



Motion patterns in political speech and their influence on personality ratings

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ABSTRACT

When people form impressions about others, they are mostly influenced by non-verbal cues. Thus, politicians and other leaders are judged by the behavior they display. To analyze the relation between non-verbal behavior and impression formation body movements of politicians giving a speech were transformed into animated stick figures. Subjects then rated the stick-figure movies on the five factor model of personality. Motion analysis revealed that observers associate extraversion, agreeableness, conscientiousness, emotional stability and openness with different motion qualities such as the amount of motion and its flow. Additionally, we found significant correlations between these personality traits and dominant activation of different body parts. The current study underlines that body motion is a powerful signal in human communication.

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1. Motion patterns in political speech

People judge others by their appearance. Especially in situations in which contradictory information from different communication channels is presented our impressions are mainly influenced by non-verbal cues (Mehrabian, 1972). Moreover, observers are able to use “thin slices” of behavior to make quick and accurate judgments of other people's personality (Albright, Kenny, & Malloy, 1988; Ambady & Rosenthal, 1992; Borkenau, Mauer, Riemann, Spinath, & Angleitner, 2004). Given the important role of non-verbal cues in human communication it is clear that politicians and other leaders need rhetorical skills comprising verbal and non-verbal elements. Prominent leadership theorists agree that articulating a vision is central to charismatic leadership, but it is also necessary to communicate a vision successfully (Bass & Avolio, 1990; Conger, 1991). Some researchers suggest that leaders and followers construct the leader's charismatic image through impression management and impression formation processes (Gardner & Avolio, 1998). To examine how these processes affect the perception of leader charisma non-verbal cues and speech content were systematically manipulated in several experiments by having actors perform different communication styles. Observers regard expressive behavior, which is communicated by non-verbal cues such as body gestures, word fluency and eye contact, as more charismatic than behavior that lacks these qualities. Speech content seems less

influential (Awamleh & Gardner, 1999; Gardner, 2003; Holladay & Coombs, 1993, 1994).

Charismatic performances also convey affective information. Speakers with an expressive non-verbal style that is associated with charismatic leadership can evoke relatively strong and positively toned expressions of emotion in an audience (Cherulnik, Donley, Wiewel, & Miller, 2001). Similar findings were provided by Kempter (1993), whose analyses revealed that video clips of politicians can elicit strong physiological responses (i.e. changes in the skin conductance) in observers. Surprisingly, these electrodermal reactions were partly independent from the personal attitude towards the observed person. In a follow-up study Kempter (1998) extended his experimental setting by transferring the body movements of politicians onto computer-animated dummies. When he compared personality ratings of the original movies with that of their computer-animated counterparts he found only insignificant differences. Thus, there are great individual differences in the public performances of politicians and some seem to have a strong impact on the emotional state of their audience. Moreover, it is very likely that emotionally charged signals, which influence charisma and personality ratings, are communicated by body motion.

Indeed, people are very adept at using motion cues as a source of information. In 1973 Johansson attached point lights to persons' major joints and filmed them moving in front of a dark background. Although only the moving dots could be seen in the resulting movies, people were still able to recognize a human body in motion. In contrast, when presented with single frames of the movies, participants only perceived random distributions of dots. Since then it has been demonstrated that such point light displays do not only enable observers to recognize a human body, but also contain information about the age, the gender and the emotional

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state of a person (Blake & Shiffrar, 2007; Dittrich, Troscianko, Lea, & Morgan, 1996; Kozlowski & Cutting, 1977; Montepare & McArthur-Zebrowitz, 1988; Pollick, Patterson, Bruderlin, & Sanford, 2001; Troje, 2002).

An alternative method for the analysis of body motion was developed by Grammer, Filova, and Fieder (1997), Grammer, Honda, Juette, and Schmitt (1999). They divided movies into single pictures (i.e. frames) and converted the color information of the pixels into gray-scale values. Changes in these values, which are determined by subtracting successive frames, correspond to the amount of movement that occurs. This method, which the authors call motion energy detection, was applied to analyze dance movements. Women, who display expressive behavior with the upper half of their body, were regarded as more attractive, whereas men's attractiveness was rated higher when showing expressive movements with the lower half of their body. In a follow-up study Bechinie and Grammer (2003) asked students to assess themselves on the five factor model of personality after having danced in front of a video camera. To classify different patterns of body motion an artificial neural network (SNNS) was applied. The dancer's self descriptions served as learning output for the neural network and the input layer was fed with data derived by motion energy detection. The different movement patterns provided sufficient information for the network to recognize extraversion and agreeableness in 55% of all cases, and emotional stability and conscientiousness in 80% of all cases. Based on these findings, Oberzaucher and Grammer (2008) developed a multi level communication model in which they emphasize that it is not only important which signal is presented (e.g. certain gestures) but also how it is executed. The speed, the duration and the flow of a single movement can change its meaning.

In the present study we linked research investigating the influence of non-verbal signals with the methodical approaches on the analysis of body movements. Our main interest was to overcome the limitations that might arise from using actors as social stimuli by providing evidence that short video sequences displaying politicians making a public speech contain enough variance to extract different aspects of motion behavior. Furthermore, we wanted to find out if observers use the extracted motion qualities to judge the personality of the speakers. To diminish the influence of confounding variables we encoded the behavior of the politicians by transferring their body movements onto animated figures with very simple features. Although the methods applied are novel and on an exploratory stage, we consider them as promising means to identify meaningful signals within the behavioral stream.

2. Method

2.1. Participants

One hundred and fifty persons (75 female and 75 male) participated in a rating-experiment. Most of them were students at the faculty of life sciences at the University of Vienna. The age of the participants ranged from 18 to 60 years ($M = 23.02$; $SD = 4.77$).

2.2. Materials

The homepage of the German Houses of Parliament contains speeches stored as video files. All movies present the speakers in a front view. This facilitates behavior encoding and guarantees the comparability of the displays. Following a chronological order 40 speeches (20 female and 20 male speakers) of a parliamentary session (08.03.2007) were selected. To achieve gender equality concerning the number of speeches deviations from this order were sometimes necessary. Sequences of 16 s were selected ran-

domly. For behavior encoding the first author developed a computer program that enables a user to run through a movie stepwise. Starting at the first picture (i.e. frame) of the selected sequences, landmarks were positioned on different spots of a speaker's body using the computer mouse. Dots were placed onto the forehead, the hollow of the throat between the collar bones, the ears, the shoulders, the elbows, the hands, onto the corners of the lectern, and onto a spot in the middle of the body near the navel (i.e. center of gravity). By rearranging the landmarks according to the position shifts that the upper half of a body carries out between single frames the behavior of the speakers was recorded and stored in time series of two dimensional coordinates. To reduce the workload only every third frame was encoded and the missing frames filled up by linear interpolation (159 frames per clip). Using these data we created stick-figure movies, which served as an abstract model of the politicians' motion behavior (see Fig. 1 and *Stick Figure Movie*). We chose the stick figure approach, because Troje and Westhoff (2006) showed that observers do not recognize point light displays of a human body accurately when the point lights for the legs are missing.

For the rating experiment the first author developed a computer program that selects a subset from the available stick-figure movies and presents them in random order on a computer screen. The questionnaire consisted of 20 items and was a brief German version of the NEO-FFI (Borkenau & Ostendorf, 1991). The items, which were based on a 7 point Lickert scale, were displayed to the left of the movie window. We inserted a slider control between the pairs of adjectives. Using the mouse cursor the participants could drag a bar to the right or the left side. The position of the bar corresponded to the different levels of the Lickert scale.

2.3. Analysis

The encoding procedure translated the speaker's body movements into arrays of coordinates. To extract single movement units, we calculated distances between different coordinates of the above mentioned landmarks (see Fig. 1). We determined vertical arm movements (y -coordinates of lectern landmark – y -coordinates of right or left hand landmark), horizontal arm movements (x -coordinate left shoulder – x -coordinate left hand; x -coordinate right shoulder – x -coordinate right hand), shoulder turn (x -coordinate right shoulder – x -coordinate left shoulder), vertical movements of the body (y -coordinate throat – y -coordinate

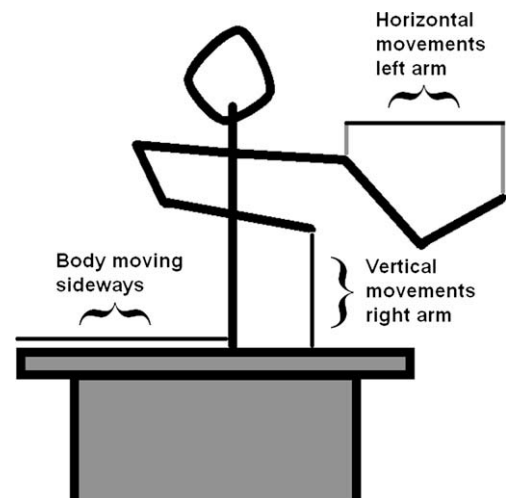


Fig. 1. Distances between coordinates provide movement units. Figure gives three examples.

center of gravity), swaying of the body (x-coordinate center of gravity – x-coordinate throat), the body moving sideways (x-coordinate center of gravity – x-coordinate left lectern landmark), turning of the head (x-coordinate right ear – x-coordinate left ear), vertical head movements (y-coordinate forehead – y-coordinate chin), and head tilts (y-coordinate right ear – y-coordinate left ear). Thus, the motion behavior of each speaker was divided into eleven movement units, each represented as a time series of changing distances. To remove static information from these data (e.g. holding an arm high without moving it yields a large distance between hand and lectern), we determined the local maxima and the local minima of every movement unit and extracted the oscillation heights that are produced by successive local extremes (see Fig. 2). The direction of a single movement (e.g. arm moving up or down) was neglected in the analysis.

There were two approaches to examine the speakers' motion behavior. First, we created new analysis tools to detect certain patterns in the behavioral stream. These computations led to different units of measurement, which will be described step by step below. Second, we fed the movement units into a principal component analysis to uncover functional relations, which helped to assign data to several movement categories.

2.3.1. Number of turning points

The movements of the stick-figures can be depicted as a graph with local minima and local maxima. By counting the minima and maxima of all movement units we created a simple and size independent method to assess how much activity occurs during the speeches (see Fig. 2).

2.3.2. Turbulence coefficient

This method is used in fluid dynamics to measure speed fluctuations of a current (Schade & Kunz, 2007). Here it determines fluctuations in the behavioral stream. For instance, if the amplitudes of a movement unit resemble a sinus curve or another regular pattern the turbulence coefficient will be low. The opposite is true for a time series with a great deal of different amplitude heights. Consequently, speakers reach a high turbulence coefficient if they display an irregular pattern of phases with low and high activity (see Fig. 3).

$$SoOH = \sum_{m=1}^z \text{Oscillation height}_m \quad (1)$$

$$\text{Turbulence coefficient} = \frac{\sqrt{\frac{1}{n-1} \sum_{i=1}^n (SoOH_i - \bar{SoOH})^2}}{\frac{1}{n} \sum_{i=1}^n SoOH_i} \quad (2)$$

$SoOH$ sums up the oscillation heights of all movement units at a given point in time with z being the number of movement units and

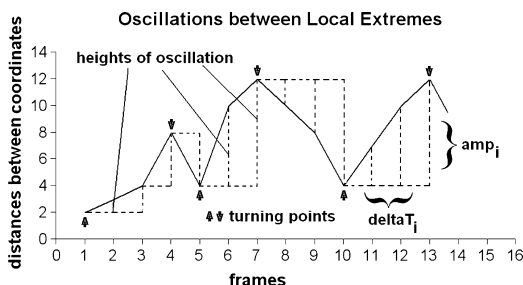


Fig. 2. Local maxima and local minima provide the number of turning points. Oscillation heights (dashed lines) represent the amount of motion that occurs between successive turning points. δT_i is the period of time between two local extremes. Amp_i is the amplitude between two local extremes.

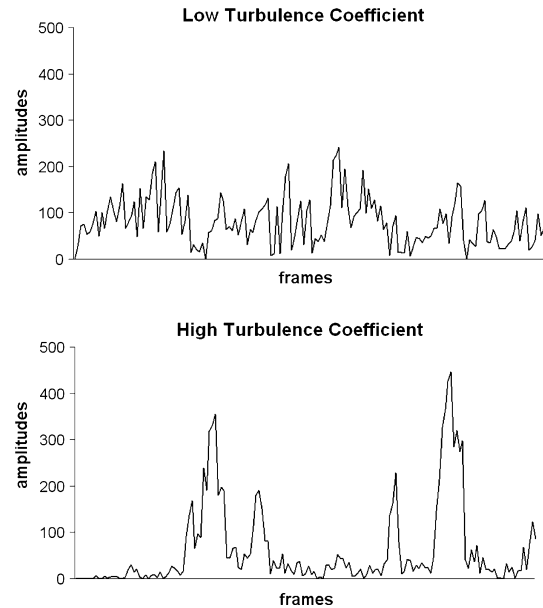


Fig. 3. Graphs are based on movement behavior of two speakers. Fewer fluctuations in amplitude height result in a low turbulence coefficient (see upper graph). Pronounced fluctuations yield a high turbulence coefficient (see lower graph).

m being the index. The length of a sequence is expressed as the number of frames and the index n .

2.3.3. Shifts in maximum activity

Some speakers prefer to use their arms for non-verbal statements, others use different body parts to present themselves. There are individual differences concerning the number of movement units that show maximum activation during a speech. To estimate the variety in dominant activation we determined the maximum oscillation height of every encoded frame and counted how often this maximum shifts from one movement unit to another.

2.3.4. Expressiveness

This method estimates how fast the speakers reach a peak of activity relative to their overall activity (see Fig. 2). To remove the influence of body height we rescaled data to values ranging from 0 to 1 first (i.e. normalization).

$$\text{NormAmp}_i = \frac{\text{Amp}_i - \text{Min}}{\text{Max} - \text{Min}} \quad (3)$$

$$\text{Expressiveness} = \sum_i^n \frac{\text{NormAmp}_i}{\delta T_i} \quad (4)$$

NormAmp_i is a data point that has been normalized. Max and Min are the maximum and minimum values of a sequence. NormAmp_i is the amplitude between a local minimum and a local maximum. δT_i is the time elapsed between a local minimum and a local maximum.

2.3.5. Angle of directions

Corresponding landmark coordinates were used to determine direction vectors (e.g. direction vector between landmark at time t and time $t+1$, at time $t+1$ and $t+2$, etc.). To obtain the main direction between successive frames we summed up the vectors of all landmark-coordinates for every point in time. Then we calculated the angles between successive direction vectors for the length of all sequences. Persons with pronounced changes in the direction of their body movements tend to produce a higher aver-

age angle, whereas persons with smooth and round movements tend to produce a smaller average angle.

$$\vec{Vec}_k = \begin{pmatrix} x_{t+1} \\ y_{t+1} \end{pmatrix} - \begin{pmatrix} x_t \\ y_t \end{pmatrix} \quad (5)$$

$$\text{Angle of directions} = \text{mean of} \left(\cos \varphi_m = \frac{\text{So}\vec{Vec}_i * \text{So}\vec{Vec}_{i+1}}{|\text{So}\vec{Vec}_i| * |\text{So}\vec{Vec}_{i+1}|} \right) \quad (6)$$

$\vec{Vec}_k$ is a direction vector of two successive frames (t and $t + 1$). $\text{So}\vec{Vec}$ denotes the sum of all direction vectors at a given point in time. Successive direction vectors (i and $i + 1$) yield an angle. The mean of all angles (all $\cos \varphi_m$) estimates how pronounced changes of motion direction are.

2.4. Procedure

Potential participants were asked if they wanted to take part in a short rating experiment. They were told that they would have to judge the personality of stick-figure movies, which are based on real life performances of persons giving a speech. The participants were brought into a room with several computers and received instructions on how to use the rating program. Every participant had to rate eight different stick-figure movies that were randomly selected among the 40 movies available. By moving the bar of the slider control to the adjective that appeared to be appropriate, the participants made their judgments on the presented stimuli. After the last movie, the program opened a window that thanked the participants for their help. Afterwards the participants were informed about the background of the study. The participants took about 15 min to finish the task and did not receive any financial reward.

3. Results

Each stick figure movie was rated by about 30 persons. These ratings were averaged for each personality factor. Statistical analysis revealed a wide range of relations between the personality ratings and the measuring units described in the methods section. The results are displayed in Table 1. Agreeableness showed a significant positive correlation with the *turbulence coefficient* ($r = .42$, $t = 2.82$) and significant negative correlation with the *number of turning points* ($r = -.38$, $t = 2.50$). This means that stick figures that tend to produce a small amount of body motion accompanied by great fluctuations in activity were regarded as more agreeable by the raters. Quite the opposite was true for stick figures that were perceived as extraverts. They displayed a high activity indicated by a high *number of turning points* ($r = .72$, $t = 6.43$) and a small amount of fluctuations in amplitude height indicated by a low *turbulence coefficient* ($r = -.46$, $t = 3.21$). There was also a significant negative correlation with the *shifts of maximum activity* ($r = -.49$,

Table 2

Principal component analysis of movement units (loadings of varimax rotation).

Movement units	Principal components		
	Horizontal mov.	Verti. arm mov.	Head mov.
Right hand horizontal	.70	.16	-.01
Left hand horizontal	.66	.25	-.02
Swaying of body	.61	.02	.24
Body moving sideways	.61	-.13	.05
Shoulder turn	.54	.14	.10
Right hand vertical	.06	.85	.01
Left hand vertical	.16	.84	.02
Head vertical	-.08	.02	.70
Head turn	.13	.03	.70
Head tilt	.10	.00	.57
Body vertical	.26	.03	.27

Note: mov. = movements, verti. = vertical, bold = high loadings that formed movement category; $n = 6360$.

$t = 3.49$). Thus, motion behavior that switches very often from one body part to another seems to communicate low extraversion. Openness was positively correlated with the measuring unit *angle of directions* ($r = .38$, $t = 2.51$). Thus, stick figures that produced pronounced changes in their motion direction were rated higher on openness. Negative correlations were found between emotional stability and *expressiveness* ($r = -.39$, $t = 2.60$) and emotional stability and *shifts of maximum activity* ($r = -.36$, $t = 2.40$). Stick figures that tended to reach their peaks of activity very fast were rated low on emotional stability. The same was true for figures, which displayed a great variety concerning dominant activation of different body parts.

Using the movement units of all speeches a principal component analysis was conducted. This procedure provided three components, which were named after the main quality of the movement units they contained. The first component explained 22.82% of total variance, the second 12.97%, and the third 10.74%. The oscillation heights of the movement units that showed high loadings on the same component were summed up to form the categories *horizontal movements*, *vertical arm movements*, and *head movements* (bold type in Table 2).

Analysis revealed a significant negative correlation between the personality factor agreeableness and *vertical arm movements* ($r = -.53$, $t = 3.77$). Thus, stick figures that produced high amplitudes while moving their arms up and down were perceived as less agreeable than stick figures that tended to avoid such movements. Extraversion on the other hand seemed to be communicated by a great amount of *vertical arm movements* ($r = .72$, $t = 6.41$). Moreover, there was also a positive correlation between this personality trait and the movement category *horizontal movements* ($r = .53$, $t = 3.84$). Pronounced *head movements* seemed to communicate low conscientiousness ($r = -.45$, $t = 3.07$), but also low emotional stability ($r = -.32$, $t = 2.05$). Furthermore, raters tended to regard stick figures displaying a great amount of *horizontal movements*

Table 1

Correlations between personality traits and movement qualities.

Measuring units	Personality trait				
	Agreeabl.	Extrav.	Conscient.	Emot. stab.	Openness
Number of turning points	-.38**	.72**	-.10	-.09	.13
Turbulence coefficient	.42**	-.46**	.27	.08	.08
Shifts maximum activity	.21	-.49**	.17	-.36*	.04
Expressiveness	-.25	-.04	-.15	-.39**	-.12
Angle of directions	-.04	.24	.23	-.28	.38**

Note: Agreeabl. = agreeableness; Extrav. = extraversion; Conscient. = conscientiousness; Emot. stab. = emotional stability; $n = 40$.

* $p < .05$.

** $p < .01$.

Table 3
Correlations between personality traits and movement units.

Movement categories	Personality trait				
	Agreeabl.	Extravers.	Conscient.	Emot. stab.	Openness
Horizontal movements	-.13	.53**	-.30	.32*	.06
Vertical arm movements	-.53**	.72**	-.01	.14	.10
Head movements	-.08	.08	-.45**	-.32*	-.30

Note: Agreeabl. = agreeableness; Extrav. = extraversion; Conscient. = conscientiousness; Emot. stab. = emotional stability; $n = 40$.

* $p < .05$.

** $p < .01$.

as emotionally stable ($r = .32$, $t = 2.05$). Although not significant, there were also other correlations of interest. These are presented in Table 3.

4. Discussion

People are very adept in ascribing meaning to human motion patterns, but which information do they rely on when making personality judgments? To answer this question we translated the body movements of politicians into time series of coordinates. The data underwent some transformations and new methods of analysis were applied to track down some of the signals contained in the behavioral stream. The obtained results indicate that observers extract meaning from both certain body parts and motion patterns that are partly independent of the body parts activated. For instance, stick figures that reached a high value on the Big Five personality trait agreeableness usually did not produce a great amount of *vertical arm movements* and displayed only a minor degree of activity with pronounced fluctuations in the amplitude height of their movements. These fluctuations were estimated by the so called *turbulence coefficient*, which is not a clear cut measuring unit. It simply tells us that a succession of amplitude heights follows a more or less irregular pattern. Thus, stick figures that displayed low activity, interrupted by phases of high activity were regarded as more agreeable than stick figures that permanently displayed a high activity throughout the length of an encoded sequence.

High extraversion on the other hand was associated with high overall activity, with small fluctuations in the behavioral stream, a small variety concerning the activation of different body parts, and a great deal of *horizontal* and *vertical arm movements*. Stick figures with high values on extraversion therefore seemed to move permanently and displayed only brief phases of low activity, which lead to small fluctuations in amplitude height. Furthermore, the arms dominated all other body parts and this yielded a low value on the variety of maximum activity.

Stick figures that displayed a great amount of *head movements* were considered as less conscientious, less emotionally stable and less open than stick figures that did not often move their heads with great amplitude. Furthermore, high values on openness seemed to be communicated by behavior with pronounced changes in movement direction, whereas stick figures with round movements were considered as less open. High emotional stability was associated with smooth transitions from one peak of activity to the next, as opposed to stick figures displaying body movements with sudden changes in amplitude height. These were considered as less emotionally stable. Additionally, speakers who changed dominant activation of their body parts very often received low values on emotional stability, whereas speakers whose movements were less “fickle” received high values on emotional stability.

Research has already demonstrated that human body motion provides information about the age, the gender, the personality and the emotional state of a person (Blake & Shiffrar, 2007; Dittrich

et al., 1996; Kozlowski & Cutting, 1977; Montepare & McArthur-Zebrowitz, 1988; Pollick et al., 2001; Troje, 2002). The current study contributes to the work in this field by identifying signals with which an observer can recognize certain qualities. Our methodical approach was mainly inspired by the so called point light experiments. We also transformed the body movements of persons into arrays of coordinates. Although our way of behavior encoding loses some information, because it reduces data to two dimensions, we are convinced that the behavior of the speakers can be captured accurately enough. The error variance created by our method is far smaller than the variance created by the behavior of the speakers. The same is also true for the units of measurement we used. They only give a rough estimate of certain motion qualities, but as the results clearly show, our subjects were no more accurate because they seemed to make their judgments using the relatively simple cues we extracted. Still, future research will have to develop and apply additional and more refined methods to examine these processes in greater detail. In contrast to the point light approach we investigated “natural” behavior. There were no actors receiving instructions on how to display different behaviors that might have no ecological validity. Furthermore, we did not attach reflective markers to a person's joints, which is a procedure that is criticized for enhancing a subject's self awareness and alerting them to the researcher's interest (Berry, Kean, Misovich, & Baron, 1991).

To generalize the conclusions drawn here more experiments with different stimuli will be necessary. Although some studies have shown that video clips of people create the same impressions as a computer animation of their behavior, we can not conclude that the original movies would be rated in the same way as our stick figures (Bente, Krämer, Peterson, & de Ruiter, 2001; Kempter, 1998). Therefore, it will be of great interest to compare ratings of additional experiments to validate the methods applied here, because it is possible that information from other communication channels (e.g. voice, facial expressions, etc.) would lead to different results. Despite the evidence that non-verbal cues have a prevailing influence on impression formation it is not clear how the different verbal and non-verbal signals act in combination. Is there redundant information and what impressions are created by contradictory signals? Although one may find some answers in the studies on the perception of charisma (visionary content plus expressive behavior is regarded very charismatic) these questions require further experiments (Awamleh & Gardner, 1999; Holladay & Coombs, 1993, 1994).

Successful leaders are great communicators on a behavioral level. Non-verbal cues such as the fluency of speech, gestures and facial expressions are the main ingredients to be regarded as a charismatic person (Awamleh & Gardner, 1999; Gardner, 2003; Holladay & Coombs, 1993, 1994). We extended these approaches and demonstrated that the motion behavior of politicians making a speech contains enough variance to extract different communication styles. Furthermore, it was possible to establish a relationship between certain qualities of body motion and personality. Questions arise about how to build a theoretical foundation for the

results derived here, such as why are vertical arm movements such a strong signal? At the current state of this research only crude speculations can be made. Maybe moving the arm up and down is the least energy consuming movement when speakers want to make their point with great vigor. Some results also give rise to the idea that the inferences the observers draw are based on simple associations. For instance, high values on the personality trait openness are partly associated with pronounced changes in movement direction. This is something one expects open persons to do. They should be open for new experiences and therefore they change their direction often. Support for such ideas can only be provided conducting further experiments.

Media reports tell us that most politicians employ consultants to coach them. Thus, none of them should display a behavior in which a potential voter recognizes low emotional stability. Although this can be due to the impoverished stimuli we used it is well established that non-verbal communication often operates on a subconscious level. The signals identified in this study may be hard to control and information about a speaker's dispositions might leak out (DePaulo, 1992; DePaulo et al., 2003). This leads to many open questions. Do the ingredients of non-verbal charisma depend on personality and are there signals that enhance a leader's public effectiveness? It is clear that most politicians are not willing to provide a self description of their personality. Thus, only indirect ways of analysis can be applied. For instance, the data basis of this study could be used to determine the success of different communication styles in different situations. Additionally, it should be possible to predict a leader's effectiveness and his or her political attitudes by the analysis of body motion. Although at an exploratory stage the current study hints that charisma is partly linked to individual differences in successfully presenting oneself on a non-verbal level.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.jrp.2010.04.002.

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