ABSTRACTS

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Flying under pressure: Effects of anxiety on attentional control, gaze behaviour and performance in a simulated landing task

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Landing an aircraft is a complex task which requires effective attentional control in order to be successful. The present study examined the influence of anxiety on attention and gaze behavior during the performance of simulated flight task. Participants undertook simulated instrument landings, in either anxiety or control conditions. Anxiety was manipulated using a combination of ego-threatening instructions and monetary incentives. Results showed an increase in percentage dwell time towards the outside world in the anxiety conditions. Visual scanning entropy, which is the predictability of visual scanning behaviour, also showed that the randomness of scanning behaviour increased in anxiety conditions. Furthermore, change in scanning randomness from the pre-test to the anxiety phase, positively correlated with both the change in cognitive anxiety and change in performance. These results support the viewpoint that anxiety can disrupt attentional control, which then may lead to changes in performance.

PERCEPTUAL TRAINING WITH ANXIETY: TRANSFER EFFECTS ON THE ANTICIPATORY JUDGMENTS OF ELITE ATHLETES

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We examined simulation training under anxiety-inducing conditions of anticipatory judgments in elite badminton players and its transfer to the real-world. Participants were assigned to an anxiety training group, no-anxiety training group or control group in a pre-acquisition-post-test design. During pre- and post-tests, laboratory- and field-based tests required them to anticipate serve direction under high and low anxiety conditions. During acquisition, training groups received information regarding "gold standard" visual search strategy and video feedback on performance. The anxiety training group completed training under anxiety-inducing conditions. Visual search was recorded throughout. In the laboratory pre-test, groups did not differ in judgement accuracy or final fixation duration, but accuracy was lower and final fixation shorter when comparing high to low anxiety. In the laboratory post-test, training groups made more accurate judgements and had longer final fixations

compared to pre-test and the control group. The anxiety training group maintained post-test performance in the high anxiety condition, whereas the no-anxiety group did not. In the field pre-test, there were no between-group differences, whereas in the post-test, both training groups made more accurate judgments compared to the control group. Anxiety training negated the effects of anxiety on later improved performance and it transferred to the real-world.

Online prediction of children with and without Developmental Coordination Disorder

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Children with developmental coordination disorder (DCD) are proposed to lack the ability to make online adaptations when performing complex movements, which may explain why DCD sufferers struggle with interceptive skills such as catching. This study aimed to probe this issue in a novel way using a 'reaction ball' (RB), which bounces unpredictably off a surface. The catcher must rely on online adjustment of movement, which will help us understand the extent to which DCD and typically developing (TD) children use online prediction for catching. 13 DCD sufferers and 20 TD children were fitted with an ASL eye tracker and completed 10 catches with a tennis ball and 10 with the RB. An ANOVA of catching performance revealed that there was a significant main effect for catching condition, $F(1,29) = 24.021$, $p<.001$ and a significant main effect for group $F(1,29)=5.798$, $p= .023$, however no significant interaction, $F(1,29)= 2.748$, $p= .108$. TD children saw a larger decrease in their performance with the RB (TD -31.11%; DCD -15.39%), which suggests they may rely more on making online predictions during the catch. However, gaze data needs to be analysed to further explain this finding.

The influence of challenge and threat states on decision-making performance

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Research has shown that individuals who exhibit a challenge state in response to pressurized motor tasks tend to perform better than those who display a threat state. However, this research has been limited to aiming tasks. Thus, the purpose of the present study was to examine the effects of challenge and threat states on the performance of a badminton

decision-making task. Twenty experienced badminton players randomly received either challenge or threat manipulation instructions and then performed a competitive decision-making task in which they had to respond to video clips of a player serving to one of four areas of the service box. The players psychological (i.e., demand and resource evaluations) as well as cardiovascular responses (i.e., cardiac output and total peripheral resistance reactivity) were assessed in order to check they were successfully manipulated into challenge and threat states. Furthermore, gaze (i.e., percentage of time spent fixating regions of importance and unimportance) and performance (i.e., decision accuracy and speed) data were continuously recorded throughout the task. Data analysis for the present study is currently under way. The results will be discussed in relation to previous research and in terms of their theoretical and applied implications.

THE USE OF CONTEXTUAL INFORMATION IN EXPERT TENNIS ANTICIPATION

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Although the expert advantage in anticipation has been frequently demonstrated in sport and other domains, research investigating how contextual information contributes to anticipation is scarce. This study assessed tennis players' ability to anticipate ball bounce location without visible superficial player kinematic information. 16 expert and 20 recreational tennis players viewed footage of points from professional tennis matches in normal video (NV) and animation (ANI) display conditions. In the animation condition, which was created using player movement and ball trajectory data, superficial player kinematics and tennis rackets were not visible. Participants anticipated ball bounce location (depth and direction) of the opponent's final shot following occlusion at racket-ball contact. There were significant display and group effects for depth, direction and both depth and direction together ($p<.01$). Experts' mean response accuracy scores were significantly higher than recreational players for depth (NV: $84.58\pm3.14\%$ vs $80.28\pm4.79\%$; $p<.01$, ANI: $69.31\pm4.42\%$ vs $65.83\pm5.41\%$; $p<.05$) and both depth and direction together (NV: $62.01\pm4.45\%$ vs $52.94\pm5.99\%$; $p<.001$, ANI: $49.10\pm4.00\%$ vs $44.00\pm6.61\%$; $p<.01$).Findings suggest that expert tennis players can use dynamic relational information in the form of court positioning to anticipate more effectively than recreational players.

Integrating Advanced Visual Information with Ball Projection Technology Constrains Dynamic Interceptive Actions

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In ecological dynamics, the concept of representative design is an important theoretical principle for studying human behaviours in sport. It proposes that informational constraints of experiments need to accurately replicate those of a studied performance environment. There should also be correspondence between participant behaviours observed and actual responses in performance environments. We tested these ideas in a one-handed catching task. 14 skilled catchers attempted to make one-handed catches, or simulate a catch in three experimental conditions: Integrated video and ball projection (VBP), Video-Only (VO), Ball Projection-Only (BPO). Hand kinematics and gaze behaviour data were collected from participants. Catching performance was more successful in VBP than BPO. In the VBP condition, ball tracking started earlier and lasted longer. Maximum grip aperture emerged earlier, with slower maximum velocity, than in BPO. In VO, movements emerged later than VBP with larger maximum and minimum grip aperture values compared to VBP and BPO. Results suggest that advance information prior to ball release, and vision of ball trajectory are essential for successful performance, and must be available to regulate action in studies of interceptive behaviours.

SPECIFIC PRACTICE CONDITIONS ENHANCE PERCEPTUAL-COGNITIVE-MOTOR SKILL ACQUISITION

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Researchers have examined the practice conditions leading to motor and perceptual-motor skill acquisition. In this study we conducted a novel examination of how practice conditions influence the acquisition of perceptual-cognitive-motor skill. Following a pre-test to determine baseline performance on a novel perceptual-cognitive-motor task, participants were assigned to one of three groups that were differentiated by the type of processing required during acquisition. The first group practised perceptual-cognitive-motor processing (PCM: n=13). The other two groups practised perceptual-motor processing (PM: n=13) or

motor processing only (M: n=13). All groups then performed a post-test to determine if learning had occurred from pre-test. There were no between-group differences in the pre-test. At post-test, the PCM group were more successful compared to the PM and M groups, had more efficient visual search patterns compared to M, but not PM group, and acquired more cognitive knowledge compared to PM and M group. These data indicate that perceptual-cognitive-motor skill was better acquired under specific practice conditions that encouraged those same processes. Conversely, skill acquisition in the other groups was attenuated by restricting the perceptual information and decision making activity. For tasks requiring perceptual-cognitive-motor skill, such as those in sport, acquisition can be enhanced by specific practice conditions.

The effect of the speed of an observed action on exercise performance

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Although the effects of action observation (AO) on motor learning and rehabilitation are well described, less is known about the effects of AO on exercise performance. The aim of the present study was to examine the effects of changes to the speed of an observed cyclical action on exercise performance. Eleven participants initially performed a 10km time trial on an arm erogmeter. Subsequently, they performed two, 9-minute arm-crank exercise bouts whilst observing a model performing the same arm-crank exercise. Each 9-minute observational video was comprised of three, 3-minute videos. In each video, the model's cadence was artificially manipulated to match either the participants' average TT cadence (AVG), 15% below (AVG-15) or 15% above (AVG+15) average cadence. Participants were naïve to the cadence manipulation. During AVG+15, cadence was 3.6% higher than during AVG and 4.8% higher than during AVG-15 (ps<0.01). Speed was 3.5% higher during AVG+15 than during AVG and 4.7% higher than during AVG-15 (ps<0.01). Power was also higher during AVG+15 than during AVG (7.9%) and AVG-15 (9%) though results were not statistically significant (p=0.056 and p=0.057 respectively). These results show that increasing the speed of the observed action elicits changes in exercise behavior.

CAN WE TRAIN THE BRAIN TO DRAIN PUTTS? AN INVESTIGATION OF THE EFFECTIVENESS OF NEUROFEEDBACK TRAINING IN SPORT

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Recent research has associated a greater reduction of frontal EEG high-alpha power during movement preparation with superior golf putting performance. To extend this research, the current study trained golfers to reduce high-alpha power before executing putts. 24 amateur golfers were assigned to a neurofeedback group, or a control group. We assessed putting accuracy and EEG activity (32 sites) in the 4-secs preceding 120 putts performed in pre and post-training sessions, separated by three 1-hour neurofeedback training sessions. The neurofeedback group were trained to reduce frontal high-alpha power by lowering the pitch of a tone, which was silenced when power was reduced by 26.8%, 53.6%, and 80.4% in the first, second, and third training sessions, respectively, thereby providing participants with a cue to putt. The control group underwent an identical procedure, except the tone that they heard was not contingent on their brain activity (i.e., the feedback was false). Results confirmed that neurofeedback training significantly suppressed pre-movement high-alpha power in the neurofeedback group. However, this training failed to selectively enhance performance, as both groups improved at a similar rate from the pre to the post-training tests. The future of neurofeedback as a tool to accelerate skill acquisition will be discussed.

Embodying an observed action is optional, involves supervisory control, and may enhance motor learning and rehabilitation: An EEG and behavioural study

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Practitioners typically use action observation (AO) and motor imagery (MI) separately for enhancing both motor learning and rehabilitation. Instead, instructing MI during AO (i.e., 'AO + MI') can enable the learner/client to better 'embody' an observed action (Eaves et al., 2014). Here we studied the behavioural and neurophysiological effects of two combined AO + MI instructions, relative to AO and MI alone. In both AO + MI conditions participants saw an instructed action (picture), then a rhythmical distracter (movie), wherein cycle time was manipulated. They then executed the instructed rhythmical action. When MI was synchronised with distracter AO (synchronised MI) their subsequent rhythmical actions were significantly closer to the distracter speeds, compared to when imagining a static hand posture during AO. For combined AO + MI, stronger event-related desynchronisation (ERD)

in the primary sensorimotor cortex reflected increased motor involvement, relative to that found in the constituent AO and MI processes alone. Additionally, ERD in the prefrontal cortex was more pronounced for AO+ synchronised MI compared to all other conditions, indicating this condition likely requires stronger supervisory control and monitoring. Based on these findings, we propose motor learning and rehabilitation should incorporate combined AO + synchronised MI instructions.

The method of response can inadvertently facilitate performance in tests of decision making

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Decision-making skill is often tested by participants selecting the most appropriate course of action when observing video stimuli representative of game situations. Response slides are commonly used to provide a frame of reference from which participants can unambiguously select their response without the slide providing information that assists in selection of the correct option. The aim of this experiment was to uncover whether response slides contain information that can in itself aid decision-making performance. Skilled and less-skilled basketball players viewed four different response slides that were digitally edited to systematically reduce the amount of information available in the slide. Participants selected the most appropriate player to pass to, both when the response slide was and was not preceded by a corresponding video clip. Results revealed that in the absence of any video information, response slides still provided significant contextual information to support better-than-chance responses in both groups. Even a rudimentary slide showing only the four potential ball-receivers in a neutral stance (i.e., with the ball-carrier and defenders removed) contained sufficient information to support better-than-chance responses. We conclude that a response slide requiring a mouse click on an empty court is the only response method appropriate for tests of decision-making.

The effectiveness of different visual training programmes on county cricket players

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The area of generalised visual training is one which divides opinion. Previous reports suggest that hundreds of repetitions are required to produce a significant effect on visual skills. Thus, a need exists to improve efficiency of training and identify the most effective forms. To analyse the ability to improve visual and cricket skills following a visual training programme and compare the effectiveness of three different visual training programmes and placebo control. 24 county cricket players were pre- and post-tested on 14 visual and 7 cricket tasks. They were randomly divided into 4 groups and underwent a six-week visual training programme consisting of practical drills, computerised drills, Nintendo Wii games, or placebo control. Analysis showed all experimental groups significantly improved from pre- to post-test, whereas the placebo group showed no significant improvement (practical, $p<.001$; online, $p<.01$; Wii, $p<.005$; placebo $p=.67$). The three vision training methods improved visual and cricket skills more than training on cricket skills alone. This supports previous studies showing visual skills can improve through many repetitions of training (e.g. Long & Riggs, 1991; Fujita et al., 2002). The improvement in cricket skills supports Wilson and Falkel's (2004) suggestion that improvements in visual skills will create 'on-field' improvements in performance.

CONTEXTUAL INTERFERENCE AND COGNITIVE EFFORT IN PERCEPTUAL-COGNITIVE SKILLS TRAINING

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The contextual interference (CI) effect shows a random order of practice leads to superior learning compared to a blocked order. Greater cognitive effort has been hypothesised during random compared to blocked practice, either through reconstructive processes prior to skill execution or elaborative comparisons directly after. The aim of this study was to examine the acquisition of anticipatory judgments under random or blocked practice conditions and the timing of cognitive effort associated with optimal acquisition. Two groups (random, blocked) anticipated shot direction from video of opponent tennis shots during a pre-test, three practice sessions, post-test, and transfer test. A secondary choice reaction time (RT) task involving responses to high but not low tones was used during practice to assess cognitive effort before and after the response. In the primary task, the blocked group had higher response accuracy (RA) across practice, but in the transfer test, the random group had greater RA. In the secondary task, the random group had slower RT compared to the blocked group both before

and after the response. Data confirmed the CI effect extends to perceptual-cognitive skills training. Random practice increases cognitive effort across acquisition, rather than independently prior to, or directly after, skill execution.

The effect of level of expertise on anticipation skill in badminton players
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It has been widely agreed that expert athletes have superior anticipation skills to that of novices (Muller & Abernethy, 2013). The aim of this study was to examine the effect of skill level was on anticipation skill in badminton. Seventeen (4 females and 13 males) university students with different levels of expertise (9 expert and 7 novice/intermediate players) were recruited. A video simulation of an elite badminton player playing a variety of overhead shots was presented to all the participants. Both anticipation time and response selection were measured in the lab and in an actual game situation. The results of the ANOVA showed a better performance by experts relative to novice players in both response selection of the lab test [$F(1, 15) = 5.669$, $p = .031$, $\eta\rho^2 = .274$. and field test $F(1, 15) = 8.495$, $p=0.011$, $\eta\rho^2 = .36$.]. Mean averages for anticipation time in the lab test was smaller for experts compared to novices ($M = 5.148$ vs $M = 3.708$). Mean averages in the field test was smaller for experts compared to novices ($M = .133$ vs $M = .202$).The findings support the notion that high spatial and temporal accuracy is required for high performance in badminton. The implication of findings for coaches is to emphasise and utilise both spatial and temporal constraints in order to improve performance.

Reinvestment and risk: The effect of analogy learning on professional action sports
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Reinvestment has been considered responsible for failure in performance under stressful environment conditions (Masters et al, 2008; Wong et al, 2008; Gucciardi & Dimmock, 2008; Poolton et al, 2007). There is currently no research investigating the effect of fear or severe risk as a potential stressor to affect performance. High-risk sports, such as skateboarding, are performed in an avenue where failure to successfully perform can result in severe physical harm and/or death. This risk is increased significantly at the professional stage by the extreme

nature of the skill/scale of movements. Professional skateboarders (n=43) were randomly allocated to one of four learning interventions (Analogy or Explicit based) along with a fifth control group. A three-week training intervention was applied, followed by a two-week retention period along with baseline, pre and post testing in-between (A-B-A-A design). Results showed that groups undergoing analogy-based (implicit) learning performed significantly better on both kinematic and subjective performance measures, than their explicit based counterparts. Analogy-based groups also showed significantly less declarative knowledge than explicit-based groups. Most importantly, analogy-based learning was shown to significantly reduce the propensity to reinvest; whilst no significant differences were found for explicit-based learning (pre to post). The theoretical and coaching implications of these findings are discussed.

The Impact of an Eye-Hand Coordination Intervention in Experienced Older Table Tennis Players

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Sports Specific versus Generalised Vision Training (GVT) has been shown to lead to task-specific improvements in sport performance. However, more dynamic GVT in the form of sport specific Eye-Hand Coordination (EHC) training may impact upon key visual and performance characteristics. The present study assessed an eight week progressive EHC intervention using a Sport Vision Trainer (SVT™).Seventeen male club level table tennis players (age 60.59±8.06yrs) (Intervention Group: IG), and fifteen age matched (57±4.7yrs) participants (Control Group: CG) participated. Training consisted of an eight week period of three x 20min sessions per week. Random practice sequences simulating rally variations in table tennis were administered, with progressive increases in difficulty. Post-task performance (EHC speed), visual search (VS: accuracy and speed) and sport specific performance test (SSPT) characteristics were assessed.Controlling for baseline performance, ANCOVA revealed that IG post-task EHC performance and VS speed was significantly faster (p<0.05) than CG, whereas post-task VS accuracy was unaffected. Pre-post-SSPT improved significantly for IG. The improved IG EHC and visual search speed showed positive impact upon both the EHC task and to underlying cognitive functions. The IG improvement on the SSPT suggests transfer of these effects to sporting performance.

Not always a disadvantage: No relative age effect in the birth dates of elite junior ice hockey forwards

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The relative age effect (RAE) refers to the higher representation of players born early in the year on youth and professional sporting teams. Although the RAE is a well-established phenomenon, recent research has pointed to violations of the RAE amongst senior performers at the pinnacle of their sport (e.g., award winning players). Such violations are proposed to be due to peer effects: the increased challenge overcome by relatively late born players during their development, resulting in the acquisition of superior skill levels, which eventually translate into higher achievement. The present research sought to identify the age at which peer effects appear in junior populations. Date of birth distribution was analysed for players at the Under 18 (U18) and U20 Ice Hockey World Championships between 2000 and 2014. An elite subset, comprising award winning players from those championships, was also analysed. Results indicated a RAE at U18 level, irrespective of skill level or playing position. At U20 level there was a RAE in the general population, and amongst elite defenders. However, elite forwards demonstrated no RAE. Support for this finding was obtained from an analysis of the top National Hockey League draftees from 2000 to 2013. In conclusion, peer effects appear to emerge for ice hockey forwards at the U20 level.

PERCEPTUAL-COGNITIVE SKILL SIMULATIONS: A COMPARISON OF STATIONARY AND MOVEMENT RESPONSE METHODS

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Simulation has been used to examine expert performance, but there is debate as to how physically active participants in it should be. The aim of this study was to compare the cognitive processes of skilled soccer players when responding to film-based simulations of defensive situations involving two different activity conditions. Participants either remained stationary in a seated position ($n = 10$) or were allowed to interact and move ($n = 10$) in response to the simulation. The simulation involved life-sized video of action sequences of 11 vs.11 open-play soccer situations viewed from the defender's perspective. Response accuracy and retrospective verbal reports of thinking were recorded. Participants in the movement

response group generated a greater number of verbal report statements when compared with the stationary group, with a higher proportion related to the evaluation and prediction of future options and the planning of appropriate decisional responses. Findings suggest the need to design experimental tasks that more closely recreate the constraints that exist in the actual performance setting in order to better identify the processes underlying expert performance.

Reliability of assessing time to contact information used by elite football goalkeepers in intercepting shots at goal

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Goalkeeping in football requires perception and prospective information to support action. The aim of this study was to establish reliabilities of a method for measuring the role of a candidate perceptual variable, Time to Contact (TTC), used by goalkeepers to intercept shots at goal. Eight international goalkeepers in the English Premier League (season 2013-14) were observed when intercepting a shot at goal. TTC was estimated by dividing distance between a ball and goalkeeper by its rate of change in both longitudinal (X; parallel to the touch lines) and transverse (Y; parallel to the goal line) directions. The results of Pearson correlation coefficient showed that there were good intra-rater reliabilities in calculating mean TTC in both X ($r=0.98$) and Y ($r=0.85$) directions. Inter-rater reliability measures also showed good agreement for mean TTC in both X ($r=0.91$) and Y ($r=0.96$) directions. Findings demonstrated that mean TTC in intercepted shots was positive in the X direction, whereas the mean TTC for un-intercepted shots was negative in both directions. The current system of performance evaluation for timing behaviours when attempting to save shots at goal reliably determined the role of TTC in the coupled interactions between a goalkeeper and shooter at goal in football.

The Effects of Stroboscopic Visual Training on Planning and Online Control in Manual Aiming

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Recent research has suggested that stroboscopic training may enhance sports performance. The present study was designed to investigate whether i) stroboscopic visual training improves manual aiming performance, and ii) whether improvements were due to changes in planning or online-control. 32 participants were randomly divided into either an experimental group (EG) or a control group (CG) and performed a series of manual aiming trials on a computer under both full-vision (FV) and no-vision (NV) conditions. During the training session, the EG wore stroboscopic glasses whilst the CG did not. Performance was assessed in terms of the movement variability at different stages of the kinematic profile. It was found that variable error (at the end of the movement) decreased significantly in the FV condition for the EG from pre-post training. Significant reductions in variability were not present early in the movement indicating the change occurred as a result of improved online control. The present study shows that stroboscopic training can improve performance of manual aiming, as a result of improved online control.