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GENERAL INSTRUCTION FOR THE EXAM

Written Exam Perceptual-Motor Learning in Sports

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1. On EACH response sheet, write your NAME and STUDENT NUMBER
2. The exam consists of 9 questions, most of which consist of several sub questions (up to four). Answer the questions as clear and concise ('beknopt') as possible. Only answer the question, irrelevant digressions may lead to a subtraction of points. For each question, you find in bold the number of points given for a correct answer.
3. The exam starts at 3.15pm and ends at 6pm.
4 The exam hall cannot be left before 4.15pm
5. The answers are provided at Blackboard after the exam. I will send an e-mail regarding a session discussing the exam questions and answers. (With respect to the Essay, I will provide (individual) feedback for each essay. To discuss this, students have to make an appointment.)
6. Good luck!

John

1. What is the law of practice? **(5)**
The observation that performance improves indefinitely with the greatest performance gains being evident early in practice (i.e., an exponential increase). These performance gains with practice are often described as a power function

2a. What characterises representationalists theories for perceptual motor control and learning? **(5)**
Representationalist theories try to understand the internal psychological processes that are involved when persons interact with the environment. With respect to perceptual-motor control learning they postulate motor response programs that specify the to-be-executed movements (or patterns of muscle activity patterns).
2b. Give two points of critique that have been raised against representationalists theories for perceptual motor control and learning (e.g., by proponents of anti-representationalists theories such as the ecological and dynamic systems approaches). Make sure that one of these two points of critique addresses learning. **(5)**
Progams control the movements, but it remains unclear who writes the programs (and who control the writer), where the programs originate (novelty problem) and how many programs are needed (storage problem). In addition, many representationalist theories consider the brain as a computer, that is, there is no real biological foundation.

3. Proponents of information processing theories make a distinction between 'visual hardware' and 'visual software'.
a. What is the difference between 'visual hardware' and 'visual software'? **(5)**
Visual hardware refers to general visual characteristics that are determined by the (neuro-) anatomical structure (i.e. hardware) of the perceptual system. Examples are acuity, colour vision, binocular depth perception etc. Visual software, by contrast, refers to visual processes that are often very task specific and have to be learned. Examples are recognition, anticipation, and recall of visual information.
b. Which aspect (i.e., 'visual hardware' or 'visual software') is addressed by the temporal occlusion paradigm? **(5)**
Software
c. In terms of skill-related differences, what does the temporal occlusion paradigm (see e.g., Abernethy & Russell, 1987) demonstrate? **(5)**
In general, the temporal occlusion paradigm shows that decrements in the anticipation or prediction of action outcomes (e.g., landing position of badminton stroke) are greater among high-skilled players than among low skilled-players in occlusion conditions that occlude parts of the opponent's actions before ball release/contact. This indicates that high-skilled players are more inclined to use early advance information than low-skilled players do. Players of different skill-level are tuned to different sources of information.

4. The ecological approach to perception and action distinguishes three processes of learning in relation to the control law. Name and provide a brief description of each of these processes of learning.**(10)**
i) Establishing a law of control or discovery of affordances. Learners first have to perceive what the environment offers for action, which is constrained by their action abilities. This perception is associated with establishing an (initial and coarse) coupling between movement and informational variables. ii) Education of attention/attunement. In order to improve or

optimize the law of control, the learner can attend or use a different, better specifying or more useful informational variable. iii) Calibration. Fine tuning of the coupling between movement and information variables is reached through calibration, which is represented in the law of control by adjusting the constants that express the particular relationship between movement and informational variables.

5. Oudejans et al. (2005) attempted to improve basketball players' shooting skill. To this end, they used two training methods.
a. Which two methods were used to facilitate shooting performance? **(5)**
Practicing by using glasses that only provided vision of the target during the final period before ball release. Training basketball shooting from behind a screen. Both procedures were directed at providing vision of target after the hands passed the line of sight.
b. Which of the three processes of learning proposed by ecological psychology did they try to exploit with these training methods? **(5)**
Education of attention
c. The results indicated that the basketball players improved shooting performance. Do the other observations of Oudejans et al. (2005) definitely and unmistakenly provide support that the learning process at which the two training methods were directed indeed had taken place? Explain.**(5)**
The final period of shooting was indeed prolonged and there were indications that it improved performance. However, since no gaze measures were taken, we cannot know for sure whether different information was used (or at different instants). The findings are 'only' consistent with the hypothesis of education of attention. Yet, as the authors argue, given the skill level of the participants it is perhaps more likely that rather than changing the use of variable, they changed to more useful values of the variable.

6. In many interactive sports (e.g., tennis, fencing, boxing) there is an overrepresentation of left-handers among elite athletes (i.e., more left-handers than in the general population).
a. How would the common-coding approach explain this overrepresentation? In your answer refer to the motor familiarity hypothesis.**(5)**
Motor familiarity holds that perception of actions performed by others is more accurate when the performed action is part of the observer's action repertoire. Consequently, for a right-hander it is easier to predict the action of right-handers than of left-handers. Hence, in a population where the majority of players is right-handed, left-handers have an advantage.
b. How would the ecological approach explain this overrepresentation? **(5)**
*Because players more often encounter right-handers than left-handers, they are better tuned into the specifying information sources for right-handers than left-handers. Consequently, prediction of right-handed action is more accurate, irrespective of the handedness of the observer***.**
c. Experimentally, how could you make a distinction between the common-coding and ecological explanations for the overrepresentation of left-handers among elite athletes? **(5)**
Use an occlusion paradigm in which left-handed and right-handed tennis strokes are shown. Left- and right-handed participants are required to predict the outcome of the presented actions. Common-coding predicts that perception is more accurate when facing a player with the same handedness, whereas ecological psychology predicts that perception is more accurate against right-handed players.

7a. How do learning with an internal focus of attention and an external focus of attention differ? **(5)**
During learning with an internal focus of attention, attention is directed towards the movement, movement patterns or moving limbs, whereas during learning with external focus attention is directed towards the effects or outcomes of the movements (outside the skin).
7b. Common-coding predicts that learning with external focus of attention would be more beneficial. Why? **(5)**
Because common-coding presumes that action are planned (and represented) in terms of their effects.
7c. Provide an example from the studies of Wulf and co-workers that demonstrated that the external focus of attention is more beneficial for learning. **(5)**
E.g., when learning to slalom ski, focus on the timing of the force by the feet (i.e. internal focus) resulted in a decreased performance during retention in comparision to a focus on the timing of force on the moving platform (i.e., external focus).

8. Willingham (1998, 1999) distinguished three control principles, one of which is the principle of disparate representations.
a. Describe the principle of disparate representations. **(5)**
*The four control processes (strategic, perceptual-motor integration, sequencing and dynamics) make use of representations that code the environment or movement in different ways or within different frames of reference. Strategic processes code allocentrically, i.e., objects are coded relative to their surroundings. Perceptual-motor integration and sequencing processing code egocentrically, i.e. objects are coded relative to the action system or effectors, and the dynamic processes codes movements in terms of muscle activity patterns***.**
b. How do studies examining perception and action using visual illusions speak to this principle? **(5)**
In studies with visual illusion, perception (and strategic processes) is compared to action (i.e., perceptual-motor integration). They basically show that perception is tricked by illusions, but actions are not. This shows that perception, but not action codes the environment (or spatial target) in allocentric coordinates, i.e. relative to their (visual) surroundings.
c. Another of Willingham's control principle is the dual mode principle, expressing that control and learning processes can operate in either a conscious or an unconscious mode. What change takes place during conscious learning of perceptual-motor integration and sequencing processes in terms of representations? **(5)**
In the initial phase of conscious learning, the strategic process controls perceptual-motor integration and sequencing. Consequently, the (sequence of) spatial targets are coded in allocentric space. With learning, the strategic process withdraws and perceptual-motor integration and sequencing are supported by dedicated unconscious processes that code the targets in egocentric space. Hence, a change from allocentric to egocentric representations occurs with learning.
d. The ecological approach rejects representations. How would they describe the same change in learning of perceptual-motor integration? **(5)**
Education of attention, in which a change occurs from using allocentric information to egocentric information.

9. Masters and Maxwell (2004; see also Maxwell et al., 2001) describe errorless learning as a form of implicit learning.

a. Why, according to Masters and Maxwell, is errorless learning considered as a form of implicit learning? **(5)**
The idea is that working memory is involved in identifying and correcting errors during explicit learning and performance. The learner formulates and tests hypotheses to achieve the best movement solution. If errors are absent, the contribution of working memory diminishes (there are no errors to identify or correct, nor can hypotheses be tested; errors allow for elimination of faulty strategies/solutions). Implicit learning is learning without the accumulation of declarative knowledge in working memory.

b. What experimental evidence do Maxwell et al. (2001: in Masters & Maxwell, 2004) present that errorless learning is indeed a form of implicit learning? **(5)**
They used a golf putting task that gradually increased in difficulty (by increasing distance to the hole). Maxwell et al showed that errorless learning induced a greater reliance on implicit learning because after errorless learning performance did not break down under dual task loading (i.e., performance was independent of working memory). They also used verbal protocols to measure the amount of declarative knowledge that the participants had accumulated during learning. They did not find a difference between errorless and errorful groups. However, video analyses indicated that the errorless groups tested fewer hypotheses (they less often changed grip etc.).