort to appear natural and credible, the L has to exercise *voluntary control*—both verbal and nonverbal—on the sequence of his/her actions when telling a lie. However, this *control*, if not well administered, takes on a rigid and excessive form which reasonably surpasses the limits and standards of the truthful communication, thus *transforming itself into overcontrol*, as can be seen from the results of the experiment in the L1 condition. Here, much more than in the L2 condition, the voice of subjects described as "overcontrolled liars" becomes flat and assumes a deeper tone which has an undesired effect of becoming a leakage cue potentially revealing their intention to lie. In effect, according to some scholars, it is not the posture, the emblems, or the facial expressions but the voice with its variations that represents the channel mostly supplying leakage cues (Buller & Aune, 1987; Buller & Burgoon, 1994; Ekman & Friesen, 1969; Zuckerman & Driver, 1985).

And yet further important and significant emotional processes are involved in the communicative act of deception. In fact, to lie is to transgress from cultural standards in force. The lie also shows a lack of respect and care for the receiver. It produces anxiety in the L either because it comes to be associated with negative and unpleasant past experiences in similar situations (*the theory of the conditioned answer*), or because it is the result of opposing and conflicting inclinations between telling the truth and lying (*the conflict theory*), or lastly, because there is an anticipation of the punishment should the lie be detected (*the punishment theory*) (Zuckerman et al., 1981). Whatever the most plausible explanation, there is no doubt that in many cases the lie solicits *emotional arousal* in the L.

In this research such emotional arousal appears particularly marked and evident in the L2 condition, when the H has an inquiring air. Generally speaking, emotional arousal and tension in subjects produces a higher F_o, an increase in F_o variability, an extended F_o range as well as the presence of short pauses: all of which might denote *fear* in the vocal expression (Williams & Stevens, 1972; Van Bezooijen, 1984; Anolli & Ciceri, 1992). More precisely, in L2 the rate of speech becomes frequently interrupted by short pauses that correspond to an altered respiration rate. In the same

conditions the disfluency index becomes higher (because there is a greater number of interrupted and repeated words) and subjects tend more frequently "to forget" one of the arguments to mention.

These conditions of emotional arousal, typical of various forms of anxiety and stress, fostered by the H's suspicious nature, are probably stirred by the risk of "losing face" (Goffman, 1959). In fact, in our culture the detection of a lie intrinsically implies a threat to one's image. This is the reason why, then, this potential attack at one's own self-esteem converts itself into the self-conscious (or moral) emotions such as *guilt, shame,* and *embarrassment.* Nevertheless, whereas shame and embarrassment are elicited by the risk of being directly ridiculed or disapproved of by the H when detected by an external judge, the feeling of guilt—owing to the awareness that one is deceiving another—is not elicited by detection, but rather may even spur a spontaneous "confession" that liberates the L from his/her "internal judge" (Ekman & Frank, 1993).

Apart from their cognitive and emotional traits, lies also have strong *social connotations.* They are intrinsically interpersonal: if one hides, it naturally means there is *someone* to hide from. Telling lies is a way of influencing someone else and a way of handling a relationship. Hence, a lie, like all communicative acts, is a *relational game between two subjects*: at one end one finds the speaker playing the role of the more or less able liar; at the other end the other person in the role of the victim or detector. Consequently, the lie's *success* depends on the interaction between the L's communicative ability and the H's acquiescent and passive attitude; alternatively, its *failure* is determined by the opposite interaction (the L's inability to deceive and the H's ability to detect him/her). This game so characteristic of the lie has come out clearly in this research. In the L1 condition, with the compliant H, there are greater chances that the lie will succeed. In fact, it is in the comparison between L1 and T, more than in the comparison between L2 and T, that the subjects' voice performance remains unchanged. On the contrary, when the H takes up the active inquiring role (the L2 condition) the chances that the lie will not succeed increase, as the L's leakage cues become more numerous and more frequent. In fact, in the L2 condition there is heightened emotional arousal that causes changes in the subjects' normal voice pattern with the appearance of vocal features that recall fear and anxiety.

In this game between two subjects, the distinction between a *prepared lie* and an *unprepared lie* should be clarified. The prepared lie, which is more explicitly revealed in the L1 condition, produces in subjects greater cognitive efficiency and less emotional arousal. This allows subjects to plan and carry out precise communicative strategies for the lie they intend

to tell, with the result that their voice performance is the same in both T and L1 statements. These strategies, in effect, include the ability to make the true/false border hazy by using ambiguous expressions such as vague, evasive, or obscure utterances or by behaving in a reticent way which may include avoiding the H's gaze or being aloof, etc. (Bavelas et al., 1990; Buller & Burgoon, 1994; Ebesu & Miller, 1994).

The unprepared lie, instead, more frequently told in the L2 condition where the L is disorientated by the unexpected and suspicious reaction of the H, produces in the liar more emotional arousal and less cognitive efficiency. As a result, more leakage cues appear. These take the form of variations in the vocal production between true and false statements, utterances that do not respect structural patterns, a repetition of words, linguistic errors, interruption of words, etc., as other research has also shown (DePaulo et al., 1985; Zuckerman & Driver, 1985).

Lastly it is worth examining a few of the psychological aspects that regard the so-called *good liars*, i.e., those subjects whose voice performance remains unchanged in T, L1, and L2; those subjects who, at least where the voice is concerned, show efficient control, do not give away any sign that might reveal their lies and preserve "naturalness" and spontaneity. An initial explanation for this particular talent in telling lies rests in their personalities. They are *extroverts*, dominant people who are used to social interaction (Riggio & Friedman, 1983; Riggio, Tucker, & Throckmorton, 1987). In other words, they are good actors and excellent directors of themselves. A second explanation may be reached by attributing these good liars what is called a *Machiavellian personality* (O'Hair et al., 1981). Ebesu and Miller (1994), in fact, describe one particular genre of lie that is characterized by the importance placed on the objective to be gained rather than the means used to win it. The Machiavellian liars possess remarkable ability in controlling and keeping emotions at bay, which permits them to distance themselves from their interlocutor and from the side-effects of the deceit. To them the lie is a strategic tool for achieving their aims in certain situations.

And yet, there may also be a functionalistic explanation for this particular skill. The L's ability is made more effective by a process of *self-deception*, whereby the subject convinces him/herself that truth and lie are the same thing. In other words, the subject modifies in a practical manner his/her "true" beliefs in order that they might coincide with the "false" ones. This is an operation that transforms one's way of interpreting and describing reality. Thus, by manipulating information this self-deception leads to a correlation between the interior and the exterior, between private belief and public communication. This behavior that witnesses the subject's be-

coming a victim of his own lie can be explained by the subject's need to preserve a high self-esteem when he/she can no longer bear the thought of being a liar, or when the truth is less acceptable than the lie (Longo & Ashmore, 1995). Therefore, lying to oneself helps one to lie to others because it makes the L more able and his communication more credible.

This self-deception can be sustained by means of various strategies that interpret reality. For instance, the selective attention that filters only the information that confirms the deceptive vision of things; the search of a logical conclusion to one's beliefs by finding confirmations that support them; the *self-serving bias* that attributes success to the liar, while failure is put down to chance and bad luck (Baumeister, 1993). The ambiguous and hazy reading of an event being falsified may also function as a strategy that leads to self-deception, seeing that the condition necessary for self-deception and deception in general is a lack of objectivity regarding any experience.

Baumeister (1993) describes the condition that permits the falsification of facts with the effective metaphor *shades of gray*. In normal every day situations an event cannot simply be described as true or false, black or white, but rather as different shades of gray, nearer or farther from the two extremes. Thus, the able liars gradually come to believe in the lie, by re-evaluating the event they are lying about with the search and selection of proofs that confirm the lie. They therefore do not stop at convincing the H that they are being truthful, but they convince themselves of it too by exerting upon themselves the *force de conviction* (the force of conviction) (Boudon, 1990).

In conclusion, the lie's complexity and the degree of differentiation in the way it is vocally expressed confirm its importance in human interaction and its being an indispensable instrument for a balanced handling of social relationships. In fact, despite the fact that lies are banned from social relationships because of the importance that these place on honesty and naturalness, the lie—as this research has paradoxically revealed—formally and concordantly enters into social relationships as a regulating and controlling factor in daily interaction, and as an instrument that safeguards and builds one's self-esteem.

Note

1. The presence of values belonging to several F_0 variables as well as the presence of specific variables have been considered elements worthy of discriminating subjects' position in one class or another. The positive difference in the F_0 minimum or F_0 maximum values or in values along the F_0 range have not been considered important enough to discriminate

access to one class as opposed to another. What has been regarded as a discriminating factor, though, is a rise or a fall in the mean F_o or its standard deviation. In fact, it must be noted that minimum and maximum values can indicate only one increase or decrease in the F_o range values, whereas the mean and deviation standard constitute variation in tone values that are much more consistent.

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