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A Behaviour Sequence Analysis of Nonverbal Communication and Deceit in Different Personality Clusters

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Despite difficulties in interpretation, nonverbal communication is especially important in forensic settings, such as police investigations. Three distinct clusters of personality disorders have been outlined as being associated with criminal behaviour. Understanding the similarities and differences between these personality clusters and nonverbal communication could help investigators look for key signs of psychological distress or deception. The current research proposes a novel approach to nonverbal communication: behaviour sequence analysis (BSA). An application of this approach is outlined to investigate whether criminals with different personality types are better at concealing emotions and nonverbal communication when being interrogated. The results indicate that while sequences are generally similar across clusters, individuals from different personality clusters exhibit unique patterns. This research provides an initial step towards a new area of nonverbal communication research and application, which could be used in future research to highlight increased possibility of deception or concealment of emotion.

Keywords: behaviour sequence analysis; deception; nonverbal communication; personality.

Introduction

Personality disorders (PDs) in psychology are typically diagnosed using the *Diagnostic and Statistical Manual of Mental Disorders – Fifth Edition* (*DSM-V*; APA, 2013). Within the *DSM-V*, personality disorders are defined as

> an enduring pattern of inner experience and behavior that deviates markedly from the expectations of the individual's culture, that are pervasive and inflexible, have an onset in adolescence or early childhood, is stable over time, and leads to distress or impairment. (APA, 2013, p. 685)

The *DSM-V* lists ten personality disorders, which are grouped into one of three distinct clusters labelled A, B, and C. Each of these clusters has been found to be associated with criminal behaviour (Davison & Janca, 2012) and individually associated with different types of crime (Francia et al., 2010). While there is a wealth of research on these personality clusters, interpersonal styles, and criminal behaviours (Furnham & Taylor, 2011; Navarro & Karlins, 2008), there is less research on the relationship between personality clusters and deception (Paulhus & John, 1998). Given the relationship between these personality clusters and criminal behaviour, it is possible that individuals with these personality clusters will be involved in police investigations or questioning during their lifetime. A key concern, therefore, is to understand whether certain personality clusters are better

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at deceiving or masking psychological distress, and whether there are methods to overcome this investigative limitation. The psychological literature on lie detection focuses on a number of aspects, from spoken language (Porter & Yuille, 1996) to nonverbal communication (DePaulo et al., 2003). The current research outlines a new method – behaviour sequence analysis (BSA) – for studying nonverbal communication patterns. As an illustrative example of how BSA can be used, the nonverbal communication of criminals who have been diagnosed with personality clusters (A, B, or C) will be investigated. BSA will be outlined and shown to provide a complementary method to existing nonverbal communication approaches. The present research, therefore, builds on a growing area in the research (Burgoon, Proudfoot, Schuetzler, & Wilson, 2014; Burgoon, Schuetzler, & Wilson, 2015).

Individuals with Cluster A personalities are generally defined as being bizarre or eccentric in contrast to the general population. Cluster A includes paranoid, schizoid, and schizotypal PDs, which have been linked to extremely violent behaviour, including murder, robbery, blackmail, arson, and kidnapping (Burton, McNiel, & Binder, 2012). Links have also been shown between Cluster A and incarceration for prostitution (Warren et al., 2002). Cluster B personalities are described as being dramatic and/or erratic, and include antisocial, borderline, histrionic, and narcissistic PDs. These disorders are characterised by callous and impulsive behaviour towards others, usually involving an obvious lack of empathy or respect for social norms. The majority of the literature suggests that Cluster B is closely linked to many types of criminal behaviour (Howard, 2015). Individuals diagnosed with narcissistic and borderline PDs are strongly associated with acts of antisocial behaviour (Conrad & Morrow 2000; Leichsenring & Leibing, 2003; Wilkins & Warner 2001). Some of the crimes that are strongly associated with borderline personality disorder (BPD) are serial killings (Papazian, 2001), rage-based and impulsive murders (Cartwright, 2001), and domestic violence (Else, Wonderlich, Beatty, Christie, & Staton, 1993). Cluster C personalities are often referred to as anxious and/or fearful, consisting of avoidant, dependent, and obsessive-compulsive PDs. Huang et al. (2009) suggested that Cluster C personalities do not tend to be related to violent crimes, but they do tend to be common within acts of anti-social behaviour and minor crimes, such as shoplifting. However, there are still reported cases of homicides amongst this group (Laajasalo, Ylipekka, & Häkkänen−Nyholm, 2013). Although there is some conflict over the exact offences related to each group, the overwhelming majority of the research shows that there is a strong connection between PDs and offending behaviour (Davison & Janca, 2012).

If an individual has committed a criminal act and is subsequently interrogated or interviewed by an investigator, he or she may attempt to conceal his or her true emotions about the crime in order to avoid being exposed as guilty. Research has suggested that when an individual tries to conceal an emotion, he or she may exhibit what is referred to as psychological distress, or 'emotional leakage' (Waxer, 1977). Emotional leakages are when clues to an individual's true emotions are exhibited without conscious awareness or recognition. For example, an individual is happy about something but attempting to mask that happiness with false sadness, he or she may show a brief smile or a raising of the corners of the lips without conscious realisation. This expression that the individual is attempting to mask, which lasts only for a fraction of a second, is known as a micro expression (Ekman & Friesen, 1969). Previous research has indicated that some facial muscles, which are associated with emotion, cannot be consciously repressed, and that the stronger the emotion is, the harder it is to conceal (Krauss, Chen, & Chawla, 1996). Research into micro tells is a development in classic behaviour analysis, which shows that some individuals have

particular idiosyncratic behaviours that indicate whether they are lying, commonly referred to as *tells* (Collett, 2003; Navarro & Karlins, 2008). This has led to the development of training programmes within the justice system to teach law officials and agents how to infer emotional states and intentions. However, simply recognising one single behaviour as an indication of deception may not be TPPL_A_1308783 reliable, due to individual differences and variations. (Blanck, Rosenthal, Snodgrass, DePaulo, & Zuckerman, 1981). Some practitioners have suggested that clusters of behaviours are better indicators of deceptive intent (Navarro & Karlins, 2008; Poppe, Van Der Zee, Heylen, & Taylor, 2014). More recently, however, researchers have taken this field a step further by suggesting that it may not just be a case of one or several behaviours occurring, but instead that the sequence of behaviours may be a better indicator of deception (Keatley, 2016).

Behaviour Sequence Analysis (BSA)

BSA is a method that is useful for outlining the dynamic relationship between chains of events or behaviours (Beaune, Giebels, & Taylor, 2010; Keatley, Barsky, & Clarke, 2017; Taylor et al., 2008). In particular, rather than investigating specific behaviours in isolation (e.g. single *tells*), BSA allows an examination of transitions between behaviours. Sequence analysis in the present research involves three main stages (Clarke & Crossland, 1985). First, taking an individual's entire response to a question and then *unitising* the response into discrete behaviours or units of action. Next, *classification*, which involves placing behaviours or event into categories that are functionally similar. Finally, *analysis* involves measuring the transitions between behaviour pairs.

BSA can be used to investigate the sequence of behaviours that a suspect (or interviewee) makes after being asked a question. For instance, the suspect first exhibited a furrowed brow (coded as behaviour 'A') followed by shaking his or her head (coded as behaviour 'B') and finally followed by looking up (coded as behaviour 'C'). In this simplified example, the lag-one sequence analysis involves testing whether 'A→B', 'A→C', 'B→C' pairs were more likely to happen than would be expected by chance alone. This process is repeated over a much larger behaviour list and across participants to indicate which behaviour pairs and chains are seen more within the data set.

BSA has previously been used in a range of social interactions and episodes, including marital conflict (Gottman, 1979), violent episodes between people (Beale, Cox, Clarke, Lawrence, & Leather, 1998; Turner & Clarke, 2009), police interrogations (Beaune et al., 2010; Taylor et al., 2008), drink driving (Keatley et al., 2016), and rape (Fossi, Clarke, & Lawrence, 2005; Lawrence, Fossi, & Clarke, 2010). It has also previously been used in relation to nonverbal communication and deception (Keatley, 2016). This research shows that an examination of the sequence of behaviours that individuals exhibit when lying highlights differences between different individuals and different types of lie (i.e. lies about different subjects). The current research, therefore, continues a growing trend in the literature by applying BSA to different personality clusters.

Present Study

The present study uses BSA to investigate behaviours displayed by real-world recordings of individuals lying. The sample consists of criminals and people of at high levels of power who were recorded making statements that were later unequivocally exposed as being untrue. The clips are divided into groups, depending on which personality cluster the participant belongs to according to official diagnosis. Each individual was analysed separately and the resulting sequences were compared between groups. The findings of the current research add to the growing literature

on nonverbal communication analysis, as well as offering a novel step forward in analysing behaviours. In particular, the current research outlines similarities and differences between the deceptive behaviour sequences of individuals from the three personality clusters and a control group (of non-cluster individuals). Given the novel approaches used in the current research, no formal hypotheses were made. If sequences are found to be similar across groups then it may be concluded that individuals display similar behavioural patterns regardless of personality cluster. However, if there are differences between groups then this research may indicate a novel approach to investigating deception behaviours for different personality clusters.

Methods

Participants

A sample of 30 individuals (22 male, 8 female) between the ages of 19 and 53 years was collected via online websites, archive footage documents, and listed police reports. Inclusion criteria are that the person was officially diagnosed as having a personality disorder, distinguished into a particular cluster, and unequivocally exposed to be lying by later investigation and evidence. There is no indication of any medical condition that would affect the body movements of any participant in the study. It was important to use real-world data so that the results could be made as valid as possible; however, there are limited clear video segments of statements caught on camera which are later unequivocally shown to be lies and which are made by people who are also classified into a personality cluster. Therefore, the stopping criterion was when no more recordings of people lying in real life, who are clearly diagnosed as having a classifiable personality disorder, were available. The personality types for each participant were recorded through the examination of released police reports and were then categorised into four groups (according to *DSM-V* classification). The groups consists of Cluster A ($n = 8$), Cluster B ($n = 9$), Cluster C ($n = 5$) and a control group of individuals who are not categorised as belonging in any of the personality clusters ($n = 8$).

Materials

Through several media sources and released police reports, video recordings of politicians, criminals and famous people were collected. Each recording contains real-world examples of participants constructing deceptive statements. Each clip used for analysis was a question–response segment. When a new question began, the previous sequence would terminate and a new sequence commenced. The crimes varied across the groups and therefore were not used as a grouping variable for analysis.[1] However, all crimes were of a serious offence (e.g. murder). A total of 111 clips were obtained across the sample ($n = 28$ for Cluster A, $n = 24$ for Cluster B, $n = 30$ for Cluster C, and $n = 29$ for the control group). The length of the clips ranges from 4.0 to 65.0 seconds ($M = 18.3$, SD = 12.2).

Coding Procedure

The clips were sequenced based on a question and answer style. When a question was asked, triggering a false response, the recording of behaviours would begin until the end of the response. Alternatively, if a new question was asked then the sequence would end and a new one would begin in response to the new question.

In order to obtain an accurate analysis of micro expressions and discrete body movements, clips were viewed frame by frame. An extensive and detailed coding scheme was created which includes every documented micro expression and micro tell.[2] These include every nonverbal behaviour associated with deception throughout the nonverbal communication literature (Vrij, Semin, & Bull, 1996), as well as any behaviour or movement exhibited by the participants. Identical coding systems were used for each

cluster group. In order to ensure inter-rater reliability, two individual researchers analysed each clip, resulting in good reliability (Cohen's $k = .80$). No issues were encountered during analysis or coding by either researcher, as the nature of the task is straightforward.

Statistical Analysis

The clips were organised into separate groups based on personality cluster. They were then coded into chains of distinct categories and implemented into the statistical software R (R Core Team, 2013). A BSA program was used to analyse the data. Frequencies of individual behaviours were calculated first, then sequence analysis was performed.

Results

Analyses were conducted on a total of 111 sequences of deceptive statements produced in response to a question being asked. The first stage of the BSA was to investigate the frequencies of individual behaviour events (Table 1).

The first thing to note is that there is variation between the type of behaviour that occurs most frequently in each of the four groups. However, head nodding occurs frequently in Cluster A ($n = 36$), Cluster B ($n = 31$), Cluster C ($n = 20$), and the control group ($n = 15$). Other behaviours vary in frequency between groups, and there is no single behaviour that occurs a lot more than any other behaviour for any group. This, therefore, does not support the view that there are clear individual behaviours or 'tells' for deception or psychological distress. Instead, the frequencies show clusters of behaviours with similar frequencies across all groups. Indeed, the frequency table alone does not support any particular bodily movement as a sign of deception. Therefore, further analysis may indicate whether there are differences in sequences of behaviours between groups.

A lag-one behaviour sequence analysis was conducted on each cluster and the control group (Figures 1–4). The first thing to note about the analyses is that a lag-one sequence analysis was conducted. This means that only transitions between pairs of behaviours are analysed and tested.[3] These pairs then form longer chains. However, it would be incorrect to view the diagram and suggest that longer chains are being analysed. The correct way to interpret the diagram is by moving from one behaviour (*the antecedent*, i.e. the 'start') to the next behaviour (*the sequitur*, i.e. *Body-Tilts forward*). It can then be seen whether the transition between these two behaviours was more likely or less likely than expected by chance according to a standardised residual. The state transition diagrams have been developed to make the interpretation of sequences easier to follow.[4] All transitions in the diagram are significant ($p < .05$).

The diagrams should be read one step or transition at a time. For instance, for Cluster A individuals, several behaviours are likely to follow from the start of a question being asked, including *Body-Tilts forwards*, *Body-Self-touch*, *Body-Point part of body towards exit*, *Eyes-Look to the side*, and *Head-Tilt sideways*. The arrow thickness indicates different criteria of standardised residuals, which is standard practice in sequence analysis (Townsend et al., 2016); therefore, it can be seen that *Eyes-Look towards exit* is the most likely sequitur to *Eyes-Look to the side*, for instance. There are a number of chains of behaviours and loops that Cluster A individuals exhibit during a response pattern; however, the most likely final behaviours are: *Head-Nod* and *Eyes-Irregular blinking*. In contrast, Cluster B individuals are much more likely to begin their responses with *Hands-Clenching fists* or *Mouth-Opening mouth*, and much more likely to finish their response patterns with *Mouth-Pressing lips together*. Cluster C individuals, however, are more likely to begin with *Eyes-Look towards exit*, *Eyes-Furrow eyebrows*, or *Eyes-Look to the side*. Cluster C individuals are also more

Table 1. Frequencies of behaviours exhibited by individuals in the four groups.

Cluster A		Cluster B		Cluster C		Control group	
Behaviour list	Freq	Behaviour list	Freq	Behaviour list	Freq	Behaviour list	Freq
Eyes-Looks to the side; Head-Nods head.	36	Eyes-Looks down.	32	Head-Circle head.	26	Eyes-Looks to the side.	21
		Head-Nods head.	31	Eyes-Looks to the side.	23	Face-Raises eyebrows.	19
Face-Furrows eyebrows (pull brows down).	22	Head-Shake head.	30	Head-Shake head; Eyes-Look towards exit.	22	Face-Furrows eyebrows (pull brows down); Head-Nods head.	15
Head-Tilts head sideways.	17	Face-Furrows eyebrows (pull brows down).	25				
Face-Raises eyebrows.	13	Face-Raises eyebrows.	20	Head-Nods head.	20	Head-Shake head.	14
Body-Self-touch (other/body).	12	Head-Tilts head sideways.	14	Face-Raises eyebrows; Face-Furrows eyebrows (pull brows down).	19	Head-Tilts head sideways.	13
Eyes-Looks down; Eyes-Look towards exit.	11	Mouth-Pressing lips together; Head-Tilt head forward.	10			Eyes-Looks down; Head-Circle head.	12
				Eyes-Looks down.	17		
Body-Half shrug; Body-Twitch leg; Head-Circle head.	9	Eyes-Irregular blinking; Mouth-Licking lips.	8	Eyes-Irregular blinking.	16	Hands-Self-touch (rubs hand or fingers).	9
				Head-Tilts head sideways.	13	Eyes-Avert eyes.	8
		Eyes-Looks to the side; Hands-Slams hands down; Mouth-Full mouth smile; Head-Tilts head down; Eyes-Looks up.	7	Mouth-Pressing lips together.	9	Mouth-Pressing lips together; Eyes-Look towards exit.	7
Mouth-Full mouth smile; Mouth-Pressing lips together; Head-Shake head; Head-Tilt head forward.	8			Eyes-Looks up.	8		
				Face-Tightening jaw.	7	Mouth-Full mouth smile.	6
				Face-Keep a 'frozen' face; Mouth-Licking lips.	6	Body-Half shrug; Hands-Raises hands.	5
Head-Tilts head up.	7	Eyes-Avert eyes; Hands-clenching fists.	6	Eyes-Avert eyes.	5	Face-Keep a 'frozen' face; Eyes-Irregular blinking.	4
Body-Tilts forwards	6			Body-Tilts forwards.	4		
Mouth-Half smile (from one side of the mouth); Body-Point part of body towards exit	5	Eyes-Pupil dilation; Body-Tapping foot; Hands-Raises hands; Mouth-Opens mouth.	5	Head-Tilts head down.	3	Mouth-Harsh swallow; Body-Self-touch (face).	3
				Hands-Self-touch (rubs hand or fingers); Mouth-Harsh swallow; Body-Twitch leg; Head-Tilts head up.	2		

(*continued*)

Table 1. (*Continued*)

Cluster A		Cluster B		Cluster C		Control group	
Behaviour list	Freq	Behaviour list	Freq	Behaviour list	Freq	Behaviour list	Freq
Face-Keep a 'frozen' face; Eyes-Irregular blinking; Mouth-Pouting (push lips forward and together).	4					Body-slouching; Hands-Twitch hand; Hands-Reach hand out; Head-Tilts head up; Body-Tilts forwards; Eyes-Looks up.	2
		Body-Half shrug; Mouth-Harsh swallow; Mouth-Pouting (push lips forward and together); Body-Pointing (away); Head-Tilts head up.	4				
Face-Self-touch (mouth); Hands-Clenching fists; Hands-Folded palms; Hands-Self-touch (rubs hand or fingers); Body-Fidget; Head-Tilts head down; Body-Disconnects; Eyes-Looks up.	3			Body-scratching; Body-Half shrug; Face-Flair nostrils; Eyes-Widen eyes; Hands-Raises hands; Mouth-Pouting (push lips forward and together); Mouth-Half smile (from one side of the mouth); Mouth-Full mouth smile; Body-Self-touch (other/body); Speech-Clear throat; Body-Point part of body towards exit.	1		
						Body-scratching; Face-Tightening jaw; Eyes-Pupil dilation; Mouth-Licking lips; Body-Steps backwards; Mouth-Pouting (push lips forward and together); Body-Creating physical barrier; Mouth-Half smile (from one side of the mouth); Body-Fidget; Body-Twitch leg; Mouth-Opens mouth; Body-Self-touch (other/body); Body-Puffed chest; Body-Stiffen shoulders.	1
		Body-Straightening up; Hands-Palms outwards; Body-Twitch leg; Body-Self-touch (face);	3				
Face-Self-touch (head); Eyes-Avert eyes; Body-Slouching; Face-Tightening jaw.	2	Face-Flair nostrils; Mouth-Half smile (from one side of the mouth); Hands-Reach hand out;	2				

(*continued*)

Table 1. (*Continued*)

Cluster A		Cluster B		Cluster C		Control group	
Behaviour list	Freq	Behaviour list	Freq	Behaviour list	Freq	Behaviour list	Freq
		Head-Circle head; Body-Disconnects.					
Body-Shrugging; Eyes-Pupil dilation; Body-Straightening up; Face-Flair nostrils; Body-Crossing arms; Hands-Palms outwards; Mouth-Licking lips; Hands-Raises hands; Body-Steps backwards; Hands-Slams hands down; Body-Pointing (away); Body-Stiffen shoulders.	1						
		Body-Shrugging; Face-Keep a 'frozen' face; Body-slouching; Eyes-Widen eyes; Face-Scratching; Hands-Self-touch (rubs hand or fingers); Mouth-Biting lip; Body-Fidget; Eyes-Look towards exit; Body-Self-grooming.	1				

Note: Behaviours with the same frequency are grouped together.

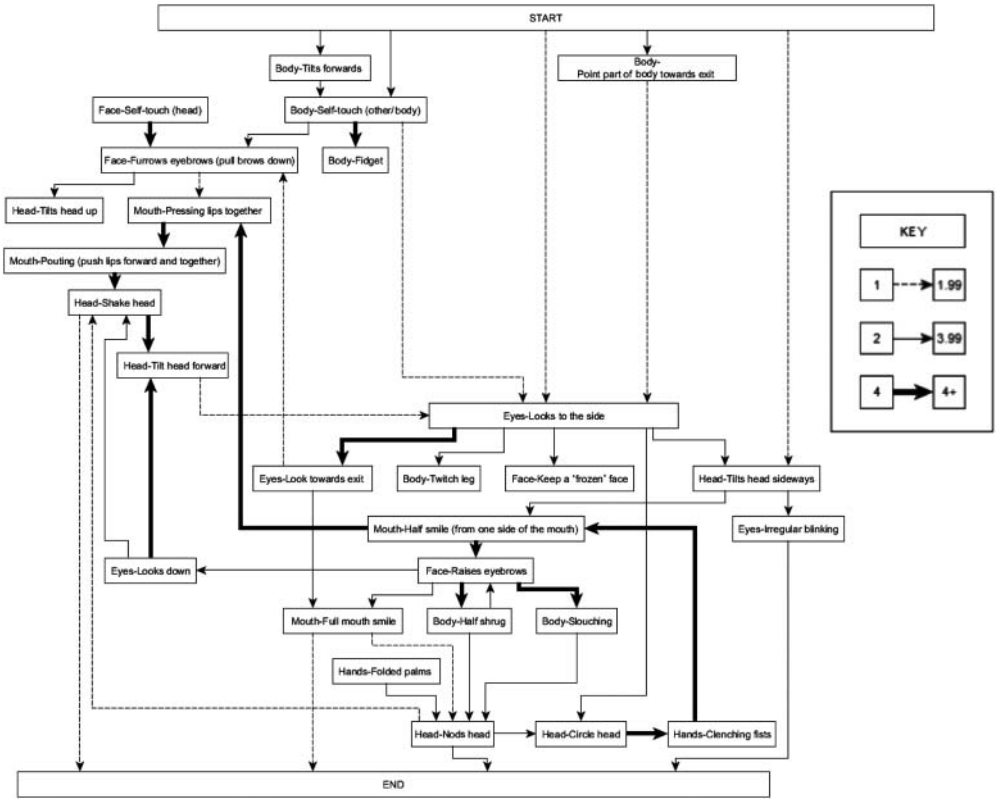

Figure 1. Sequence analysis of behaviours shown by Cluster A individuals.
Note: All transitions are significant ($p < .05$); key indicates line thickness related to standardised residuals.

likely to end their sequence with *Mouth-Tightening jaw*. Finally, individuals from the control condition are more likely to start their responses with *Head-Tilt sideways* movements, and are much more likely to end their sequence of behaviours with *Mouth-Pressing lips together*, *Hand-Reach hand out*, or *Head-Shake head* movements.

Discussion

The aim of the current study is twofold: to present a novel method for investigating nonverbal communication, and to test this in an applied setting via BSA of real-world criminal lies, with a particular focus on investigating similarities and differences in nonverbal communication between personality clusters when trying to deceive an interviewer. This research is particularly important in terms of police investigation due to high correlations between individuals with personality disorders and criminal behaviour. The findings provide general support for previous research in the literature which highlights a number of behavioural idiosyncrasies linked to deception (Sporer & Schwandt, 2007). In particular, one of behaviours most frequently displayed in all four groups is the movement of the individual's gaze. The most frequent behaviour displayed during the creation of lying statements for both Cluster A and the control group is looking to the side, which is the second most frequent for Cluster C. However, this is not the case for Cluster B, wherein the individuals tended to look to the

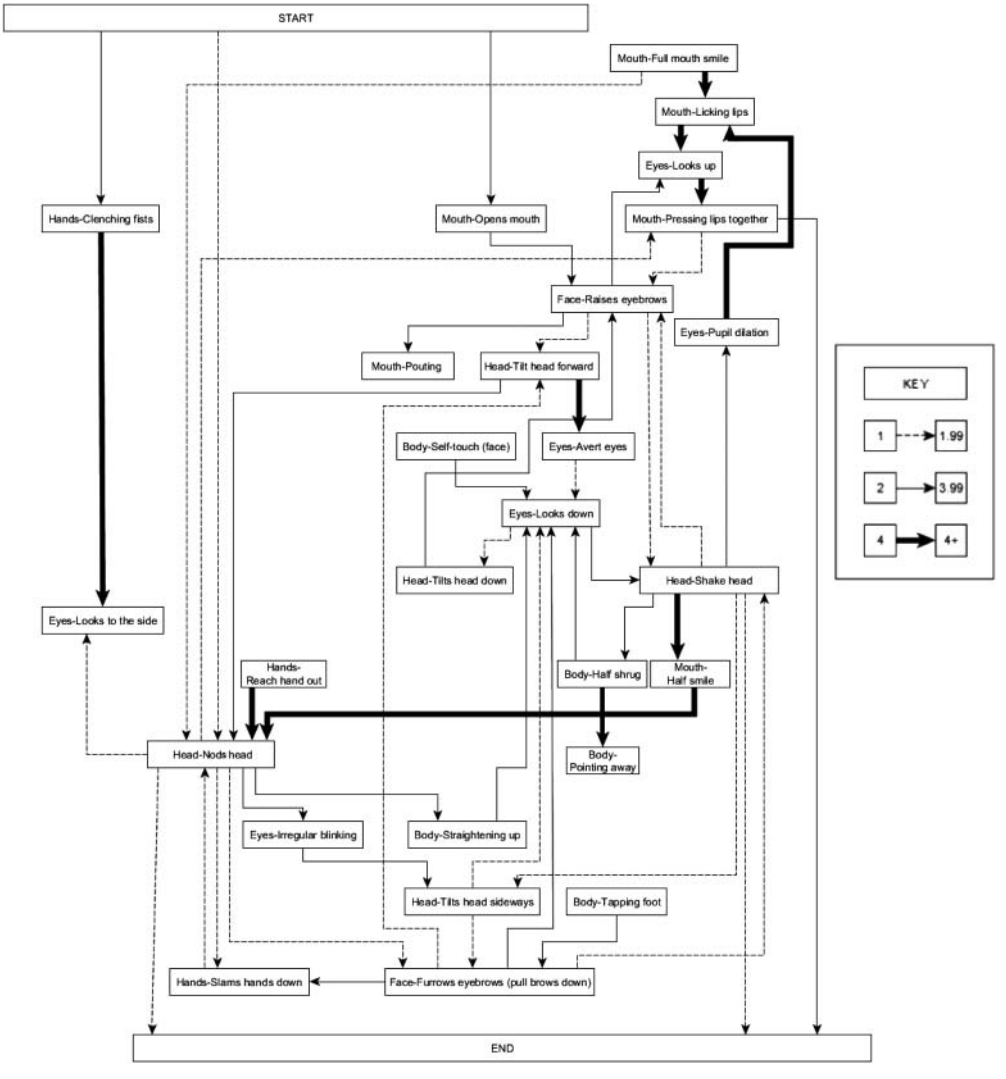

Figure 2. Sequence analysis of behaviours shown by Cluster B individuals.
Note: All transitions are significant ($p < .05$); key indicates line thickness related to standardised residuals.

side a limited number of times, instead averting their gaze downwards more regularly than any other behaviour. This suggests that across all personalities, frequent eye movements may be indicative of deceptive intent, although the types of eye movement may be different depending on personality type. This further supports previous research into rapid eye movements as cues to deception detection (Mann, Vrij, & Bull, 2002). Another behaviour that occurs frequently across all personality types is the furrowing of eyebrows; however, this is the least common in the control group and most the common in Cluster B, suggesting that many are similar between all personality clusters but that there are certain behaviours that are far less common for the control group. For example, individuals from Clusters A, B, and C commonly nod their head when constructing a lie, which

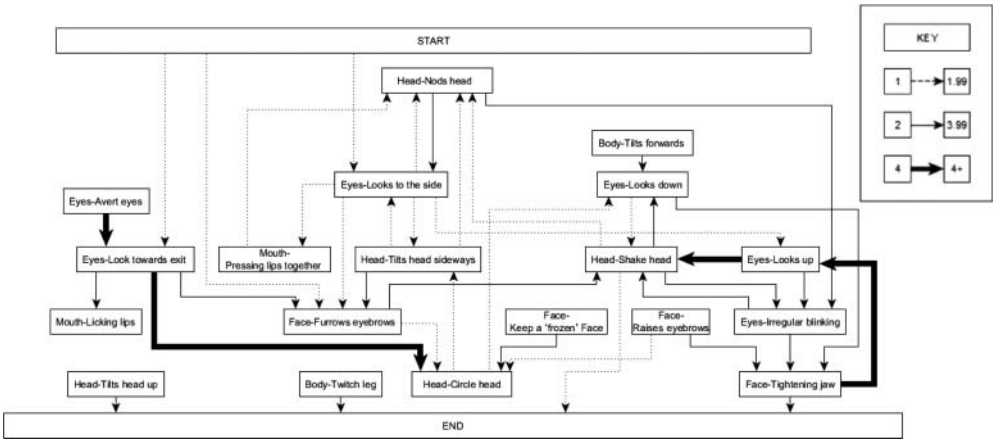

Figure 3. Sequence analysis of behaviours shown by Cluster C individuals.
Note: All transitions are significant ($p < .05$); key indicates line thickness related to standardised residuals.

is far less frequently displayed in the control group. Moreover this suggests that some behaviours displayed by the non-cluster individuals may be amplified by those with a personality disorder.

Although there is no isolated sequence that each individual group shares, the fact that the patterns between groups are so different demonstrates that different personality types do change nonverbal communication behaviour during deception. This also suggests that different personality types may be better at hiding deception than others. This could become a basis for police investigation, as once a person's personality type has been identified, it could be used to provide a more reliable sequence of behaviours that is likely to suggest deceptive intent.

If a BSA approach was used to identify patterns in the behaviour of each individual personality cluster when being deceptive, it would determine whether the current literature on nonverbal cues to deception can be applied to individuals of both normal and abnormal mental health. For example, if individuals with a Cluster A personality disorder have a tendency to look down and then shake their head followed by the shrugging of their shoulders when constructing a false statement, whereas individuals with Cluster B or C personalities do not display this sequence, then individual difference patterns could emerge. This could provide a useful next step for other research in the field, currently using electronic body sensors to map movements (Poppe et al., 2014). If interrogators were aware of these behaviour patterns then they may be better able to identify when a suspect is being deceptive by monitoring when a particular sequence of behaviours occurs. Of course, the occurrence of a particular sequence does not necessarily mean that a person is being deceptive, but it may indicate a higher probability of deceptive intent. In such cases, it would also allow investigators to identify how different personality types react to different questions through involuntary changes in their behaviour. These changes in behaviour can be used to indicate the most appropriate area of questioning to focus on. The BSA method can also be used with recorded interviews, allowing analysts more time to study behavioural sequences.

Owing to the nature of the study, a limitation is that gathering baseline behaviours or sequences of behaviours during truthful responses for each participant was not possible, and therefore only lying statements were

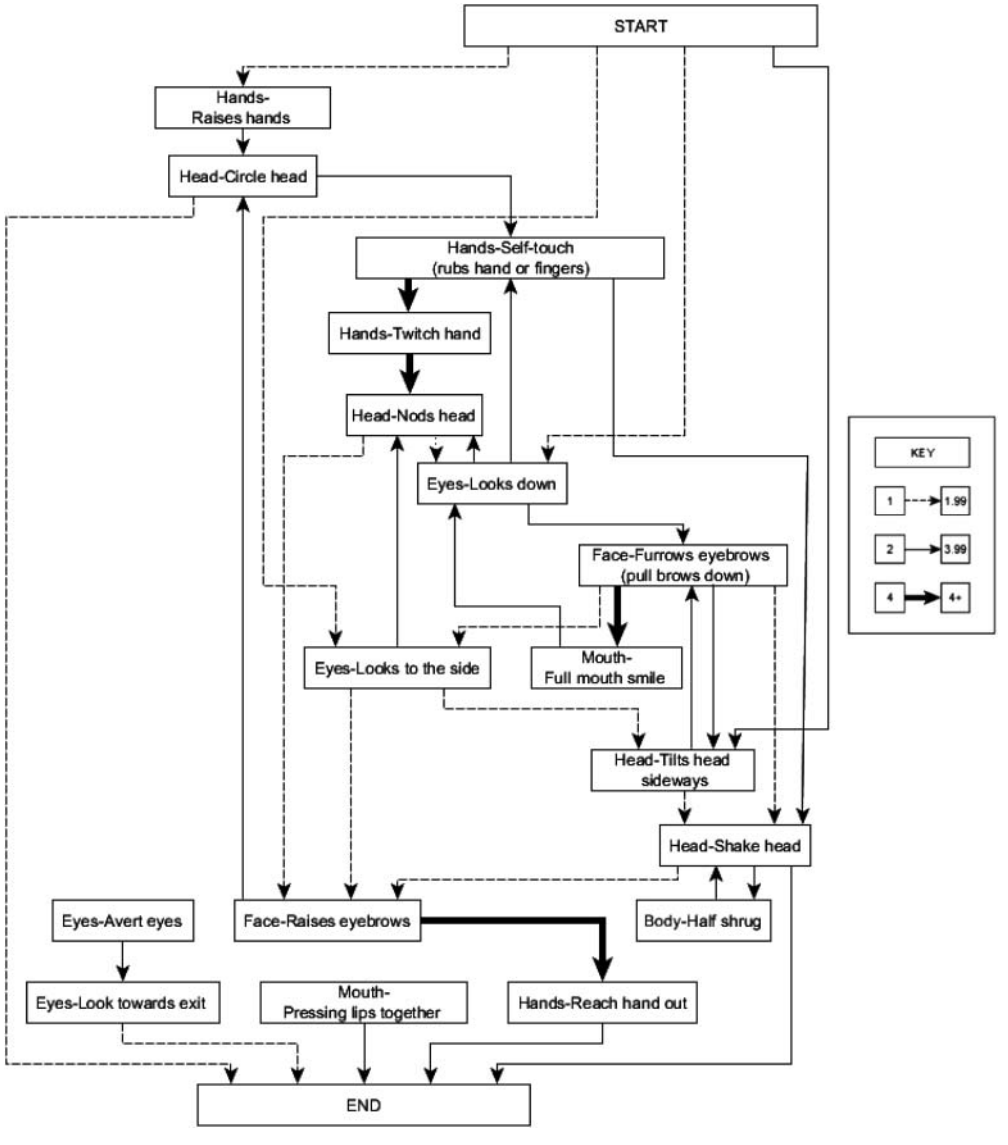

Figure 4. Sequence analysis of behaviours shown by individuals in the control group.
Note: All transitions are significant ($p < .05$); key indicates line thickness related to standardised residuals.

analysed. This means that there are no baselines from which to measure changes in behaviour. Future research should, therefore, compare behaviour patterns during the production of both truthful and deceptive answers. Findings from such work would indicate which behaviours are isolated to deceptive responses and which are shared between both truthful and dishonest answers, therefore suggesting which behaviours are superior indicators of deception rather than simply identifying which behaviours indicate an emotional response.

Overall, the present study introduces a novel method for investigating nonverbal communication and deception by analysing

real-world behaviours that naturally occur rather than in a laboratory setting. This is a major strength as it means that the sequences produced were not artificial and are more generalisable. This new method was used to show how individuals with different personality clusters exhibit different nonverbal communication patterns when attempting to deceive an interviewer. While this area of research is still very new, the potential benefits to investigation and behaviour research are large, especially if the method was to be combined with computer-based motion-tracking technology.

Notes

1. While we it is appreciated that this is another way of analysing the data, it was not possible given the variation in the actual crimes. For completion, the data set was analysed based on crimes committed, but no clear patterns emerged. Additional analyses are available from the corresponding author on request.
2. Available from the corresponding author on request.
3. Higher-order analyses are possible (e.g. lag-two); however, these are typically more complex and require more data, with limited gains in terms of analytical outcomes. Higher-order analyses are available from the corresponding author on request.
4. Available from the corresponding author on request.

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