Coding Body Language in Sports: The Nonverbal Behavior Coding System for Soccer Penalties (NBCSP)

Article *in* Journal of Sport and Exercise Psychology · March 2021

DOI: 10.1123/jsep.2020-0066.

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***Journal of Sport & Exercise Psychology*, (Ahead of Print)**
https://doi.org/10.1123/jsep.2020-0066

Human Kinetics
ORIGINAL RESEARCH

Coding Body Language in Sports: The Nonverbal Behavior Coding System for Soccer Penalties

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Nonverbal behavior (NVB) plays an important role in sports. However, it has been difficult to measure, as no coding schemes exist to objectively measure NVB in sports. Therefore, the authors adapted the Body Action and Posture Coding System to the context of soccer penalties, validated it, and initially used this system (Nonverbal Behavior Coding System for Soccer Penalties [NBCSP]) to explore NVB in penalties. Study 1 demonstrated that the NBCSP had good to excellent intercoder reliability regarding the occurrence and temporal precision of NVBs. It also showed that the coding system could differentiate certain postures and behaviors as a function of emotional valence (i.e., positive vs. negative emotional states). Study 2 identified differences in NVB for successful and missed shots in a sample of penalties (time spent looking toward the goal, toward the ground, right arm movement, and how upright the body posture was). The authors discuss the utility of the coding system for different sport contexts.

***Keywords*:** body movement, emotion expression, pride

Advancement of knowledge often goes hand in hand with methodological development. In the field of nonverbal behavior (NVB)/nonverbal communication, an important methodological milestone was the development of the Facial Action Coding System (Ekman & Friesen 1976, 1978; Ekman et al., 1971) that subsequently led to a rapid accumulation of knowledge regarding the importance of the face in communicating information about internal states, such as emotions, attitudes, or social intentions (Matsumoto & Hwang, 2013). The Facial Action Coding System has become the standard tool for measuring facial expressions. It is an anatomical system for describing all observable facial movements, breaking facial expressions down into small segments. Although the face can probably be considered the most important channel for communicating nonverbal information in humans (Matsumoto et al., 2013), the body has also been shown to be an important medium in this respect (e.g., Aviezer et al., 2012). Unfortunately, methodological advancement in the field of body movement research in nonverbal communication has been slower and proven more difficult due to the large degrees of freedom in whole-body movements. Potentially, the discrepancy between possibilities to measure NVB in the face in comparison with the body might have led to an overemphasis of facial nonverbal communication compared with bodily nonverbal communication. However, promising progress regarding the measurement of bodily cues in nonverbal communication has been made with the development of the Body Action and Posture Coding System (BAP, Dael et al., 2012a), which is one of the only comprehensive coding systems for body movement that has been validated in terms of its potential to measure emotion expressions in video-recorded social situations. In the present research, we attempted to use and adapt the BAP to the context of competitive sports, as hardly any other social context is documented and video recorded to a similar degree (Furley, 2019) and is as replete with naturally occurring emotional expressions as modern sports competitions (Furley & Schweizer, 2020). Physicalist coding systems, such as the BAP, are the most promising tools for capturing these naturalistic nonverbal expressions, as they can be used on televised recordings, have high degrees of reliability and objectivity, and are free of subjective evaluations of NVB (Bente et al., 2008). Although these coding systems are time-consuming and less precise than motion-capture devices (which are frequently used in sport science in biomechanical studies), such technology is not feasible to analyze NVB in naturally occurring televised sport events; indeed, Bente et al. (2008) suggested that “these devices are quite obtrusive and often impractical for use in natural settings, since they require the attachment of sensors and the installation of stationary laboratory equipment” (p. 272).

Of further relevance to the present research, a growing number of studies using the thin-slices approach (Ambady et al., 2000) has demonstrated that people without any particular training in recognizing or coding NVB are able to make a range of accurate inferences based on short recordings of NVBs during sport competitions. For example, people can tell whether athletes are currently leading or trailing during sports competitions based on NVB during breaks in the game (Furley & Schweizer, 2014, 2016a), whether athletes are playing at home or away based on short recordings of athletes prior to the start of a game (Furley et al., 2018), whether soccer referees are communicating an ambiguous or an unambiguous decision (Furley & Schweizer, 2016b), and whether a soccer penalty taker is experiencing an upcoming penalty as a challenge or a threat (Brimmell et al., 2018). All these empirical studies illustrate that people can pick up valid nonverbal cues from televised sports competitions and use these to inform fairly accurate inferences. These findings are supportive of the basic fact that social interactions imply an interplay of encoding and decoding information between individuals. Regarding nonverbal communication, encoding describes the process of showing a specific pattern of muscle movements and behavior that are associated with certain internal states (e.g., emotions or

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behavioral intentions), whereas decoding describes the process of observing, interpreting, and acting on these NVBs (reviewed, e.g., in Matsumoto et al., 2013). Research has shown that even slight movements of body parts or of a facial muscle affect people's views of their interaction partners (for reviews, see Argyle, 1988; DePaulo & Friedman, 1998).

A shortcoming of this previous work on NVB in sports is that the research did not answer the question of which precise facial and bodily cues informed the observers' inferences. Only one study indicated that both cues in the face and in the body of athletes were important in informing observers about the current score of the depicted athletes (Furley & Schweizer, 2016a). Hence, the present research sought to adapt, validate, and initiate the use of the BAP (Dael et al., 2012a) for measuring NVB in naturally occurring televised sports events.

The Present Research

Hardly any other sporting event is characterized by such intense emotional displays in close succession as penalty shootouts in soccer. From one moment to the other, excessive celebration might be replaced by misery, as success and failure lie very close together in these situations (Furley et al., 2020). Furthermore, the penalty situation is rather standardized in comparison with the complexity of normal gameplay, which makes it a suitable starting point for using the BAP to measure the naturally occurring NVB of penalty takers in high-stakes situations. In addition, the clarity of success and failure in soccer penalties again make it a suitable scenario to explore differences in NVB as a function of success and failure. Hence, it is not surprising that some of the few studies that have used behavioral coding techniques on footage from televised sports events have done this in the context of soccer penalties. However, these studies used coding systems that were created in an ad hoc manner for the purposes of the respective study and only had the potential to look at gross body movements following penalty kicks (e.g., raising fists above the head; Moll et al., 2010) or gross body movements in preparation of penalty kicks (e.g., turning back toward the goalkeeper after placing the ball on the penalty spot; Jordet & Hartman, 2008). A further shortcoming of these coding studies was that coding was only possible in a dichotomous manner (e.g., player raised both hands above head vs. did not; player turned back toward the goalkeeper vs. did not) and therefore were limited in their potential to detect more nuanced subtle forms of NVB. In addition, these ad hoc coding systems did not allow for any exploratory research to identify certain nonverbal tendencies as a function of context variables in sports.

Given the problems, shortcomings, and lack of nonverbal coding studies in the field of sports, which are partly due to the absence of validated coding schemes, we attempted to build on the progress made in the psychological literature by adapting a fairly recent observational coding tool, the BAP (Dael et al., 2012a). Per definition, observational coding is based on explicit operational definitions of an a priori defined set of behavior codes and a fixed coding procedure. In this respect, observational coding schemes provide a manageable protocol for describing behavior by detailing behavioral codes and a step-by-step guide on how to assign numerical values to behavioral codes in video-recorded social interactions. This procedure decreases the degree of observer inferences and makes the measurement of NVB more objective. Moreover, the resulting variables extracted from videos can be verified and replicated by other coders.

The BAP is a time-aligned microdescription tool of body movements on three different levels (anatomical level, functional level, and form level). It has been shown to have acceptable intercoder reliability for the occurrence, temporal precision, and segmentation of body movements. Furthermore, the BAP has been validated in a study in which actors were asked to express certain emotions. The video material of these actors was subsequently coded with the BAP and provided evidence that different emotions were associated with distinct types of body postures and actions (Dael et al., 2012a). A similar study (Dael et al., 2012b) employed 10 professional actors to portray a set of 12 emotions. The results showed that the BAP allowed for the detection of several patterns of body movement that systematically occurred in portrayals of specific emotions. Therefore, the authors concluded that the BAP is a valid tool for distinguishing certain emotions based on body movements. A recent review of nonverbal coding systems for bodily behaviors (Witkower & Tracy, 2019) described the BAP as the most comprehensive system and therefore most suitable system for exploratory research on naturally occurring NVB in everyday contexts.

Based on these considerations, the main goal of the present research was to examine if the BAP could be adapted and used as an objective measure of NVB in the context of sports. To this end, we first adapted the BAP to the sport context or, more specifically, to the context of soccer penalties. We labeled this adapted coding scheme the Nonverbal Behavior Coding System for Soccer Penalties (NBCSP). Subsequently, we used a validation technique similar to Dael et al.'s (2012a) by having actors perform penalty preparations while instructed to show certain emotions/internal states (e.g., pride, dominance, self-confidence, shame, submission, and insecurity) and, afterward, coding the behaviors of the actors in an attempt to find associated body movements with the instructed expressions. This approach has been the standard procedure to validate nonverbal coding schemes of the whole body (Dael et al. 2012a, 2012b). The rationale of this approach is based on the premise that actors can encode internal states like emotions with full-body movements that show considerable overlap with body movements that coincide with real-world internal states. Or, stated more specifically, an actor can portray an emotion like joy or fear in a similar way to how this would be encoded when he or she actually feels these states (see Dael et al. 2012a, 2012b; Harrigan et al., 2005 for a review). While numerous studies have used facial action coding to decode NVB in video recordings of emotional situations in the real world (see Matsumoto et al., 2013 for a review), we are not aware of any studies that have done this using the BAP. Therefore, the second study utilized the NBCSP to analyze a sample of penalties from the German Bundesliga soccer games to explore potential differences in preperformance NVB associated with successful and unsuccessful soccer penalties.

Study 1: Development and Validation of the NBCSP

Method

Participants. Male participants ($N = 9$; $M_{age} = 25.56$, $SD = 3.69$) were obtained as actors for the validation study. This sample size was based on the 10 actors used in the validation study of the original BAP (Dael et al., 2012a, 2012b; one actor did not show up due to illness when we created the video material of the preperformance NVB during penalties). All actors were active soccer players or had been active soccer players in their past. There were no differences in age or expertise within the group. A random sample of coders ($n = 2$) for the video stimuli were recruited from the local university, to validate the coding system through intercoder reliability assessments. Using two coders is standard procedure in this type of research (Dael et al. 2012a, 2012b; Harrigan et al., 2005). The study was carried out in full accordance with the Declaration of Helsinki 1975, and written informed consent was obtained from all participants.

Stimuli. The video stimuli for the coders were obtained using similar procedures as previous research that manipulated the preperformance NVB of soccer penalty kicks (Furley, Dicks, & Memmert, 2012) in which actors were asked to prepare penalties either in a dominant or a submissive way. All video footage was filmed using a Nikon D500 digital video camera (Nikon Corp., Chiyoda, Japan). The camera was placed 1 m next to the left goal post on a standard-sized soccer pitch on artificial turf and was set to a height of 1.80 m. Prior to commencing the penalty shooting, the participants received a script of the schedule and an explanation of the emotion/internal states they should enact when preparing the penalty. Based on the prominent principle of antitheses in NVB, which suggests that clear differences between nonverbal expressions evolved in order to distinctively differentiate between emotions/internal states of opposite functioning (Darwin, 1872/1998), we decided to manipulate three different opposing emotions/internal states that have been proposed to be relevant in a penalty taker's NVB (Furley & Schweizer, 2020): dominance versus submissiveness, pride versus shame, and self-confidence versus insecurity. An additional reason for choosing these internal states was that research has identified specific postures and movements that can distinguish between these states (for reviews, see Argyle, 1988; DePaulo & Friedman, 1998; Furley & Schweizer, 2020). These identified postures and movements informed the instructions the actors got for their penalty preparations.

Dominance versus submissiveness. The actors were instructed to display dominance through an erect posture (pulling back shoulders and chest out) during the whole procedure, occupy more space by lightly spreading out the limbs from the torso, hold the head high with the chin parallel to the ground, have the eyes on the same level as the camera, and the gaze should be directed at the camera for 90% of the procedure. They were instructed to show submissiveness through a slouched posture with the head and the chin pointing down; to not occupy too much space by placing the limbs close to the body, touching the torso; shoulders hanging to the front; and to angle the gaze downward for 90% of the time and only show abrupt gaze shifts toward the camera. These NVBs were based on previous research on dominance and submissiveness in both the penalty situation (Furley et al., 2012a) and dominance/submissiveness displays in more general everyday situations (Carney et al., 2010; Carney et al., 2005).

Pride versus shame. To show pride, the participants were asked to expand themselves and show an upright posture, with the head tilted slightly upward, a small smile, and arms raised above the head with hands in fists or on the hips (Shariff & Tracy, 2009). The shame expression was described as consisting of the head tilted downward, a lowered eye gaze, and a slumped posture (Keltner, 1995; Tracy & Matsumoto, 2008; Shariff & Tracy, 2009). Previous research has shown that pride and shame can be reliably distinguished based on these NVBs (Martens et al., 2012).

Confidence versus insecurity. We did not give the actors precise instructions about how to express these opposing states, but decided to let the actors display their subjective interpretation of self-confidence and insecurity (see Dael et al., 2012a, 2012b for a similar procedure). The rationale for this was to test whether the NBCSP could identify body actions and postures associated with these states when the actors were free to encode these internal states without any prior instruction. Research has shown that observers have a fairly intuitive understanding of the NVB associated with confidence (Ambady & Rosenthal, 1993; Argyle, 1988). An upright posture and direct eye contact (Ridgeway, 1987; Ridgeway et al., 1985) have been associated with confidence, and a lack thereof with insecurity.

Filming procedure. The order of the acted penalty preparations was predefined in a protocol. Instructions on how to prepare the attempt were adapted from Furley et al. (2012a). The starting point was 2 m behind the penalty spot, while holding the ball with both hands in front of their torso at the height of the stomach. The subsequent penalty attempt began with the athlete walking to the penalty spot, placing the ball on the mark. Once the ball was in the correct spot, the athlete walked backwards (facing the goalkeeper) to a predefined mark 2.5 m behind the penalty spot and 1 m to the left of the goal or to the right of the goal, depending on whether the penalty taker was left or right footed. After the setup, the participants began with the run-up to shoot the penalty and finished with shooting the penalty. All participants went through the sequence a couple of times to ensure that the preparation phase for the penalty was similar for every participant.

Stimuli selection and specifications. Each athlete performed two penalties for each condition, meaning a total of 12 videos for every actor. The footage was edited using the program iMovie (Apple, Inc., Cupertino, CA). In the final stage, six videos (one for each condition) of each participant were taken for further investigation and coding. A total of 54 videos was presented to two different coders to assess intercoder reliability. The software Anvil (www.anvil-software.de) (a video annotation research tool, version 6.0; Kipp, 2007) was used to present the videos. The coder sat on a chair with the computer screen (19 in.) on the table and 60 cm away from the coder. The videos were presented in a random order, including all 54 videos. The total set of video clips had a total of 11.785 frames, with 25 frames per second, and had an average duration of 218.24 frames (8.7 s).

The Nonverbal Behavior Coding System for Soccer Penalties. The BAP (Dael et al., 2012a) was used as the basis for the adapted NBCSP. In general, NVB was divided into two central units after Harrigan (2005), a body posture unit and body action unit. Body posture is defined by a general alignment of a single or multiple articulator/s (e.g., torso or extremities) in reference to a specific resting arrangement of the respective body parts. Habitual changes of the posture represent posture shifts (e.g., a person leaning forward). Dael et al. (2012a, p. 101) described action units as a "local excursion of one or a set of articulators (mostly the arms) outside a resting configuration with a very discrete onset (start point), a relatively short duration, and a distinct offset (endpoint) where the articulator returns to a resting configuration (e.g., head shake, pointing arm gesture)." The focus of coding was on all visible body parts of the upper body, whereas leg movements were not considered due to a lack of theoretical background to code leg movements properly. Following the guidelines from Dael et al. (2012a), anatomical articulation and the form of the movement were distinguished. Anatomical articulation describes the particular body part, which is moving and responsible for the respective movement. The description rules were adapted from Dael et al. (2012a), who followed the kinesiological standards from Hinson (1977) and Neumann (2002).

Only reliable codes (with acceptable levels of intercoder agreement) were used, and behavior codings were adapted to fit the context of penalty shots in soccer (see Table 1). A few coded behaviors could currently not be evaluated because they occurred with a low proportion (<5% of the entire corpus of emotional portrayals; Dael et al., 2012a). Therefore, they were excluded from the NBCSP. Two form-related categories, lateral whole-body posture and arm posture symmetry, were not coded reliably. Thus, they were also excluded. All behaviors that were excluded from the original study were also excluded for the NBCSP (see Table 1 for a complete list of coded behaviors).

To preserve a maximum amount of information, we used the proportion of duration within each portrayal as the measurement unit of the behavior variables. The use of duration data of this set of variables is justified by a very high intercoder agreement (kappa using a time window of 440 ms, $M = 0.80$, $SD = 0.12$). Several adjustments were realized to fit the coding scheme to the context of soccer penalty kicks and the sports environment (see Table 2).

Naturally, large numbers of behavior codes lead to a very tedious and time-consuming coding process. To address the economic issues of observational coding, several behaviors that were not reliable and arguably have a low chance of occurring in the penalty context were removed from the NBCSP (see Supplementary Table S1 [available online]).

All listed movements in the coding scheme (see Table 1) can be considered spatial movements caused by muscle contraction and not passive displacements. For example, the motion of the head caused by the bending of the trunk is passive, and thus, only articulation of the trunk will be coded (Dael et al., 2012a). Codes for actions and postures are organized at two integrated levels: anatomical articulation (i.e., which body part is actively moving) and form of the movement (i.e., how is the body part moving). Movements are generally described in terms of both the direction and orientation in three-dimensional space by adopting an anatomical external frame of reference (Rosenfeld, 1982). Directions of movements are described using the orthogonal axes of the body (sagittal, vertical, and transverse). The direction of a posture code refers to the end position in reference to the anatomical standard position (e.g., head to the right). Directions of action units are coded independently from posture units, as these refer to the movements themselves. Furthermore, the orientation of the participant is coded continuously from the viewpoint of the goalkeeper as either facing or averted from the goalkeeper. Contrary to the original BAP, we did not code on a functional level (including emblems, illustrators, and manipulators) because these are arguably not of particular relevance in the preparatory NVB of penalty takers. A soccer penalty usually does not comprise any verbal interaction or intentions other than shooting the ball, and therefore, functional-level coding is not useful in this context (but might be in other sport contexts).

The NBCSP uses the same time-locked, temporal behavioral segments (i.e., with a clear beginning and end of behavior) as units of analyses as the original BAP. For each movement, a defined onset and offset of the movement were coded. Behavioral segments could show overlaps between onset and offset (e.g., left head turn and head tilt upward). Posture units were segmented into two phases. The first phase is a transition phase that delineates a postural shift, the actual movement within the time segment to achieve the end position. The second phase is the time segment where the posture is at its end position and similar to the coded direction, called the configuration phase. Action units were segmented into subunits according to the type of movement, and repetitive movements were excluded from segmentation to ensure that repetitive movements would only be coded once and not repeatedly. Gaze direction was coded identically to the orientation of the athlete.

Coding Procedure. Dael et al.'s (2012a) Anvil (Kipp, 2007) template was adapted for the NBCSP, as it provides an intuitive graphical user interface to simplify the coding process. The template is composed of a manual handbook, the definition of terms, and an html file with the explained coding scheme (see https://osf.io/d73zv/files/). The NBCSP coding scheme can be implemented in Anvil, which offers an intuitive graphical user interface through which body movements in the video can be transferred to their respective codes while accurately specifying the onset and offset of a behavior. The template was translated into the German language, as the coders were from Germany. Two coders were selected to code the video footage. First, to ensure correct coding, both coders were briefed and got an explanation for the whole procedure through a tutorial video (see https://osf.io/d73zv/files/). The video explained the procedure of how to properly code the videos. Second, the coders first worked on an example video to familiarize themselves with the procedure. The coders were asked to follow a fixed order of coding, which was written in the coding manual (see https://osf.io/d73zv/files/).

The coding took approximately 15–25 min per video (average duration time of the video was 8.7 s). Coding all the videos in Study 1 took one coder approximately 18 hr. The videos were presented without sound to assure no bias from noise and verbal communication during the coding. The first step in the process for the coders was to watch the whole video sequence at normal speed. Following the first impression of the footage, the coders went through the videos frame by frame to code the respective behaviors and determined the beginning and end of the movement. The order of coding was predefined through the coding manual, which the coders needed to follow while coding. They always started by focusing only on one particular body part in isolation (e.g., head, neck, arms) at one time. Following the first step, the coders had to differentiate between actual movement and passively influenced articulators. Next, the behavior was defined as posture or action. In the next steps, they described the anatomical articulation (e.g., lean, extension) and the direction of the movement. After selecting the behavioral category, the onset and offset were determined. This order was realized for all videos.

Data Analyses

The Anvil software (version 6 from 2017) exports text files that are composed of the category of behavior (rows) and the occurrence and temporal precision (columns). SPSS (version 22; IBM Corp., Armonk, NY) was used for all further analyses. In line with Dael et al. (2012a), intercoder reliability was calculated at three levels: (a) the occurrence versus nonoccurrence within the portrayal, (b) temporal precision, and (c) segmentation. Occurrence agreement was calculated using Cohen's kappa (Cohen, 1960), depending on the presence or absence of a behavior within the portrayal ($n = 54$).

Due to problems computing kappa temporarily (Bakeman & Gottman, 1987), kappa was assessed on different time intervals, identical to the approach used by Dael et al. (2012a for full details). This approach helped to preserve a maximum amount of information, particularly on the timing and the duration. Compliance on the segmentation of postures in transition and configuration phases was ensured by computing kappa for behavior units, where both coders marked the behavior as present. Action segmentation agreement was performed using the number of subunits coded by each coder in every portrayal, followed by correlation analyses. High correlations are an indicator of linear relationships between frequencies of subunits coded by both coders. Kappa values between .40 and .60 are assumed to be

Table 1 Complete List of Behaviors Coded With the Body Action and Posture Coding System

Behavior variable	Short description
Head orientation	
1. Facing	Face is oriented toward the goalkeeper
2. Averted	Face is oriented away from the goalkeeper
Head posture	
3. Vertical head tilt toward an upward position	A rotation of the head around the transversal axis that results in the head lifted up relative to the anatomical standard position
4. Vertical head tilt toward a downward position	A rotation of the head around the transversal axis that results in the head tilted down relative to the anatomical standard position
Trunk orientation	
5. Facing	The trunk is oriented toward the goalkeeper
6. Averted	The trunk is oriented away from the goalkeeper
Trunk posture	
7. Trunk is in an upright position	The upper body is in the standard anatomical position
8. Trunk lean toward a forward position	The upper body leans forward relative to the anatomical standard position
9. Trunk lean toward a backward position	The upper body leans backward relative to the anatomical standard position
10. Lateral trunk lean toward a left position	A lateral flexion of the trunk that results in the upper body leaning laterally to the left relative to the anatomical standard position
11. Lateral trunk lean toward a right position	A lateral flexion of the trunk that results in the upper body leaning laterally to the right relative to the anatomical standard position
12. Spine movement toward a bent position	The spine is bent so the trunk is less erect or upright relative to the anatomical standard position
Whole-body posture	
13. Whole body moves or leans toward a backward position	The whole body, including the lower part (hips and legs), moves or leans backward relative to the anatomical standard position
14. Whole body moves or leans toward the frontal middle position	The whole body, including the lower part (hips and legs), moves or leans toward a frontal middle position relative to the anatomical standard position
15. Whole body is in an upright position	The whole body is in the anatomical standard position
Arm posture	
16. Left arm at side	The left arm and hand hangs at the side of the body
17. Left arm at side (very close, almost touching the trunk)	The left arm and hand hangs very close at the side of the body
18. Left arm at side (close)	The left arm and hand hangs at the side of the body, occupying more space
19. Left arm held in front	The left hand and/or arm is held in front of the body
20. Left hand at waist	The left hand rests on the hip
21. Left hand at head/neck	The left hand is held behind the back of the head or neck
22. Left shoulder lean toward a backward position	Left shoulder leans backward relative to the anatomical standard position
23. Left shoulder lean toward a forward position	Left shoulder leans forward relative to the anatomical standard position
24. Right arm at side	The right arm and hand hangs at the side of the body
25. Right arm at side (very close, almost touching the trunk)	The right arm and hand hangs very close at the side of the body
26 Right arm at side (close)	The right arm and hand hangs at the side of the body, occupying more space
27. Right arm held in front	The right hand and/or arm is held in front of the body
28. Right hand at waist	The right hand rests on the hip
29. Right hand at head/neck	The right hand is held behind the back of the head or neck
30. Right shoulder lean toward a backward position	Right shoulder leans backward relative to the anatomical standard position
31. Right shoulder lean toward a forward position	Right shoulder leans forward relative to the anatomical standard position
32. Both arms held in front	Both hands and/or arms hold each other in front of the body

(continued)

Table 1 *(continued)*

Behavior variable	Short description
Gaze	
33. Toward	The gaze is directed toward the goalkeeper
34. Upward	The gaze is directed forward and above the goalkeeper
35. Downward	The gaze is directed forward and below the goalkeeper
36. Averted sideways	The gaze is directed away from the goalkeeper to the left or right, regardless of vertical direction (up or down)
37. Eyes closed	Both eyes are closed
Head action	
38. Left head turn	A left rotation of the head around the vertical axis
39. Right head turn	A right rotation of the head around the vertical axis
40. Upward head tilt	An upward rotation of the head around the sagittal axis
41. Downward head tilt	A downward rotation of the head around the sagittal axis
Trunk action	
42. Forward trunk lean	A forward leaning movement of the trunk
43. Backward trunk lean	A backward leaning movement of the trunk
Arm action	
44. Left arm action upward	The left arm moves upward
45. Left arm action downward	The left arm moves downward
46. Left arm action forward	The left arm moves forward
47. Left arm action backward	The left arm moves backward
48. Left arm action away from the body	The left arm moves away from the body
49. Left arm action toward the body	The left arm moves toward the body
50. Right arm action upward	The right arm moves upward
51. Right arm action downward	The right arm moves downward
52. Right arm action forward	The right arm moves forward
53. Right arm action backward	The right arm moves backward
54. Right arm action away from the body	The right arm moves away from the body
55. Right arm action toward the body	The right arm moves toward the body
56. Symmetrical arms action	Both arms jointly move in a symmetrical fashion
57. Asymmetrical arms action	Both arms jointly move in an asymmetrical fashion
Other	
58. Touch	One body part touches another body part or an object as part of an action

fair, between .60 and .75 as good, and above .75 as excellent (Fleiss, 1981). Finally, we followed the procedure of Dael et al. (2012a), who set a benchmark for coded behaviors and did not interpret the kappa of codes that occurred in less than 5% of the portrayals.

Results

Orientation and Symmetry. The full details of the intercoder reliability results, including occurrence and temporal agreement, can be found in the Supplementary Table S2 (available online). Intercoder agreement on occurrence was good to very good (averted: .65 and facing: .79) for head orientation and very high for trunk orientation and asymmetrical arm action (trunk orientation: .93 and asymmetry: .96), whereas symmetrical arm action only had a fair agreement of .49. Temporal agreement, on the other hand, was very high for both symmetry categories (.90 for both categories). Head orientation (.68) and trunk orientation (.75) had a good temporal agreement, which can be considered reliable.

Gaze. Only two variables for this category occurred above the set threshold of .05 and were analyzed regarding interrater agreement. Gaze had a good time kappa of .72 (toward) and .68 (downward).

Posture. Posture was coded for the following four categories: head posture, trunk posture, whole-body posture, and arm posture. The head posture categories, vertical head tilt toward an upward position and vertical head tilt toward a downward position, both had a high occurrence agreement. Temporal precision was higher, with a very high agreement for vertical head tilt toward a downward position of .75 and an excellent precision for vertical head tilt toward an upward position of .87. For trunk posture, three of the six variables were not coded (<0.05% occurrence) enough for interpretation. For the trunk postures for the upright position and trunk lean toward a forward position, no occurrence kappa could be calculated. Spine movement toward a bent position had a fair occurrence agreement of .54. Kappa values on time precision were also fair for spine movement and trunk posture toward a forward position. Excellent time precision could be shown for the posture trunk in an upright position (.92). Whole-body posture had a fair to good occurrence agreement, and time kappas were good for both codings (.60 each).

Intercoder agreement on occurrence differed from very good to no good agreement for arm postures. For both arms, the agreement of arm at side (close) was very low (right: .30; left:

Table 2 List of New Behaviors Added to the Nonverbal Behavior Coding System for Soccer Penalties

Behavior variable	Short description
1. Trunk is in an upright position	The upper body is in the standard anatomical position
2. Downward head tilt	A downward rotation of the head around the sagittal axis
3. Upward head tilt	An upward rotation of the head around the sagittal axis
4. Right shoulder lean toward a forward position	Right shoulder leans forward relative to the anatomical standard position
5. Right shoulder lean toward a backward position	Right shoulder leans backward relative to the anatomical standard position
6. Right arm at side (close)	The right arm and hand hangs at the side of the body, occupying more space
7. Right arm at side (very close, almost touching the trunk)	The right arm and hand hangs very close at the side of the body
8. Left shoulder lean toward a forward position	Left shoulder leans forward relative to the anatomical standard position
9. Left shoulder lean toward a backward position	Left shoulder leans backward relative to the anatomical standard position
10. Left arm at side (close)	The left arm and hand hangs at the side of the body, occupying more space
11. Left arm at side (very close, almost touching the trunk)	The left arm and hand hangs very close at the side of the body
12. Whole body is in an upright position	The whole body is in the anatomical standard position
13. Vertical head tilt toward a downward position	A rotation of the head around the transversal axis that results in the head tilted down relative to the anatomical standard position

.10). Very high to excellent occurrence agreement was evident for the left arm at side, left arm held in front, left shoulder leaning toward a backward position, right arm at side, and both arms in front. Other arm postures had a high kappa value. Temporal precision ranged from good to high agreement. Left arm at side (close) had a fair agreement in comparison with the right arm (left: .47; right: .67).

Action Form. The following behavioral categories were coded for action form: head action, trunk action, and arm action. All in all, the occurrence kappas had fair to high reliability (between .49 and .96), and the temporal kappas ranged from high to very high (.60–.90). The time kappa for symmetry arm action was excellent (.90). The action form, right arm action backward, only showed fair intercoder reliability (.52). Due to rare codings of the head and trunk action categories, the occurrence kappa could not be calculated for these categories. This was also the case for the left and right head turn and for the arm actions (left arm action upward and downward, right arm action upward and downward).

Differential Effects of Emotional Instructions on NVB in Penalties. Initially, we analyzed the effects of all six internal states (positive: pride, dominance, and self-confidence; negative: shame, submissiveness, and insecurity) on bodily NVB (proportion of the duration of the behavior during the penalty preparation was used as the dependent variable). Subsequently, we collapsed the three positive states (pride, dominance, and self-confidence) and three negative states (shame, submissiveness, and insecurity) to the dichotomous variable positive and negative internal states.

A one-way multivariate analysis of variance (MANOVA) showed a statistically significant difference for the six different conditions, F (55, 179.480) = 4.320, $p < .001$; Wilks' $\Lambda = 0.020$; $\eta_p^2 = .542$. Table 3 summarizes the individual proportions of duration for the six emotional conditions. The follow-up univariate analyses of variance (ANOVAs) showed that the left arm action proportions of duration, $F(5, 48) = 5.765$, $p < .001$, $\eta_p^2 = .375$, right arm action, $F(5, 48) = 5.654$, $p < .001$, $\eta_p^2 = .371$, right arm action away from the body, $F(5, 48) = 6.583$, $p < .001$, $\eta_p^2 = .407$, vertical head tilt toward an upward position body, $F(5, 48) = 5.199$, $p = .001$, $\eta_p^2 = .351$, head action, $F(5, 48) = 26.370$, $p < .001$, $\eta_p^2 = .733$, left arm action toward the body $F(5, 48) = 6.108$, $p < .001$, $\eta_p^2 = .389$, and symmetrical arms action, $F(5, 48) = 8.262$, $p < .001$, $\eta_p^2 = .463$, significantly differed as a function of emotional conditions.[1]

For the behavior variables where the Levene's F test revealed that the homogeneity of variance assumption was not met, Welch's F test was used. An alpha level of .05 was used for all subsequent analyses. The one-way Welch's ANOVA of proportion duration means revealed statistically significant differences for several behavioral variables (see Table 4).[2]

Tables 3 and 4 show that the three positive (pride, dominance, and self-confidence) and three negative states (shame, submissiveness, and insecurity) were coded similarly and showed little differences within the positive and negative emotional categories. Therefore, we collapsed the three positive and three negative internal states to one valence variable that only distinguished between the positive and negative valence. An additional one-way multivariate analysis of variance was performed to investigate the differences between positive and negative emotions, $F(24, 29) = 21.658$, $p < .001$; Wilks' $\Lambda = 0.053$; $\eta_p^2 = .947$. Only the behavior variables with homogeneity of variance were included in this analysis. The rest of the behavior variables, which did not meet the prerequisite, were again analyzed using Welch's F test. Tables 5 and 6 show the results of the two tests. Significant differences between negative and positive emotions on NVB are given in bold.

Discussion Study 1

The goal of Study 1 was to test the applicability of an objective coding system to measure NVB in the context of sports. The flexibility of the BAP allowed for the creation of a subsystem from the original coding system to measure NVB during soccer penalties (i.e., the NBCSP). Therefore, Study 1 can be regarded as a successful first step in developing an objective measurement tool

Table 3 Univariate Analysis for Behavioral Categories and Emotional Display Conditions on Proportion of Duration During Penalties

Behavior variable	Insecurity	Confidence	Shame	Pride	Submissiveness	Dominance	*df* (model, error)	*F*	η_p^2	*p*
Vertical head tilt toward an upward position	0.30 (0.27)	0.63 (0.26)	0.26 (0.29)	0.78 (0.13)	0.29 (0.39)	0.56 (0.32)	5, 48	5.199	.351	**.001**
Left arm at side (very close)	0.26 (0.21)	0.20 (0.14)	0.28 (0.18)	0.33 (0.19)	0.32 (0.19)	0.34 (0.16)	5, 48	1.472	.095	.424
Left arm held in front	0.56 (0.28)	0.57 (0.23)	0.64 (0.20)	0.45 (0.29)	0.39 (0.23)	0.56 (0.17)	5, 48	1.472	.133	.216
Right arm held in front	0.64 (0.22)	0.66 (0.18)	0.67 (0.17)	0.59 (0.15)	0.59 (0.18)	0.56 (0.19)	5, 48	0.529	.052	.754
Head action	0.89 (0.24)	0.19 (0.27)	0.69 (0.21)	0.15 (0.24)	0.86 (0.21)	0.08 (0.08)	5, 48	26.370	.733	**.001**
Left arm action	0.50 (0.21)	0.40 (0.18)	0.33 (0.14)	0.63 (0.30)	0.74 (0.24)	0.74 (0.20)	5, 48	5.765	.375	**.001**
Left arm action toward the body	0.15 (0.13)	0.10 (0.15)	0.30 (0.23)	0.09 (0.15)	0.50 (0.27)	0.27 (0.16)	5, 48	6.108	.389	**.001**
Right arm action forward	0.29 (0.17)	0.21 (0.12)	0.14 (0.08)	0.21 (0.30)	0.12 (0.06)	0.15 (0.11)	5, 48	1.365	.124	.254
Right arm action backward	0.15 (0.11)	0.16 (0.07)	0.13 (0.06)	0.14 (0.07)	0.16 (0.09)	0.14 (0.08)	5, 48	.161	.016	.976
Right arm action away from the body	0.20 (0.31)	0.40 (0.20)	0.05 (0.08)	0.44 (0.07)	0.32 (0.13)	0.44 (0.22)	5, 48	6.583	.407	**.001**
Symmetrical arms action	0.20 (0.11)	0.10 (0.06)	0.05 (0.07)	0.04 (0.06)	0.07 (0.04)	0.02 (0.04)	5, 48	8.262	.463	**.001**
Asymmetrical arm action	0.60 (0.13)	0.51 (0.18)	0.38 (0.19)	0.47 (0.22)	0.35 (0.17)	0.46 (0.24)	5, 48	2.111	.180	.080

Note. Values are presented as *M* (*SD*). Significant *p* values are marked in bold.

for posture and body movement in sports for both research and practical applications.

As an initial step in validating the NBCSP, we determined the intercoder reliability on three levels (occurrence, temporal precision, and segmentation). Unfortunately, analyzing segmentation proved to be problematic (this was similar to the original study by Dael et al., 2012a). Therefore, the kappa coefficients on the transition and configuration phases could not be calculated or interpreted because the distributions were not equal. A possible explanation for this might be the short duration of the portrayals in which postures often only included a configuration phase or transition phase. Hence, the present analyses focused on occurrence agreement and temporal precision to validate the NBCSP. Occurrence and temporal precision had good (.60) to excellent (.95) kappa values for intercoder reliability.

However, some behavior variables only had a fair kappa score for agreement (spine movement toward a bent position; occurrence agreement: .54, temporal agreement: .56). This inconsistency may be due to an imprecise explanation of the behavior variable, that uncertainty of the coder could influence the coding procedure. Despite fair, good, and excellent intercoder reliability for most NVB, a few behavior variables were not coded reliably. The posture behavioral variables left (.10) and right (.30) arm close at the side had poor occurrence agreements; however, for temporal precision, a good kappa value was measured for right arm at side (.67). These possible sources of error could be due to the difficulty of distinguishing between three possible coding variables for arm at side. We would, therefore, recommend using two codes for the arm at side posture instead of three, which could be right/left arm at side very close and right/left arm further away from the body.

The highest agreement was found for trunk in an upright position (.92) and upward head tilt (.95). It can, therefore, be assumed that these behavior variables are unique and potential coders can easily differentiate the codings from other postures or action variables. Looking at the results, the data revealed several behaviors that occurred very rarely (see Supplementary Table S3 [available online]) and did not reach the <5% threshold, such as trunk posture and hand at waist or neck; also, a wide range of arm actions did not meet the criteria for interpretable analysis.

Concerning the question of whether the NBCSP could detect behavioral differences as a function of emotional states, ambiguous results were found. Given the fact that the three positive and three negative states already show substantial overlap in their theoretically assumed expression (Argyle, 1988; Carney et al., 2005; Carney et al., 2010; DePaulo & Friedman, 1998; Furley & Schweizer, 2020; Martens et al., 2012; Ridgeway, 1987; Ridgeway et al., 1985), we did not necessarily expect the NBCSP to be able to detect differences between dominance, pride, and confidence, but did expect to find differences for the positive and negative states. This was also supported by the results showing clear differences in certain movements/postures as a function of positive versus negative internal states. The behaviors that were most informative about the valence of the internal state were head facing versus averted, head tilt up versus down, trunk facing versus averted, gaze up versus down, trunk lean toward a forward position, whole body moves or leans toward a backward position, whole body is

Table 4 Robust Tests of Equality of Means

Behavior variable	Insecurity	Confidence	Shame	Pride	Submissiveness	Dominance	Statistic[a]	*df*1	*df*2	Estimated ω^2	*p*
Head facing	0.21 (0.22)	0.82 (0.10)	0.12 (0.13)	0.84 (0.10)	0.03 (0.04)	0.67 (0.14)	158.678	5	21.156	0.936	**.001**
Head averted	0.79 (0.22)	0.18 (0.10)	0.88 (0.13)	0.16 (0.10)	0.97 (0.04)	0.33 (0.14)	158.678	5	21.156	0.936	**.001**
Vertical head tilt toward a downward position	0.84 (0.10)	0.26 (0.09)	0.92 (0.11)	0.31 (0.20)	0.96 (0.07)	0.36 (0.18)	77.019	5	21.934	0.876	**.001**
Trunk facing	0.27 (0.23)	0.84 (0.09)	0.45 (0.42)	0.84 (0.10)	0.47 (0.50)	0.66 (0.14)	11.658	5	21.657	0.496	**.001**
Trunk averted	0.73 (0.23)	0.16 (0.09)	0.55 (0.42)	0.16 (0.10)	0.52 (0.50)	0.34 (0.18)	11.658	5	21.657	0.496	**.001**
Trunk is in an upright position	0.44 (0.17)	0.62 (0.17)	0.66 (0.27)	0.64 (0.13)	0.74 (0.04)	0.72 (0.09)	5.844	5	20.925	0.309	**.002**
Trunk lean toward a forward position	0.31 (0.15)	0.13 (0.13)	0.13 (0.16)	0.03 (0.03)	0.10 (0.11)	0.03 (0.03)	7.299	5	21.163	0.368	**.001**
Spine movement toward a bent position	0.14 (0.06)	0.07 (0.09)	0.12 (0.07)	0.13 (0.03)	0.18 (0.03)	0.13 (0.03)	4.321	5	21.905	0.235	**.007**
Whole body moves or leans toward a backward position	0.56 (0.17)	0.31 (0.09)	0.38 (0.16)	0.28 (0.04)	0.61 (0.16)	0.22 (0.03)	15.332	5	21.282	0.570	**.001**
Whole body is in an upright position	0.33 (0.14)	0.51 (0.10)	0.44 (0.19)	0.57 (0.07)	0.27 (0.21)	0.61 (0.05)	10.534	5	21.470	0.468	**.001**
Left arm at side	0.08 (0.14)	0.13 (0.16)	0.02 (0.03)	0.13 (0.18)	0.01 (0.02)	0.12 (0.29)	2.606	5	20.118	0.129	.057
Left arm at side (close)	0.36 (0.26)	0.02 (0.04)	0.01 (0.03)	0.03 (0.06)	0.04 (0.13)	0.03 (0.05)	2.861	5	21.715	0.146	**.039**
Left shoulder lean toward a backward position	0.26 (0.21)	0.20 (0.14)	0.08 (0.08)	0.10 (0.12)	0.44 (0.52)	0.12 (0.13)	2.375	5	21.897	0.112	.073
Right arm at side	0.03 (0.04)	0.10 (0.10)	0.28 (0.42)	0.19 (0.30)	0.05 (0.04)	0.07 (0.07)	1.674	5	21.584	0.058	.183
Right arm at side (very close, almost touching the trunk)	0.46 (0.25)	0.11 (0.11)	0.29 (0.15)	0.20 (0.18)	0.29 (0.20)	0.33 (0.40)	3.689	5	21.923	0.199	**.014**
Right arm at side (close)	0.25 (0.22)	0.08 (0.10)	0.30 (0.23)	0.05 (0.10)	0.25 (0.23)	0.16 (0.22)	3.183	5	21.818	0.168	**.026**
Right arm held in front	0.65 (0.22)	0.66 (0.18)	0.67 (0.17)	0.59 (0.15)	0.59 (0.18)	0.56 (0.19)	0.481	5	22.357	0.009	.787
Right shoulder lean toward a backward position	0.20 (0.17)	0.37 (0.20)	0.13 (0.10)	0.25 (0.15)	0.19 (0.04)	0.11 (0.06)	4.451	5	21.278	0.281	**.006**
Right shoulder lean toward a forward position	0.30 (0.15)	0.15 (0.15)	0.22 (0.13)	0.03 (0.07)	0.25 (0.08)	0.07 (0.12)	9.917	5	22.034	0.452	**.001**
Gaze toward	0.10 (0.09)	0.62 (0.12)	0.42 (0.44)	0.73 (0.12)	0.02 (0.03)	0.70 (0.13)	118.144	5	20.192	0.684	**.001**
Gaze downward	0.84 (0.12)	0.41 (0.14)	0.91 (0.08)	0.45 (0.25)	0.88 (0.33)	0.34 (0.12)	35.845	5	21.918	0.763	**.001**
Upward head tilt	0.10 (0.12)	0.03 (0.08)	0.05 (0.08)	0.37 (0.21)	0.01 (0.03)	0.01 (0.03)	5.547	5	21.402	0.296	**.002**
Downward head tilt	0.22 (0.17)	0.04 (0.06)	0.02 (0.04)	0.10 (0.11)	0.07 (0.06)	0.02 (0.04)	3.632	5	21.940	0.195	**.015**
Trunk action	0.36 (0.11)	0.22 (0.06)	0.25 (0.06)	0.21 (0.02)	0.74 (0.29)	0.23 (0.13)	8.344	5	20.654	0.404	**.001**
Forward trunk lean	0.44 (0.18)	0.23 (0.10)	0.42 (0.23)	0.08 (0.06)	0.68 (0.24)	0.24 (0.06)	16.652	5	21.571	0.591	**.001**
Backward trunk lean	0.12 (0.10)	0.25 (0.08)	0 (0)	0.16 (0.02)	0.14 (0.33)	0.20 (0.14)	162.536	5	19.208	0.749	**.001**
Left arm action away from the body	0.07 (0.11)	0.35 (0.22)	0.34 (0.35)	0.42 (0.11)	0.15 (0.17)	0.47 (0.17)	11.297	5	22.045	0.488	**.001**
Left arm action toward the body	0.15 (0.13)	0.10 (0.15)	0.30 (0.23)	0.09 (0.15)	0.50 (0.27)	0.27 (0.16)	4.331	5	22.247	0.235	**.007**
Right arm action toward the body	0.21 (0.12)	0.05 (0.13)	0.38 (0.17)	0.02 (0.03)	0.48 (0.22)	0.31 (0.16)	20.826	5	19.783	0.268	**.001**

Note. Values are presented as *M* (*SD*). Significant *p* values are marked in bold. Robust tests of equality of means cannot be performed for left shoulder lean toward a forward position and left arm action forward because at least one group has 0 variance.
[a]Asymptotically *F* distributed.

Table 5 ANOVA Results for Mean Differences Between Positive and Negative Emotional Displays

Behavior variable	Positive emotion	Negative emotion	F	*df* (model, error)	η_p^2	p
Head facing	**0.77 (0.13)**	**0.12 (0.16)**	257.94	1, 52	.832	**<.001**
Head averted	**0.22 (0.14)**	**0.87 (0.16)**	257.94	1, 52	.832	**<.001**
Vertical head tilt toward an upward position	**0.66 (0.26)**	**0.28 (0.31)**	23.48	1, 52	.311	**<.001**
Trunk is in an upright position	0.66 (0.14)	0.61 (0.22)	0.87	1, 52	.016	.357
Spine movement toward a bent position	**0.11 (0.06)**	**0.14 (0.06)**	4.30	1, 52	.076	**.043**
Left arm at side (very close, almost touching the trunk)	0.29 (0.17)	0.27 (0.19)	0.16	1, 52	.003	.692
Left arm held in front	0.53 (0.21)	0.53 (0.26)	0.01	1, 52	.000	.930
Left shoulder lean toward a forward position	0.14 (0.13)	0.11 (0.17)	0.54	1, 52	.010	.467
Right arm at side	0.12 (0.19)	0.12 (0.26)	0.00	1, 52	.000	.997
Right arm at side (very close, almost touching the trunk)	0.21 (0.27)	0.35 (0.22)	4.19	1, 52	.075	.046
Right arm held in front	0.60 (0.17)	0.64 (0.19)	0.48	1, 52	.009	.492
Right shoulder lean toward a forward position	**0.09 (0.12)**	**0.26 (0.12)**	26.51	1, 52	.338	**<.001**
Both arms held in front	0.47 (0.17)	0.42 (0.26)	0.79	1, 52	.015	.380
Gaze downward	**0.40 (0.18)**	**0.88 (0.20)**	84.89	1, 52	.620	**<.001**
Downward head tilt	0.05 (0.08)	0.10 (0.13)	2.69	1, 52	.049	.107
Backward trunk lean	**0.20 (0.09)**	**0.09 (0.20)**	7.34	1, 52	.124	**.009**
Left arm action	0.59 (0.27)	0.52 (0.26)	0.88	1, 52	.017	.354
Left arm action away from the body	**0.41 (0.17)**	**0.19 (0.25)**	14.75	1, 52	.221	**<.001**
Right arm action	0.59 (0.26)	0.52 (0.27)	0.92	1, 52	.017	.342
Right arm action forward	0.19 (0.19)	0.18 (0.13)	0.03	1, 52	.001	.857
Right arm action backward	0.15 (0.06)	0.15 (0.08)	0.00	1, 52	.000	.983
Right arm action away from the body	**0.43 (0.17)**	**0.19 (0.22)**	20.04	1, 52	.278	**<.001**
Right arm action toward the body	**0.12 (0.18)**	**0.36 (0.21)**	19.81	1, 52	.276	**<.001**
Symmetrical arms action	**0.05 (0.06)**	**0.10 (0.10)**	5.05	1, 52	.089	**.029**
Asymmetrical arms action	0.48 (0.20)	0.45 (0.20)	0.41	1, 52	.008	.523

Note. Values are presented as *M* (*SD*). Significant *p* values and respective means are marked in bold. ANOVA = analysis of variance.

Table 6 Robust Tests of Equality of Means for Behavior Variables for Positive and Negative Emotions

Behavior variable	Positive emotion	Negative emotion	Statistic[a]	*df*1	*df*2	Estimated ω^2	p
Vertical head tilt toward a downward position	**0.31 (0.16)**	**0.91 (0.16)**	75.034	1	50.499	0.293	**<.001**
Trunk facing	**0.78 (0.14)**	**0.40 (0.39)**	22.493	1	32.125	0.675	**<.001**
Trunk averted	**0.22 (0.14)**	**0.60 (0.39)**	22.493	1	32.125	0.675	**<.001**
Trunk lean toward a forward position	**0.06 (0.09)**	**0.18 (0.17)**	10.179	1	40.113	0.475	**.003**
Whole body moves or leans toward a backward position	**0.27 (0.07)**	**0.52 (0.18)**	42.004	1	32.896	0.366	**<.001**
Whole body is in an upright position	**0.56 (0.09)**	**0.35 (0.19)**	28.979	1	36.026	0.721	**<.001**
Left arm at side	**0.13 (0.21)**	**0.04 (0.09)**	4.331	1	35.408	0.235	**.045**
Left arm at side (close)	**0.02 (0.05)**	**0.14 (0.23)**	6.184	1	28.236	0.324	**.019**
Left shoulder lean toward a backward position	0.14 (0.13)	0.26 (0.35)	2.685	1	33.187	0.134	.111
Right arm at side (close)	**0.10 (0.15)**	**0.27 (0.22)**	11.376	1	46.341	0.489	**.002**
Right shoulder lean toward a backward position	0.25 (0.18)	0.18 (0.30)	2.845	1	44.616	0.018	.099
Gaze toward	**0.68 (0.13)**	**0.18 (0.30)**	62.173	1	34.912	0.849	**<.001**
Head action	**0.14 (0.21)**	**0.81 (0.23)**	122.910	1	51.509	0.693	**<.001**
Upward head tilt	0.14 (0.21)	0.05 (0.09)	3.524	1	34.202	0.189	.069
Trunk action	**0.22 (0.08)**	**0.45 (0.27)**	17.632	1	30.407	0.606	**<.001**
Forward trunk lean	**0.19 (0.11)**	**0.51 (0.25)**	39.803	1	35.245	0.418	**<.001**
Left arm action toward the body	**0.15 (0.17)**	**0.32 (0.25)**	7.589	1	45.418	0.378	**.008**

Note. Values are presented as *M* (*SD*). Significant *p* values and respective means are marked in bold.
[a]Asymptotically *F* distributed.

in an upright position, left arm action, right/left arm away from the body, spine movement toward a bent position, and forward trunk lean. These findings are in line with previous research on bodily cues associated with the internal dimensions of dominance versus submissiveness, pride versus shame, and confidence versus insecurity (Argyle, 1988; Carney et al., 2005, 2010; DePaulo & Friedman, 1998; Furley & Schweizer, 2020; Martens et al., 2012; Ridgeway, 1987; Ridgeway et al., 1985).

In sum, the results from Study 1 show that meaningful differences in certain NVBs can reliably be detected with the NBCSP as a function of acted internal states (e.g., emotions) during the soccer penalty preparation. For this reason, we attempted to use the NBCSP in a first exploratory study to measure the NVB of professional soccer players from the German Bundesliga as a function of whether they scored or missed the penalty.

Study 2: Using the NBCSP to Detect Differences in NVB Between Successful and Unsuccessful Penalties

Method

Participants. The same coders as in Study 1 ($n = 2$) coded the video stimuli in Study 2. The study was carried out in full accordance with the Declaration of Helsinki 1975, and written informed consent was obtained from all participants.

Stimuli. The video stimuli for the coders were obtained from the Deutsche Fußball Liga (German Soccer League). The Deutsche Fußball Liga gave us all recorded penalties in the German Bundesliga between 2011 and 2016. Initially, we received footage from almost 400 penalties. We screened all the penalties for suitability for the study depending on whether sufficient footage from the preperformance NVB of the penalty taker was shown. This led to a reduction of videos to 100: 69 scored versus 31 missed (which also resembles the success rate of 70% that is typically found in soccer penalties). For the coding study, we used a random selection procedure to reduce the videos to 48 (36 goals vs. 12 misses), given the amount of time that the behavioral coding takes. The videos were composed of different soccer players for each video from the German Bundesliga. The total set of video clips had a total of 6.588 frames, with 25 frames per second, and had an average duration of 137.25 frames (5.5 s). Coding all the videos in Study 2 took one coder approximately 15 hr.

The Coding System. The same coding system and procedure as in Study 1 were used in Study 2.

Results

Table 7 lists the behavioral variables that met the assumption of homogeneity of variance and were subsequently analyzed with multivariate analysis of variance. The analysis showed no statistically significant overall difference in behavioral displays for successful or missed penalties, $F(13, 34) = 1.920$, $p = .063$; Wilks' $\Lambda = .577$; $\eta_p^2 = .423$. Yet, in the subsequent analysis employing ANOVA, significant differences emerged for head facing in successful penalties ($M = 0.70$, $SD = 0.04$) and missed penalties ($M = 0.36$, $SD = 0.07$). Similar results were evident for head averted when the penalty was made ($M = 0.30$, $SD = 0.04$) compared with when a penalty was missed ($M = 0.63$, $SD = 0.07$).

For the rest of the behavior variables that did not meet the homogeneity of variance assumption, Welch's ANOVAs were conducted to investigate differences in bodily displays for successful and missed penalties. Table 8 shows the results for these analyses. For successful penalties, trunk is in an upright position ($M = 0.24$, $SD = 0.39$) was significantly different than for missed penalties ($M = 0.02$, $SD = 0.01$). Further significant differences as a function of missed versus scored penalties are listed in Table 8 with their means, p values, and the estimated effect size.

Discussion Study 2

The goal of Study 2 was to use the NBCSP to explore differences in a penalty taker's NVB as a function of whether they scored or missed the penalty. The results of Study 2 showed several differences in NVB for successful and missed penalties (see Tables 7 and 8). The postures head facing and head averted seem to be crucial indicators for successful penalties. This finding is in line with the previous research of Jordet and Hartman (2008), although they only looked at the behavior of whether penalty takers turned their

Table 7 MANOVA Result for Mean Differences of Behavior Variables for Goals and Misses

Behavioral variable	Goal	Miss	*F*	*df* (model, error)	η_p^2	*p*
Head facing	**0.70 (0.04)**	**0.36 (0.07)**	18.12	1, 46	.283	**<.001**
Head averted	**0.30 (0.04)**	**0.63 (0.07)**	17.95	1, 46	.281	**<.001**
Vertical head tilt toward an upward position	0.32 (0.27)	0.34 (0.27)	0.07	1, 46	.002	.790
Vertical head tilt toward a downward position	0.33 (0.33)	0.25 (0.26)	0.59	1, 46	.013	.448
Trunk lean toward a forward position	0.46 (0.36)	0.50 (0.26)	0.15	1, 46	.003	.701
Left arm at side	0.01 (0.02)	0.01 (0.01)	0.02	1, 46	.000	.883
Right arm at side (very close, almost touching the trunk)	0.05 (0.18)	0.16 (0.21)	3.76	1, 46	.075	.059
Both arms held in front	0.01 (0.04)	0 (0)	0.47	1, 46	.010	.495
Trunk action	0.05 (0.18)	0 (0)	1.05	1, 46	.022	.310
Left arm action toward the body	0.07 (0.19)	0.01 (0.01)	1.05	1, 46	.022	.311
Right arm action forward	0.03 (0.15)	0 (0)	0.63	1, 46	.014	.430
Right arm action backward	0 (0)	0 (0)	0.59	1, 46	.013	.446
Asymmetrical arms action	0.21 (0.33)	0.28 (0.33)	0.34	1, 46	.007	.565

Note. Values are presented as *M* (*SD*). Significant *p* values and respective means are marked in bold. MANOVA = multivariate analysis of variance.

Table 8 Robust Tests of Equality of Means for the Behavior Variables for Successful or Missed Penalties

Behavior variable	Goal	Miss	Statistic[a]	*df*1	*df*2	Estimated ω^2	*p*
Trunk facing	0.50 (0.36)	0.38 (0.22)	2.192	1	31.265	0.099	.149
Trunk averted	0.49 (0.36)	0.62 (0.22)	2.467	1	31.396	0.119	.126
Trunk is in an upright position	**0.24 (0.39)**	**0.02 (0.01)**	11.449	1	35.179	0.491	**.002**
Spine movement toward a bent position	**0.61 (0.41)**	**0.97 (0.06)**	26.454	1	38.850	0.702	**<.001**
Whole body is in an upright position	**0.81 (0.27)**	**0.98 (0.04)**	13.683	1	38.725	0.540	**.001**
Left arm at side (close)	**0.62 (0.38)**	**0.97 (0.04)**	28.468	1	37.457	0.337	**<.001**
Left arm action away from the body	**0.07 (0.24)**	**0 (0)**	27.770	1	36.742	0.712	**<.001**
Right arm action	**0.67 (0.37)**	**0.97 (0.04)**	22.559	1	37.288	0.666	**<.001**
Right arm action away from the body	**0.39 (0.22)**	**0.09 (0.06)**	53.616	1	44.704	0.829	**<.001**
Right arm action toward the body	**0.23 (0.34)**	**0.60 (0.15)**	25.333	1	41.344	0.692	**<.001**
Symmetrical arms action	**0.13 (0.30)**	**0.01 (0.01)**	6.673	1	35.191	0.344	**.014**
Right shoulder lean toward a forward position	**0.05 (0.10)**	**0.28 (0.16)**	20.316	1	13.858	0.641	**.001**
Gaze downward	**0.11 (0.18)**	**0.83 (0.09)**	329.847	1	40.512	0.968	**<.001**

Note. Values are presented as *M* (*SD*). Significant *p* values and respective means are marked in bold. Robust tests of equality of means cannot be performed for behavior variables—left arm at side (very close, almost touching the trunk), left arm held in front, left shoulder lean toward a backward position, right arm held in front, right shoulder lean toward a backward position, gaze toward, head action, upward head tilt, downward head tilt, forward trunk lean, backward trunk lean, left arm action, left arm action forward, whole body moves or leans toward a backward position—because at least one group has 0 variance.
[a]Asymptotically *F* distributed.

back toward the goalkeeper after placing the ball on the penalty mark or walked backward facing the goalkeeper to the spot where they were going to commence their run-up. This finding is further in line with research in penalties that has shown an association between looking toward the target (i.e., the goal) and success in scoring penalties (Wilson et al., 2009). In addition, this finding can be interpreted as supportive of research on penalties demonstrating that soccer players who avert their gaze from the goal area are perceived in a more negative manner by opposing goalkeepers and, consequently, the goalkeepers expect to perform better against these players (Furley, Dicks, & Memmert, 2012; Furley, Dicks, et al., 2012; Greenlees et al., 2008).

Another significant indicator differentiating between successful and unsuccessful penalty kicks is gaze downward. Obviously, penalty takers in soccer need to look downward to the ball to pick up information about the location of the ball in order to hit it accurately. However, it seems that spending "too" much time looking downward is associated with both negative emotional states (Study 1) and unsuccessful penalty performance (Study 2). When scoring penalties (Study 2) or showing positive emotional displays (Study 1), penalty takers on average only spent about 40% of the time looking downward as opposed to over 80% of the time when missing the penalty or showing negative emotional displays. Again, this finding is supportive of previous research that has linked gaze behavior to success in penalties (Greenlees et al., 2008; Jordet & Hartman, 2008; Wilson et al., 2009).

It seems noteworthy that there was some interesting overlap between some NVBs identified in Study 1 as a function of negative/positive internal states and NVBs in Study 2 as a function of missed/scored penalties. For example, concerning the behavioral indicator of facing the goalkeeper, penalty takers were facing the goalkeeper 70% of the time when they scored the penalty in Study 2. This was similar to the 77% of the time in the positive emotion clips in Study 1. For the missed penalties in Study 2, penalty takers were only facing the goalkeeper 36% of the time and 12% of the time for the negative emotion conditions in Study 1. These analogies between Study 1 and Study 2 might be suggestive that penalty takers in Study 2 were experiencing some of the positive or negative internal states that were investigated in Study 1, and this affected penalty performance. More specifically, a dominant and confident penalty taker in Study 2 might have been more likely to score and might have expressed these experienced internal states in a similar way to the actors in Study 1. However, we acknowledge that this is speculative at present, and more research is needed on the correspondence of NVB, emotions, and performance in sport.

One unanticipated finding was that the proportion duration of the whole body in an upright position was lower for successful penalties as opposed to unsuccessful penalties. This outcome stands in contrast to Study 1 and to previous studies (Tracy et al., 2009) that suggested that an upright posture is associated with positive emotional states. We do not have an explanation for this; however, we want to emphasize that this finding needs to be corroborated in further research before concluding that an upright position of the whole body might be an indicative cue for successful penalties.

Another significant difference that was evident in Study 2 was right arm action away from the body. Again, some caution is warranted concerning this cue, as arm action during penalty preparation is often part of sport-specific movements (i.e., the biomechanics of kicking). Nevertheless, for successful penalties, right arm action was evident on average during 39% of the video duration in the successful penalties and only during 9% of the unsuccessful penalties. Again, this was a similar pattern as compared with the positive emotions (43%) and negative emotions (19%) in Study 1. Several other significant indicators for arm actions were evident in the analyses, but equally, have to be interpreted with caution. Potentially, these findings might suggest that certain arm actions are important to get the biomechanics right for an optimal penalty execution. If this is not the case (e.g., limited right arm action), then penalty execution might suffer, contributing to less successful kicks.

In summary, the results from Study 2 corroborate the findings of previous studies showing that lay people can pick up valid information from athletes' NVB to make fairly accurate inferences about internal states (Brimmell et al., 2018; Furley & Schweizer, 2014, 2016a; Furley et al., 2018) by identifying some objectively measured postures and behaviors from professional soccer players during their penalty preparation with the NBCSP. Supporting previous research (Jordet & Hartman, 2008), successful penalty takers spent more time facing the goalkeeper and less time looking downward. Furthermore, it seemed that successful penalty takers showed more movement with their right arm. Somewhat surprisingly, they also showed a less upright whole-body posture.

General Discussion

The goal of the present research was to adapt the BAP (Dael et al., 2012a) to the context of soccer penalties, validate, and initially use this system (NBCSP) to explore naturally occurring NVB in high-pressure performance environments. Study 1 demonstrated that the NBCSP had good to excellent kappa values for intercoder reliability regarding the occurrence and temporal precision of certain postures and NVBs, although segmentation of behaviors proved to be problematic. Regarding validation of the NBCSP, Study 1 showed that the coding system could differentiate certain postures and behaviors as a function of emotional valence (i.e. positive vs. negative emotional states). Study 2 demonstrated that the NBCSP could be used to identify differences in NVB for successful and missed penalties. More specifically, the preparatory behavior of penalty takers seems to differ in the amount of time they spend looking toward the goal, toward the ground, in their right arm movement, and in terms of how upright their whole-body posture is.

The results of Study 2 corroborate previous research that has linked gaze behavior to success in penalties (Jordet & Hartman, 2008; Wilson et al., 2009). In addition, the results from Study 2 are in line with research that has demonstrated that a gaze averted from the goal in penalty takers affects the impression formation and outcome expectation of goalkeepers (Furley, Dicks, & Memmert, 2012; Furley, Dicks, et al., 2012; Greenlees et al., 2008). This might suggest that goalkeepers have learned that there is a contingency between gaze behavior toward the goal and penalty performance, which in turn affects their impression of the penalty taker and their anticipated performance against him. Alternatively, it might be a more general effect, as an averted gaze is perceived negatively in a variety of social situations (e.g., Argyle, 1988; Matsumoto et al., 2013).

Previous research on penalties has distinguished between a keeper-dependent and a keeper-independent penalty-taking strategy (e.g., van der Kamp, 2006). In the keeper-dependent strategy, a penalty taker chooses a target area (e.g., the bottom right corner) before or during the run-up and continuously (re)assesses the target area relative to the goalkeeper's actions. In the keeper-independent strategy, a penalty taker decides on a target area to kick the ball before the run-up (or even before the match) and maintains that decision irrespective of the goalkeepers' actions during the run-up. Pertinent to the present research, a study has suggested that these different strategies coincide with different NVBs during the run-up (Noël et al., 2015). In addition, research has shown that penalty takers use deceptive strategies by artificially altering and/or over-exaggerating their NVB in terms of their kinematics (Smeeton & Williams, 2012) and gaze behavior (Wood et al., 2017). Taken together, this research highlights that various other factors besides internal states like emotions affect the NVB during the preparation of penalty kicks. Therefore, further research should attempt to distinguish between the deliberate use of NVB (e.g., in attempts of athletes using NVB to manipulate or deceive their opponents) and NVB that automatically coincides with emotional states (see Furley & Schweizer, 2020 for more detail on the distinction between deliberate and autonomous forms of NVB).

The present research has some notable strengths and weaknesses. We consider it a strength that the present research (to the best of our knowledge) presents the first attempt to establish a comprehensive behavioral coding system that can be used for exploratory research in the context of sports. While previous attempts have been made to code highly specific NVBs in an ad hoc manner (Furley et al., 2017; Jordet & Hartman, 2008; Moesch et al., 2015; Moll et al., 2010), it has been criticized (Furley & Schweizer, 2020) that there are no comprehensive coding schemes to explore naturally occurring NVB or to use these coding schemes as a dependent variable (e.g., to investigate differences between successful and less successful performances). In this respect, the present research highlights how the BAP can be adapted to certain contexts and serve as a useful instrument for both researchers and practitioners with an interest in NVB.

However, the present research is not without limitations. The first limitation is the problem of analyzing the segmentation of movements, which was possible in the BAP, but not the NBCSP. This might be due to the nature of the videos showing the preparatory behavior of a soccer penalty kick and therefore showing fairly short sequences of fast movements that did not allow for the accurate coding of the transformation and adaptation phases. Another limitation pertains to Study 2, as it only analyzed a small sample of televised recordings from the German Bundesliga and did not show standardized recordings or camera perspectives of the preparatory penalty behaviors. While we made sure that only videos were included that met the criteria of the same interlocutor direction as applied in the validation analysis, the videos still differed to some extent. Furthermore, we had to exclude about half of the available videos from the sampled material due to large differences in perspective (e.g., from behind, from the left) that were not sufficient to ensure proper coding with the NBCSP. Therefore, we have to acknowledge that televised recordings of sports events can be problematic for NVB coding, and efforts have to be made to ensure that codings are based on similar video material. Another limitation was that both the BAP and the NBCSP at present do not allow one to code lower body movements, which arguably might also have an impact on emotional displays in soccer. Moreover, further validation and reliability studies of the BAP and the NBCSP would be beneficial to help establish their use in sport settings. A helpful approach in this respect could be to compare manual codings with kinematic analyses in real-world settings. Finally, a known problem with behavioral coding is the time-consuming nature of this method. Therefore, we recommend that a reduction of variables should be considered, depending on the research question.

Although measuring naturally occurring NVB of the whole body is a challenging and time-consuming endeavor, we consider sports a fruitful context in this respect. The present research demonstrated that the BAP can be considered a useful methodological tool and adapted to certain contexts of competitive sports. As hardly any other social context is documented and video recorded to a similar degree (Furley, 2019) and is as replete with naturally occurring nonverbal expressions, we believe that valuable insights can emerge from this research approach.

Notes

1. Tukey post hoc tests for the left arm action showed differences in the proportion of duration between the self-confidence condition and the emotions submissiveness ($p = .020$) and dominance ($p = .021$) and between dominance and shame ($p = .003$). For right arm action away

from the body, Tukey post hoc tests showed differences between the positive emotional display condition self-confidence and shame ($p = .002$) and between the negative emotion shame and all three positive emotions, self-confidence ($p = .002$), pride ($p < .001$), and dominance ($p = .001$). For the behavioral categories left arm at side very close, $F(5, 48) = 1.007$, $p = .424$, $\eta_p^2 = .095$, left arm held in front, $F(5, 48) = 1.472$, $p = .216$, $\eta_p^2 = .133$, right arm held in front, $F(5, 48) = 0.529$, $p = .754$, $\eta_p^2 = .052$, right arm action forward, $F(5, 48) = 1.365$, $p < .251$, $\eta_p^2 = .124$, right arm action backward, $F(5, 48) = 0.161$, $p = .976$, $\eta_p^2 = .016$, and asymmetrical arm action, $F(5, 48) = 2.111$, $p = .080$, $\eta_p^2 = .180$, no differences for the three positive and three negative emotional conditions could be found.

2. Games-Howell post hoc tests were performed to examine differences between the six experimental conditions and can be found in the supplementary material (https://osf.io/d73zv/files/).

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