The Impact of Contextual Priors and Anxiety on Performance Effectiveness and Processing Efficiency in Anticipation

David P. Broadbent[1,2*]; N. Viktor Gredin[2]; Jason Rye[2]; A. Mark Williams[3]; Daniel T. Bishop[1,2]

[1] *Centre for Cognitive Neuroscience, College of Health and Life Sciences, Brunel University London, London, United Kingdom*

[2] *Division of Sport, Health and Exercise Sciences, Department of Life Sciences, Brunel University London, London, United Kingdom*

[3] *Department of Health, Kinesiology, and Recreation, University of Utah, Salt Lake City, Utah, United States of America*

*Corresponding author

Dr David Broadbent

Department of Life Sciences (HNZW 271)

Brunel University London

London

UB8 3PH

Phone: +44 (0)1895 265426

E-mail: david.broadbent@brunel.ac.uk

Abstract

It is proposed that experts are able to integrate prior contextual knowledge with emergent visual information to make complex predictive judgments about the world around them, often under heightened levels of uncertainty and extreme time constraints. However, limited knowledge exists about the impact of anxiety on the use of such contextual priors when forming our decisions. We provide a novel insight into the combined impact of contextual priors and anxiety on anticipation in soccer. Altogether, 12 expert soccer players were required to predict the actions of an oncoming opponent while viewing life-sized video simulations of 2-versus-2 defensive scenarios. Performance effectiveness and processing efficiency were measured under four conditions: no contextual priors (CP) about the action tendencies of the opponent and low anxiety (LA); no CP and high anxiety (HA); CP and LA; CP and HA. The provision of contextual priors did not affect processing efficiency, but it improved performance effectiveness on congruent trials. Anxiety negatively affected processing efficiency, but this did not affect the use of contextual priors or influence performance effectiveness. It appears that anxiety and prior contextual information impact attentional resources independent of each other. Findings are discussed with reference to current models of anticipation and anxiety.

Keywords: decision making; soccer; probabilistic information; mental effort; expertise

Introduction

In many professional domains, experts have been shown to make accurate decisions under severe time constraints and extreme pressure (Williams, Ford, Eccles, & Ward, 2011). In sport, researchers have focused primarily on the ability of experts to use vision to identify key environmental information, such as opponent kinematics, in order to predict upcoming events (Mann, Williams, Ward, & Janelle, 2007). However, researchers have recently highlighted the importance of contextual (non-kinematic) sources of information in shaping anticipatory behavior (Loffing & Cañal-Bruland, 2017). Accordingly, Cañal-Bruland and Mann (2015) advocated the need for more research in this area to guide current practices and ultimately to develop an overarching theoretical framework that may predict and explain anticipatory behaviour. Moreover, research is required to examine the interaction between anxiety and the use of contextual information to guide anticipation, as contradictory explanations currently exist (Cocks, Jackson, Bishop, & Williams, 2015; Runswick, Roca, Williams, Bezodis, & North, 2017). In this paper, we provide novel insight into the impact of contextual priors and anxiety on performance effectiveness and processing efficiencies using a novel, video-based soccer anticipation task.

In the sport domain, a large body of work has demonstrated that skilled athletes utilise advance environmental information such as opponent kinematics to predict upcoming actions (Williams et al., 2011). In contrast, it is only relatively recently that researchers have considered the contribution of contextual sources of information (Cañal-Bruland & Mann, 2015). Several sources of contextual information that contribute to anticipation have been identified, including the relative positions of players (Murphy et al., 2016; Cocks et al., 2015), the state of the game (Runswick et al., 2017), and contextual priors regarding the action tendencies of opponents (Loffing, Stern, & Hagemann, 2015; Mann, Schaefers, & Cañal-Bruland, 2014; Navia, van der Kamp, & Ruiz, 2013). Using a soccer-based

anticipation task, Gredin, Bishop, Broadbent, and Williams (in press) demonstrated that, for soccer experts, contextual priors regarding opponents' action tendencies guided visual attention toward more pertinent environmental information and that this, in turn, biased their expectations early in the trial. When the final action was congruent with the opponent's action tendencies, contextual priors enhanced performance for both experts and novices. However, on incongruent trials, contextual priors had a negative impact on the performance of novices, but not experts: they were able to integrate late kinematic information with the contextual priors to confirm their advance expectations and consequently maintain performance. Whilst it is acknowledged that experts can utilise contextual sources of information to facilitate anticipation, it remains relatively unclear as to how various constraints shape the use of contextual information, such as changes in anxiety levels (Cañal-Bruland & Mann, 2015).

The anxiety-performance relationship has been widely researched, resulting in the development of numerous theories and models. *Attentional Control Theory* (ACT; Eysenck, Derakshan, Santos & Calvo, 2007) is one of the more commonly cited theories and it has several assumptions at its core. ACT predicts that cognitive anxiety impacts working memory by depleting attentional resources, thereby reducing the amount of free attentional capacity to engage in task-related activities. This shift in attentional allocation adversely affects not only performance effectiveness, but also *processing efficiency*, an index of the resources invested to complete the task. Processing efficiency can be measured through changes in the underlying processes used during performance, such as mental effort (e.g., Wilson, Smith, Holmes, 2007) or visual search behaviours (e.g., Wilson, Wood & Vine, 2009). Notably, anxiety is said to impair efficient functioning of the goal-directed attentional system and increases reliance on the stimulus-driven attentional system (Corbetta & Shulman, 2002). Specifically, threatening stimuli in the environment preferentially attract visual attention and

are consequently difficult to disengage from (Nieuwenhuys & Oudejans, 2010). Nieuwenhuys and Oudejans (2012) built upon ACT and proposed an *Integrated Model of Anxiety and Perceptual-Motor Performance,* which details how, if attentional resources are available, individuals can use compensatory strategies, such as increased mental effort, to enforce goal-directed attention and maintain levels of performance effectiveness, at the cost of processing efficiency (see also, Eysenck & Derakshan, 2011).

Many researchers have tested the predictions from these models, but only a few have specifically examined the impact of anxiety on the use of contextual information during anticipation. Cocks et al. (2015) manipulated video stimuli from professional tennis matches such that kinematic information was removed in one condition by replacing the players with animated blocks so that only contextual information (i.e., sequential relative positioning of the players) was available to the participants. Processing efficiency was significantly reduced in this animated condition due to the task requiring increased mental effort. When the animated condition was coupled with high anxiety there were not enough resources available to maintain performance effectiveness (Cocks et al., 2015). In contrast, Runswick et al. (2017) showed that cricket batsmen's mental effort did not increase when they were provided with relevant contextual information (field placings, time and score), as they attempted to play a spin bowler's deliveries. Consequently, whilst anxiety affected the batsmen's visual attention, this was not compounded by the additional contextual information; hence, the batsmen could increase their mental effort in order to maintain performance effectiveness (Eysenck et al., 2007; Nieuwenhuys and Oudejans, 2012). The authors argued that anxiety and contextual information impact attentional resources through different mechanisms, and act on working memory in a cumulative, rather than an interactive, manner (Runswick et al., 2017). These papers highlight the ambiguous nature of current findings. It may be the case that various sources of contextual information are processed differently and thus, when

coupled with anxiety, they differentially affect processing efficiency and performance effectiveness. To date, no published report exists that has examined the impact of anxiety on perceptual-cognitive processes when contextual priors regarding an opponent's tendencies have been manipulated (Cañal-Bruland & Mann, 2015).

We present a novel attempt to examine the impact of anxiety and contextual priors on performance effectiveness and processing efficiencies using a film-based simulation of defensive scenarios in soccer. A group of expert soccer players predicted the direction (left or right) of a simulated life-sized opponent in 2-versus-2 soccer scenarios. Using a repeated measures design, performance effectiveness (response accuracy) and processing efficiency (mental effort) were measured under four conditions: no contextual priors regarding the action tendencies of opponents and low anxiety; no contextual priors and high anxiety; contextual priors and low anxiety; and contextual priors and high anxiety. We predicted that expert soccer players would be able to integrate contextual priors with environmental information to enhance performance on actions which are congruent with the tendencies of opponents, and maintain performance on incongruent actions (cf. Gredin et al., in press). In accordance with ACT, it was predicted that high anxiety will negatively affect individuals' processing efficiency as they increase their mental effort in order to maintain performance effectiveness (Eysenck et al., 2007).

With regard to the impact of anxiety on the use contextual information, previous research seems to suggest that these processes use attentional resources independent of each other and the subsequent impact on performance is dependent upon the resources available. Our first prediction is that the additional contextual information will increase the mental effort required to perform the task and thus, when coupled with high anxiety, the resources will not be available to maintain performance effectiveness (Cocks et al., 2015). If this is the case, then we also predict that performance in the presence of contextual priors will be

adversely affected in the high anxiety condition relative to the low anxiety condition. On the other hand, if the processing of contextual priors does not deplete cognitive resources then performance effectiveness can be maintained by increasing mental effort (Runswick et al., 2017). With this in mind, we predict that performance would not differ between low and high anxiety conditions when prior contextual information is provided.

Method

Participants

Altogether, 12 expert soccer players (*M* age = 21.28, *SD* = 2.05), with over 10 years of experience playing organised and competitive soccer (*M* = 11.5 yrs, *SD* = 2.35 yrs), participated. All participants self-classified as defenders or defensive midfield players. The sample size was derived from previous research, in which contextual information and anxiety significantly impacted anticipation task performance (Cocks et al., 2015). Written informed consent was obtained prior to taking part and participants had a right to withdraw at any point. The experiment was conducted in accordance with the 1964 Declaration of Helsinki. Approval was obtained from the lead institution's research ethics committee.

Test stimuli

The test stimuli involved simulations of a 2-versus-2 counter attack scenario in soccer (see also, Gredin et al., in press). In each sequence, an opponent (player in possession; PiP) dribbled the ball towards a moving camera. A second opponent followed the PiP, whilst being marked by a defender. In a counterbalanced design, the second opponent started and finished their run on either the left or right of the opponent in possession of the ball. The PiP then either passed or dribbled the ball to the left or right of the moving camera. The participants viewed this footage from a first-person perspective as if they were an active defender in the scenario. The participant's task was to anticipate the *direction* of the PiP's

final action. A UEFA qualified coach selected 20 trials that he considered to be most representative of actual game play, from a total of 48 test stimuli. In these 20 trials, the final action (pass or dribble) was to the left on 13 of the trials (65%; congruent with the PiP's action tendencies) and to the right in 7 trials (35%; incongruent). Footage was edited using Adobe Premiere CS5, San Jose, USA. All trials started with a one-second freeze frame and the footage was occluded 120ms prior to the final action taking place. Pilot testing using skilled soccer players, none of whom participated in the current study, demonstrated that this occlusion ensured that participants could predict the upcoming action at a level that was above chance, but below a ceiling level of performance. The 20 trials selected for this study were repeated four times to create 80 test stimuli. The test footage was projected on to a large clear white wall using an NEC PE401H projector (NEC, Tokyo, Japan).

Design and Materials

We employed a 2 (priors condition) x 2 (anxiety condition) repeated measures design. The participant's task was to predict the direction (left or right) of the PiP's final action. Performance effectiveness (response accuracy) and processing efficiency (mental effort ratings) were the dependent variables.

Performance effectiveness

Response accuracy was defined as the percentage of responses in which the direction of the PiP's final action was correctly predicted. Once the footage was occluded on each trial, participants had three seconds in which to verbally indicate the direction they thought the ball was going (left or right).

Processing efficiency

Mental effort scores were collected following each block of trials using the Rating Scale for Mental Effort (RSME; Zijlstra, 1993). The scale requires participants to provide a number from 0 to 150 to denote their perceived mental effort on the task across the block of trials. Nine descriptors are used to assist participants, and ranged from a score of 2 ("absolutely no effort") to 113 ("extreme effort").

Anxiety manipulation check

The Mental Readiness Form-3 (MRF-3) was used to measure competitive state anxiety (Krane, 1994). This 3-question form was completed at the end of each block of trials. We assessed the levels of cognitive anxiety, somatic anxiety and self-confidence on an 11-point Likert scale ranging from "worried" to "not worried", "not tense" to "tense", and "not confident" to "confident", respectively.

Procedure

Prior to the commencement of the task, participants were required to complete a consent form and demographic questionnaire. The procedure was explained to the participants and they viewed three familiarisation trials. The 80 test stimuli were then presented in 8 blocks of 10 trials. Each trial lasted approximately five seconds with inter-trial intervals of three seconds. Participants were given a two-minute break between each block of trials. Each testing session took no longer than 60 min to complete.

In four of the blocks, participants were provided with contextual priors about the action tendencies of the PiP presented on film, whereas on the other four blocks participants received no additional information. This information was provided verbally as the percentage likelihood of the PiP's outcome; left (65%; congruent trials) or right (35%; incongruent trials). Within the two information conditions, participants completed the trials under low-

and high-anxiety conditions, in an A-B-B-A (low-anxiety, high-anxiety, high-anxiety, low-anxiety) design. With this experimental design, the 20 original test stimuli were repeated across four conditions: no prior information and low anxiety; no prior information and high anxiety; additional prior information and low anxiety; and additional prior information and high anxiety. The order of presentation of conditions was counterbalanced across participants.

In the high anxiety conditions, procedures from previous research were used to induce anxiety (see Cocks et al., 2015). First, prior to starting the high anxiety conditions, participants were informed that their results were going to be evaluated by their Head Coach, in order to elicit evaluation apprehension. To elicit further apprehension, a video camera (Canon XF100, Tokyo, Japan) was placed behind them; they were told that they were being recorded and this video would be available for their coach to assess their performance (though there was no actual recording). In the low anxiety conditions, participants were told to relax and treat the task like a standard training session. On completion of each session, participants were debriefed and told that the high anxiety condition was created for experimental purposes only.

Data analysis

A preliminary analysis was undertaken to ensure that the separate high- and low-anxiety blocks in each information condition could be combined into 40 trials for high- and low-anxiety (Cocks et al., 2015). Response accuracy, processing efficiency score, and scores on the MRF-3 were compared across the respective conditions using paired samples t-tests. All comparisons were found to be non-significant (p's > .05) and, as such, the separate low- and high-anxiety blocks in each information condition were combined.

Response accuracy data were submitted to a 2 Priors (no priors, additional priors) x 2 Anxiety (low, high) x 2 Outcome (congruent, incongruent) repeated measures analysis of variance (ANOVA). Processing efficiency scores were submitted to a 2 Priors (no priors, additional priors) x 2 Anxiety (low, high) repeated measures ANOVA. Bonferroni pairwise comparisons were used for any significant within-participant main effects. Any significant interactions were subject to paired samples t-tests based on a priori predictions. Partial eta squared (η_p^2) was used as a measure of effect size. For the anxiety manipulation check, paired samples t tests were run on the MRF-3 scale ratings. The alpha level for significance was set at $p < .05$.

Results

Anxiety Manipulation Check

Paired samples t-tests revealed that participants reported significantly higher scores on cognitive anxiety in the high ($M = 4.58$, $SD = .62$), compared to the low anxiety condition ($M = 3.38$, $SD = .79$), $t(11) = 4.42$, $p < .01$, indicating that our anxiety manipulation was successful. However, the manipulation also increased participants' confidence levels under high ($M = 4.44$, $SD = 0.95$) compared to low ($M = 3.60$, $SD = 1.06$) anxiety conditions, $t(11) = 3.90$, $p < .01$. The anxiety manipulations did not alter somatic anxiety, $t(11) = .69$, $p = .51$.

Performance Effectiveness

The mean (±SD) response accuracy scores across the four experimental conditions on congruent and incongruent trials are presented in Table 1. ANOVA revealed no main effect for priors, F (1, 11) = .80, $p = .39$, $\eta p^2 = .07$, anxiety, F (1, 11) = 2.37, $p = .15$, $\eta p^2 = .18$, or outcome, F (1, 11) = 3.79, $p = .08$, $\eta p^2 = .26$. However, there was a significant Priors x Outcome interaction, $F (1, 11) = 16.87$, $p < .01$, $\eta p^2 = .61$. This interaction is presented in

Figure 1. Follow up t-tests revealed that on congruent trials response accuracy was significantly greater with the addition of contextual priors (M = 84.38, SD = 9.03) compared to when no additional information was provided (M = 73.92, SD = 8.27), p < .01. On the incongruent trials, while the addition of probabilistic information resulted in a lower response accuracy (M = 70.08, SD = 9.15), compared to the condition with no additional information (M = 77.04, SD = 9.36), albeit this did not reach significance, p = .09. There were no other interactions, p's > .05.

Processing Efficiency

The mean (±SD) rating of mental effort across the four experimental conditions is presented in Figure 2. ANOVA revealed no main effect of priors, F (1, 11) = 2.27, p = .16, ηp^2= .17. However, there was a significant main effect of anxiety, F (1, 11) = 66.67, p < .01, ηp^2= .86. Pairwise comparisons revealed that rating of mental effort significantly increased in the high anxiety conditions (M = 61.77, SD = 2.69) compared to the low anxiety conditions (M = 43.23, SD = 2.23), p < .01. There was no Priors x Anxiety interaction, F (1, 11) = .67, p = .44, ηp^2= .06.

Discussion

We used a video-based soccer anticipation task to provide novel insights in to the impact of contextual priors and anxiety on anticipation. Performance effectiveness and processing efficiency were examined across four conditions with differing levels of prior contextual information and anxiety. We predicted that performance would be enhanced by the addition of contextual priors regarding the action tendencies of the PiP (Gredin et al., in press). Moreover, we hypothesised that anxiety would negatively impact processing efficiency as individuals increase their mental effort on the task to maintain performance effectiveness (Eysenck & Derakshan, 2011). Finally it was predicted that the impact of

anxiety on the use of contextual priors would be dependent on the cognitive resources available (Cocks et al., 2015; Runswick et al., 2017).

As predicted, findings support the notion that the addition of contextual information enhances anticipation (Cañal-Bruland & Mann, 2015). Specifically, the findings demonstrate that experts can integrate prior information regarding an opponent's action tendencies with environmental information, to facilitate increased performance when the action is congruent with the tendencies of opponents (Mann, et al., 2014; Loffing et al., 2015). On trials which were incongruent, while response accuracy did decrease slightly when prior information was provided, this did not reach significance, suggesting that performance did not differ across conditions (cf. Gredin, et al., in press). The slight decrease in performance may be due to the use of the temporal occlusion paradigm. Researchers have shown that, for unexpected actions, experts use opponent kinematics in the final stages of an action to update their prior expectations and avoid decrements in performance (Gredin et al., in press). The temporal occlusion paradigm may remove important kinematic information and increase the level of uncertainty regarding this information source. Therefore individuals become biased by the contextual priors, resulting in a decrease in performance on incongruent trials (cf., Loffing et al., 2015). The current findings add to the growing body of research that has identified several different sources of contextual information and the impact they have on anticipation (Cañal-Bruland & Mann, 2015).

The manipulation of anxiety was successful as shown through an increase in cognitive state anxiety. In line with the ACT model and Integrated Model of Anxiety and Perceptual-Motor Performance, processing efficiency was negatively affected, while performance effectiveness was maintained, in the high-anxiety, relative to the low anxiety, condition (Eysenck et al., 2007; Nieuwenhuys and Oudejans, 2012). The participants increased their mental effort when more anxious, in an attempt to maintain performance effectiveness

(Eysenck & Derakshan, 2011). It appears that anxiety served as a motivational tool, as increased confidence was found in the high anxiety conditions. Anxiety was manipulated by telling participants that their performance would be recorded and then evaluated by their coach. Previously, researchers who have used this technique but have included 'false feedback' during the experimental conditions (Cocks et al., 2015; Runswick et al., 2017). In the current experiment, evaluation apprehension was increased but false feedback was not provided, so if the individuals believed they were doing well on the task then they may be motivated to maintain their performance. In future, researchers should give due consideration to the protocols used to increase anxiety as this may impact attentional control differentially (Eysenck & Derakshan, 2011).

Our novel attempt to examine whether changes in anxiety alter the use of contextual priors showed support for the prediction that these two factors impact attentional resources independent of each other (Runswick et al., 2017). The effects of anxiety are dependent on the type of contextual information and the associated cognitive demands. In the current experiment, the inclusion of additional contextual priors regarding the action tendencies of the opponent did not affect processing efficiency, leaving attentional resources available for participants to increase mental effort and counteract the effects of anxiety to maintain performance (Nieuwenhuys & Oudejans, 2012). This notion is supported by Runswick et al. (2017) who reported that adding situation-specific information in a cricket-batting task did not increase mental effort and subsequently, no interaction was reported when anxiety levels were manipulated. In contrast, the contextual information only condition in the paper by Cocks et al. (2015) did reduce processing efficiency on the task due to increased mental effort. As such, when this condition coincided with reduced processing efficiency under anxiety, there were not enough attentional resources available to maintain performance

(Eysenck et al., 2007). It appears that the effect of contextual information on processing efficiency occurs irrespective of changes in anxiety.

A limitation of the current experiment is the fact that perception and action are decoupled through the use of the temporal occlusion paradigm in an attempt to provide experimental control. The use of this method raises concerns over the external validity of the findings and their relevance to real world applications (Pinder, Davids, Renshaw, & Araujo, 2011). In future, researchers should use more representative task designs in order to maximise perception-action coupling. In a similar vein, the different sources of information available, and levels of anxiety, should be manipulated such that they are in line with the performance environment to examine the true impact of these factors on perceptual-cognitive processes (Cañal-Bruland & Mann, 2015). Moreover, in the current study there may be an overreliance on subjective ratings as a measure of cognitive effort. In future, researchers should look to use neuroscientific methods such as electroencephalography (EEG) to provide greater insight as to the impact of anxiety and contextual information on visual attention and working memory demand (Bishop, Wright, Jackson, & Abernethy, 2013).

In summary, we provide a novel insight into the combined impact of contextual priors and anxiety on performance effectiveness and processing efficiencies using a video-based soccer anticipation task. Our findings demonstrate that while providing contextual priors about the action tendencies of the PiP may not increase the cognitive demands of the task, experts are able to integrate it with environmental information to enhance performance effectiveness (Cañal-Bruland & Mann, 2015). Moreover, we report that anxiety negatively affected processing efficiency, but did not affect performance effectiveness, as individuals were able to increase mental effort and maintain performance levels (Eysenck & Derakshan, 2011; Nieuwenhuys & Oudejans, 2012). It appears that contextual information and anxiety influence performance through different mechanisms and impact attentional resources

independent of each other (cf., Runswick et al., 2017). The suggestion is that the influence of anxiety on the use of contextual information is contingent on the attentional resources available when performing the primary anticipation task. Future research is required to confirm this notion.

References

Bishop, D. T., Wright, M. J., Jackson, R. C., & Abernethy, B. (2013). Neural bases for anticipation skill in soccer: an fMRI study. *Journal of Sport and Exercise Psychology*, *35*, 98-109.

Cañal-Bruland, R., & Mann, D. L. (2015). Time to broaden the scope of research on anticipatory behavior: a case for the role of probabilistic information. *Frontiers in Psychology, 6,* 1–3.

Cocks, A. J., Jackson, R. C., Bishop, D. T., & Williams, A. M. (2015). Anxiety, anticipation and contextual information: A test of attentional control theory. *Cognition and Emotion, 30,* 1037–1048.

Corbetta, M., & Shulman, G. L. (2002). Control of goal-directed and stimulus-driven attention in the brain. *Nature reviews. Neuroscience, 3,* 201.

Eysenck, M. W., & Derakshan, N. (2011). New perspectives in attentional control theory. Personality and Individual Differences, 50, 955–960.

Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: Attentional control theory. Emotion, 7, 336–353.

Gredin, N. V., Bishop, D. T., Broadbent, D. P., & Williams, A. M. (in press). Experts Integrate Contextual Priors and Environmental Information to Improve Anticipation Efficiency. *Journal of Experimental Psychology: Applied.*

Krane, V. (1994). The mental readiness form as a measure of competitive state anxiety. The Sport Psychologist, 8, 189–202.

Loffing, F., & Cañal-Bruland, R. (2017). Anticipation in sport. *Current Opinion in*

Psychology, *16*, 6–11.

Loffing, F., Stern, R., & Hagemann, N. (2015). Pattern-induced expectation bias in visual anticipation of action outcomes. *Acta Psychologica*, *161*, 45–53.

Mann, D. T., Williams, A. M., Ward, P., & Janelle, C. M. (2007). Perceptual-cognitive expertise in sport: A meta-analysis. *Journal of Sport and Exercise Psychology*, *29*, 457-478.

Mann, D. L., Schaefers, T., & Cañal-Bruland, R. (2014). Action preferences and the anticipation of action outcomes. *Acta Psychologica*, *152*, 1–9.

Murphy, C. P., Jackson, R. C., Cooke, K., Roca, A., Benguigui, N., & Williams, A. M. (2016). Contextual information and perceptual-cognitive expertise in a dynamic, temporally-constrained task. *Journal of Experimental Psychology: Applied*, *22*, 455.

Navia Manzano, J. A., & Ruiz Perez, L. M. (2013). On the use of situational and body information in goalkeeper actions during a soccer penalty kick. *International Journal of Sport Psychology*, *44*, 234-251.

Nieuwenhuys, A., & Oudejans, R. R. (2010). Effects of anxiety on handgun shooting behavior of police officers: A pilot study. *Anxiety, Stress, and Coping*, 23, 225–233.

Nieuwenhuys, A., & Oudejans, R. R. (2012). Anxiety and perceptual-motor performance: toward an integrated model of concepts, mechanisms, and processes. *Psychological research*, *76*, 747-759.

Nieuwenhuys, A., Savelsbergh, G. J., & Oudejans, R. R. (2011). Shoot or don't shoot? Why police officers are more inclined to shoot when they are anxious. *Emotion*, *12*, 827.

Pinder, R. A., Davids, K., Renshaw, I., & Araújo, D. (2011). Representative learning design

and functionality of research and practice in sport. *Journal of Sport and Exercise Psychology*, *33*, 146-155.

Runswick, O. R., Roca, A., Williams, A. M., Bezodis, N. E., & North, J. S. (2016). The effects of anxiety and situation-specific context on perceptual–motor skill: a multi-level investigation. *Psychological Research*, 1-12.

Williams, A. M., Ford, P. R., Eccles, D. W., & Ward, P. (2011). Perceptual-cognitive expertise in sport and its acquisition: Implications for applied cognitive psychology. *Applied Cognitive Psychology*, *25*, 432-442.

Wilson, M., Smith, N. C., & Holmes, P. S. (2007). The role of effort in influencing the effect of anxiety on performance: Testing the conflicting predictions of processing efficiency theory and the conscious processing hypothesis. *British Journal of Psychology*, *98*, 411-428.

Wilson, M. R., Wood, G., & Vine, S. J. (2009). Anxiety, attentional control, and performance impairment in penalty kicks. *Journal of Sport and Exercise Psychology*, *31*, 761-775.

Zijlstra, F. R. H. (1993). Efficiency in working behaviour: A design approach for modern tools. Delft: Delft University Press.

Table/Figure titles

Table 1. Mean (SD) response accuracy (%) across the four experimental conditions on congruent and incongruent trials.

Figure 1. Mean (*SD*) response accuracy (%) with and without contextual priors on congruent and incongruent trials

Figure 2. Mean (*SD*) rating of mental effort across the four experimental conditions.