**Why the Constraints-led Approach is not Teaching Games for Understanding: A Clarification**

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Why the Constraints-led Approach is not Teaching Games for Understanding: A Clarification
Why the Constraints-led Approach is not Teaching Games for Understanding: A clarification

Background: There is some apparent confusion regarding similarities and differences between two popular physical education (PE) pedagogical frameworks, i.e., the Constraints-Led Approach (CLA) and Teaching Games for Understanding (TGfU). Purpose: Our aim in this commentary is to detail important theoretical and pedagogical concepts that distinguish these approaches, as well as to recognise where commonalities exist.

Findings: In particular we note that TGfU had its roots in the 1960s in the absence of a substantial theoretical framework, although several attempts to retrospectively scaffold theories around TGfU have subsequently emerged in the literature. TGfU is a learner-centred approach to PE in which teachers are encouraged to design modified games to develop the learner’s understanding of tactical concepts. In contrast, the CLA has arisen more recently from the umbrella of Nonlinear Pedagogy (NLP), emerging from the empirically-rich theoretical framework of ecological dynamics. The CLA adopts a ‘learner-environment’ scale of analysis in which practitioners are encouraged to identify and modify interacting constraints (of task, environment and learner) to facilitate the coupling of each learner's perceptual and action systems during learning. The CLA is a broader framework which has been adapted for the design of (re)learning environments in physical education, sport and movement therapy. Other key distinctions between the approaches include: the overall goals; the way in which the learner and the learning process are modelled; the use of questioning as a pedagogical tool; the focus on individual differences versus generic concepts; and how progressions and skill interjections are planned and implemented.

Conclusions: Despite such distinctions the two approaches are somewhat harmonious and key similarities include: their holistic perspective of the learner; the proposed role of the teacher; and the design characteristics of learning tasks in each. Both TGfU and the CLA have a powerful central focus on the nature of learning activities undertaken by each individual learner. This clarification of TGfU and the CLA is intended to act as a catalyst for more empirical work into the complementarity of these juxtaposed pedagogical approaches to learning design.

Key words: Learning Design, Pedagogy, Physical Education, Sport, Constraints-Led Approach, Teaching Games for Understanding
Shortened PE teachers abstract (150 words max)

Background: There is some apparent confusion regarding similarities and differences between the Constraints-Led Approach (CLA) and Teaching Games for Understanding (TGfU).

Aim: Our aim is to detail important theoretical and pedagogical concepts that distinguish the approaches, as well as to recognise commonalities.

Findings: We observe that TGfU emerged from operational principles of practice, in the absence of a theoretical framework, although retrospectively scaffolded theories have occurred. TGfU is a learner-centred approach which encourages teachers to design modified games to develop the learner’s understanding of tactical concepts. In contrast, the CLA has arisen within the umbrella of Nonlinear Pedagogy (NLP) based on the theoretical framework of ecological dynamics. The CLA is a ‘learner-environment’ centred approach which encourages practitioners to identify and modify constraints to develop perception-action couplings.

Conclusions: Although there are several other distinctions, importantly both TGfU and the CLA have a powerful central focus on the nature of learning activities undertaken by individual learners.
Introduction

In two recent reviews of articles in this journal we were challenged by reviewers to explain differences between the Teaching Games for Understanding (TGfU) approach and the Constraint-led Approach (CLA) since: (1) “the two approaches are the same thing, aren’t they?”, and (2) “The underlying basic principles [in the different approaches] are those of behaviourism/cognitivism (traditional approach) versus social-constructivism (CLA approach).” In our work with teachers and coaches we are finding that categorising the CLA as a games-based teaching approach is a common misapprehension, perhaps due to an early focus of CLA literature on team games (e.g., Chow et al. 2009; Renshaw, Chow, Davids, and Hammond 2010a) and published work that integrates games-centred approaches with complexity based ideas such as the CLA in education journals (e.g., Storey and Butler 2013). This may have inadvertently led to some educationists categorising the CLA as 'just another game-centred pedagogy' in line with approaches such as TGfU (Bunker and Thorpe 1982), its Southern Hemisphere derivative, Game Sense (den Duyn 1996, 1997; Thorpe 2005), Sport Education (Siedentop 2002), Play Practice (Launder 2012), Games Concept Approach (Tan, Wright, McNeill, Fry, and Tan 2002) and the Tactical Games Approach favoured by some North American pedagogues (Mitchell, Oslin, and Griffin 2012). To that end, given the view of the teachers and coaches who we work with in our teacher and coach education sessions and the comments of the academic reviewers we cite in our introductory paragraph, our aim here is to provide clarifications for physical educators and sport pedagogists on the nature of the relationship between the CLA and TGfU.

In this paper we seek to confirm that, while there may exist some similarities between the CLA and TGfU methods at an operational level, there are major
differences in theoretical principles used to guide pedagogical practice and learning design. In this context, as one of the reviewers of the manuscript noted, the implementation of TGfU and the CLA (in line with other pedagogical approaches) is situated in the ambiguities, tensions, and compromises that arise when attempts are made to apply new models in practice; and which, without reflection in practitioners, may “look like the same thing” when observed in teaching and coaching contexts.

Additionally, we have argued elsewhere that some of the key principles of TGfU can be underpinned with reference to Nonlinear Pedagogy (NLP), the framework of pedagogical principles which overarches the CLA (see Chow et al. 2007; Davids, Chow, and Shuttleworth 2005; Renshaw et al. 2010; Stolz and Pill 2014). The aim of this commentary is to clarify the misconception that the CLA and TGfU are one and the same thing. They are not. We also seek to demonstrate that while TGfU is essentially a games-based model, the CLA has the capacity to be more than ‘just’ a games-based model. While it can underpin games teaching, it's concepts have also been used for understanding learning design in many other physical activities (e.g., springboard diving (Barris et al. 2013, 2014), swimming and ice climbing (Seifert 2010; Seifert et al. 2014), rowing (Shuttleworth et al. 2010), long jumping (Greenwood et al. 2014) and sailing (Araújo et al. 2006; 2014). TGfU has been developed as an operational model for the practice of teachers of PE, whereas the CLA is a theoretically-based approach to skill acquisition and motor learning that can be applied to developing principles of practice across the whole spectrum of exercise, health, PE, sport performance and physical activities.

Because there are a number of game-centred approaches, their advocates may consider that our comparison of the CLA with TGfU (and Game Sense as the sport coaching centred derivative of TGfU), may neglect the contribution of these ‘worthy’
approaches (see Stolz and Pill 2014 for a detailed discussion of the evolution of
games-based models that have their roots in TGfU). TGfU has been selected for our
clarification first because it is the ‘founding’ approach that led to the emergence of
the various games-based approaches mentioned in the previous section and as such
has a richer research base than other similar approaches. Secondly, previous literature
has attempted to demonstrate the connections between TGfU and Non-Linear
Pedagogy (e.g., Chow et al. 2007, 2009; Storey and Butler 2013). However, it is clear
from our previous discussion, that despite the excellent coverage of the potential links
between TGFU and NLP in previous work practitioners (and some academics) are
still unclear about the similarities and differences between the two models.

It should be clearly noted that this position paper does not constitute an
attempt to discuss the relative merits of the two approaches and we will leave it to the
reader to decides on the relative strengths and weaknesses of the two approaches
However, it is worth noting that the spirit and philosophy underpinning the TGfU
approach is harmonious with much of the pedagogical philosophy of the authors of
this clarification statement. Indeed it inspired some of us who were lucky enough to
be exposed to the teachings of Dave Bunker, Rod Thorpe, and Len Almond at
Loughborough University in the 1980s. Our aim is therefore to clarify some
similarities and distinctions between the two frameworks so that readers are aware of
these subtleties when reading research and considering application of key ideas in
their practice. To situate our discussion we will first summarise the context of the
development of TGfU and consider how the zeitgeist of the times shaped the ideas
and principles of the approach.

The emergence of TGfU
Whilst the first papers on TGfU were published in 1982, the roots of the approach can be traced back to the 1960s. Thorpe and Bunker noted that the likes of Allen Wade, Eric Worthington, Stan Wigmore and Jim Greenwood exerted significant early influence on the emergence of their ideas (Thorpe 2015; Thorpe and Bunker 1986). Of particular significance was their suggestion to consider the idea that “game skills should be taught through the principles of play (Thorpe and Bunker 1986, 5)”, which was later formalised by Allen Wade (1967) in his seminal football coaching manual. The promotion of small-sided games as part of sessions to develop skills also emerged at this time, but still the main focus was on the ‘skill’ acquisition aspects of the lesson (Thorpe 2005; Thorpe and Bunker 1986).

On his return to Loughborough as a staff member, Thorpe moved away from the technique-based approach which he had been taught when he was an undergraduate at Loughborough in the early 1960s and moved towards a more cognitive orientation in his practice. This move should be seen in the context of the current trends in related fields of education and psychology at this time and alongside the development of other “cognitive-oriented learning material” like classroom studies (Pigott 1982). Even in the field of skill acquisition, the influential John Whiting was pre-eminent, publishing papers on the information processing requirements of acquiring ball skills (Savelsbergh and Davids 2002; Whiting 1969). Thorpe was heavily influenced by a wide range of pedagogical approaches, most significantly educational gymnastics and Mauldon and Redfern’s (1969) games teaching ideas. In terms of the influence of educational gymnastics, Thorpe, (2015) through an e-mail exchange with the lead author explains “Simply I was attracted by the idea of setting problems that could be answered by children at different levels of skill…[and]…perhaps the light bulb going on for me was the realisation that games set
problems all the time, whereas in Educational gymnastics the teacher had to design
the problem.”

Thorpe was also fascinated by contemporary literature in psychology (e.g. experimental psychology) and sports coaching (e.g., the Inner Game concept presented by Gallwey 1974, 1979). Thorpe highlights that he began to teach using the TGfU approach in the early 1970s before the model was named and formalised in the early 1980s. In fact in 1969 and 1970 Thorpe supervised two final year undergraduate dissertations by Graham Stevenson (1969) and Ian Graham (1970) on modified rackets well before these became common usage. The ideas developed through a constant dialogue between Thorpe, Dave Bunker and Len Almond (see Butler 2014 for a summary of the comparative ideas of these founders in terms of the intentions, beliefs and actions they believed to be fundamental to TGfU). Significant contributions were also made by colleagues at Loughborough such as Rex Hazeldine and Jim Greenwood, as well as collaborators such as Margaret Ellis, Lynn Spackman and teachers working in schools (Thorpe 2015). The significance (and relevance for this paper) is to recognise the contribution of the knowledge gained from the very many teachers the team interacted with whilst doing in-service work. Thorpe (2015) also notes “It is also worth mentioning that some teachers came up to us and said "Thank you I was doing something like this, but felt guilty because I did not have a framework or rationale." It is also worth noting that, at that time, there was little to no expectation of undertaking research in British PE colleges, and it was only through the significant encouragement of Len Almond that the TGfU model was published in 1982. As Thorpe and Bunker have highlighted in their writings and many conference presentations, TGfU was proposed as a way of improving the teaching of games in schools. This proposal emerged because they believed, through their observations in
school, that many children did not understand games, or in some cases were not even playing them. What should be made clear here is that the TGfU model was designed as a *practical approach* aimed at improving the learning experiences of children and was not developed as a theoretically-based pedagogical framework; and, incidentally, it was never intended to be (Thorpe 2015 and see Bunker 2012; Bunker and Thorpe 1982; Thorpe 2010). However, as highlighted previously, ideas are not developed in total isolation from current trends and issues. Part of the rationale for developing TGfU was that traditional approaches seemed to contrast with some basic skill acquisition principles such as play, observational learning, high amounts of practice and the failure of ‘skill’ to transfer to the real game (Bunker and Thorpe 1986; Thorpe 2005; Thorpe, Bunker, and Almond 1984). As Thorpe (2005a) in his conference keynote elucidated, “Advocates of TGfU asked themselves the question, have we concentrated too much on how “we” coach, rather than how “they” learn”? This question pre-empted future trends in education, physical education and sport pedagogy, reflecting the perceived need to move from a teacher-centred approach to a learner-centred approach to teaching game skills. Accordingly, much training and assessment of teaching and coaching methods were more operationally concerned with the mechanics of teaching such as voice projection, presence, quality of demonstrations, appearance and preparation, and class management (e.g., formation of orderly queues, use of space and tidy placement and collection of equipment), rather than focusing on assessing the ‘learning experience and environment’. These initial concerns are strongly in line with ideas of advocates for the CLA, who argue that central to the teaching and coaching process is the complementary need for a model of the learner and the learning process (Handford et al. 1997; Renshaw et al. 2010). A theoretical model of the learner and the learning process is needed to support
pedagogical decision making and the design of practice and training environments (Davids et al. 2015). The missing ingredient of designing motivating learning environments was also captured by the TGfU model (but also see Mauldon and Redfern 1969). The link between motor learning, sport psychology and physical education has always been perceived as a neglected concern for contemporary pedagogists and didacticians (Abernethy 1999; Newell and Rovegno 1990; Renshaw et al. 2010) and highlights the complementary nature of experiential and empirical knowledge in sport pedagogy and physical education (Greenwood et al. 2014). It has been argued that there is a clear need for contemporary researchers and practitioners to work together when developing new pedagogical approaches (Butler 2012). In summary, “the model was developed for PE teachers and eventually led to changes in the UK National Curriculum and the way we sampled games – words like; target, divided and shared court, fielding, invasion games appeared as we worked from common principles – space and time” (Thorpe 2005a).

**The Teaching Games for Understanding Model**

The design of appropriate games to enable learners to understand key principles of games is a key feature of TGfU. Bunker and Thorpe developed a linear, yet cyclical 6-step model (see Figure 1) where the ‘sequential aspects of the model are crucial’ (Bunker and Thorpe 1986, 10). After deciding on a *game form* that is matched to the age and experience of the learners, and a ‘close resemblance to the adult version of the game’, learners move onto developing *game appreciation* and developing *tactical awareness*. These stages are all about understanding the rules of the game and determining the best tactics to exploit them. This would include awareness of the strengths and weaknesses of opponents. *Decision making* follows based on deciding
“what to do” and “how to do it”. Key requirements for appropriate decision making include the need to recognise the cues and the selection of the most appropriate response from those (currently) available to the individual. This involves understanding the potential consequences and a calculation of risk and reward at any moment in time. *Skill execution* follows and reflects the actual execution of the chosen movement pattern. The quality of this movement is judged by the teacher and sits separate to the actual performance. For example, a young child may produce an excellent overarm throw with correct sequencing of body parts and an accurate throw but a lack of strength may mean the throw was not powerful enough to run out the baserunner. The final stage is performance which refers to the observed outcome and is measured against ‘criterion standards’ across learners. Players can therefore be classed as ‘good’ or ‘bad’ players, which should be based on the effectiveness of the decisions made as well as the quality of the techniques demonstrated. At the end of the cycle, the teacher carefully evaluates each step and if necessary revises the game form to further challenge the learners. This is a key skill for teachers and coaches and requires them to identify the most important performance aspect that an individual or a team needs to work on at any specific stage of their development and then design appropriate game forms. Bunker and Thorpe (1982) suggest that the games should be implemented by using ‘modification through representation’ or by ‘modification through exaggeration’, ‘sampling’ and ‘tactical complexity’.

*Insert figure 1 here*

**Theories and TGfU**
As we stated in our introduction, we believe that the theoretical basis for TGfU differs significantly from that underpinning NLP, as argued by Davids et al. (2005) and Chow et al. (2007) (also see later in this paper). Core to these arguments is that TGfU, originating as a pedagogical method, was not explicitly built on a theory of motor control and learning. However, in line with the zeitgeist of the times (and Thorpe’s reflections), it might be assumed that the belief that children’s games playing ability could be enhanced by acquiring a greater ‘understanding’ of games was implicitly inspired by cognitivist (most notably constructivist) approaches to human behaviour, with a particular reference for education (see Griffin, Brooker, and Patton 2005). Pigott (1982, 17) was perhaps the first academic to argue that “the rationale behind new trends in games teaching appears to be just as valid as the psychologist awakening to the importance of cognitive constructs in motor learning.”. He also acknowledged that “initial thoughts on the understanding approach to teaching games might lead one to suspect that this material was based upon little more than a dissatisfaction with current traditional curricula plus a concern for the opportunities of the less able.” (Pigott 1982, 20). In his article Pigott went on to examine the “diverse literature of motor learning and cognition” proposing the possibility that Schema theory (Schmidt 1975) could best explain how TGfU was aligned with contemporary motor learning theory with the potential to support this ‘new’ teaching direction.” (Pigott 1982, 17). He suggested that the ideas of variable practice within schema theory could enable the acquisition of motor programs needed in open skill environments while ‘higher-order’ centres in the CNS looked after the decision-making element in the understanding approach. Decision-making in new and different game requirements was said to be “under the control of higher order rules or ‘principles’ that are generalizations which can be applied to new but related
tasks” (Pigott 1982, 18). In essence, therefore, in any cognitive motor learning theory, the student sits at the centre of the process, with the goal of developing cognitive processing capacities, i.e., his or her understanding through games teaching. Consequently, TGfU is a learner-centred approach where group participants make key decisions about how to solve a problem presented by a game, which is carefully designed by the teacher. By allowing children to work out their own performance solutions with focused questioning to guide their discovery, they come to understand how to play the designated game more effectively.

As highlighted earlier, the TGfU model uses 4 pedagogical principles, sampling, modification-representation, modification-exaggeration, and tactical complexity, to provide a framework to guide teachers in TGfU game design (Thorpe, Bunker, and Almond 1984). This model contains embedded assumptions about motor learning, but it does not seek to present concepts and principles, devised in detail a priori from a rigorous theoretical model of motor learning to empirically support the design of learning environments (Chow et al. 2007; Kirk and MacPhail 2002). In this respect, it has been argued that the major contribution of TGfU has been to define a set of operational principles, underpinned by practical experience and observation in physical education classes, to aid in the design of environments for games teaching (Chow et al. 2007). Indeed, empirical research explicitly attempting to provide a theoretical rationale for TGfU has not come from the originators of the model but from advocates of the approach. As such, Schema theory (Pigott 1982), information processing (see Turner and Martinek, 1999) and situated-learning (see Kirk and MacPhail 2002) have all been proposed as viable theories to retrospectively explain how learning might occur in TGfU. Additionally, in line with the original
explanations as to why TGfU was needed, motivational theory (i.e., achievement goal theory) has also been proposed as a key concern (see Griffin and Patton 2005).

Regardless of these largely retro-fitted rationales, researchers have continued to express concerns about the ability of these theoretical frameworks to examine the efficacy of TGfU (e.g., Chow et al. 2007; Davids et al. 2005; Tan et al. 2011), a claim made by Rink, French, and Tjeerdsma (1996) and reiterated as recently by Stolz and Pill (2014). Most early research on TGfU was largely obsessed with the relative merits of teaching technique versus tactics, before later studies focussed more on practitioner-referenced methodologies (Stolz and Pill 2014). The research led to limited evidence to examine the claims made for TGfU and highlights the need for research to go beyond the dualist perspective to understand and examine the learning processes underlying TGfU (Chow et al. 2007; Tan et al. 2012) to clarify the conflicting claims made on behalf of TGfU (Rink et al. 1996; Stolz and Pill 2014).

Recently, the CLA approach has been proposed as a strong contender to provide an appropriate theoretical framework to underpin TGfU (Stolz and Pill 2014) and to examine whether TGfU is able to meet its desired outcomes (Chow et al. 2007; Davids et al. 2005). Next we describe concepts and ideas from the CLA and NLP.

**A Constraint-led approach in a Nonlinear Pedagogy**

The CLA is an ecological model centred on the mutual relationship that emerges from interactions of each individual and a performance environment. In the CLA model, more skilful performance emerges as individuals harness inherent self-organisation processes (tendencies towards coordination of motor system components or degrees of freedom). These inherent coordination tendencies emerge under interacting constraints (see Newell, 1986) acting on individual learners, especially as they
become perceptually attuned to the key information sources which can regulate their actions in specific performance environments (when performing or learning) (Chow et al. 2013, 2013a). A distinguishing feature of the CLA is that its practice design and delivery is informed by principles of a NLP, which provides a theoretical model of the learner and the processes of learning, based on the empirically-verified ideas and concepts of ecological psychology and dynamical systems theory (Chow et al. 2007, 2009, 2011; Davids et al. 2005; Renshaw, Davids, Chow, and Shuttleworth 2009; Renshaw et al. 2010, 2010a). Pedagogical principles such as information-movement couplings, representative learning design, manipulation of constraints, infusion of variability, accounting for attentional focus and attunement to affordances provides a substantial pedagogical framework for implementation of feedback, modeling, instructions, and design of practice and informational constraints (Chow 2013; Chow et al. 2015). NLP provides an empirically-verified and theoretically-rationalised description and focus for the design of learning environments in physical education and sport (Davids et al. 2005; Chow et al. 2007). This learner-environment centred pedagogy recognises the emergent, self-organising nature of learning under interacting constraints. Learners are empowered by harnessing opportunities to individually and actively explore and generate specific, functional movement solutions to satisfy the unique combination of interacting task, environment and individual constraints (or boundaries) imposed on them (for more detailed overviews see Araújo et al. 2004; Chow et al. 2006, 2007, 2009, 2013, 2013a; Davids, Button, and Bennett 2008; Davids, Chow, and Shuttleworth 2005; Handford et al. 1997; Newell 1986; Renshaw et al. 2010).

Having now summarised the key features of TGfU and the CLA, in the next two sections we will address the main thrust of our paper, consideration of some of
the key similarities and differences between the TGfU and the CLA frameworks. We begin by considering the similarities.

**Key Similarities between TGfU and the CLA**

As mentioned earlier, there are some similarities between TGfU and the CLA. These are considered now:

*Holistic skill acquisition:*

1) Both approaches support a holistic approach that attempts to engage learners on physical, cognitive and emotional levels. Through designing modified games based on representativeness, teachers who adopt TGfU and the CLA approaches use the concept of task simplification to provide emergent learning environments that guide discovery. Appropriate solutions are therefore emergent in self-organising learning systems based on the constraints (e.g., rule changes, pitch sizes) put in place by the teacher. This addition captures the discovery learning that TGfU emphasises as important in the perceptual-motor and tactical skill acquisition process of PE. However, arguably both approaches could do better in explaining why this broader form of engagement is ideal for learning movement skills and meeting the motivational needs of children in terms of competence, autonomy and relatedness (Renshaw, Oldham, and Bawden 2012). Both approaches have also been criticized and a commonly held view is that they take longer for success to be seen. While the empirical evidence is equivocal and perhaps confounded by the goals set (Stolz and Pill, 2014), future research would be beneficial.

*Individual differences:*
2) The CLA and TGfU both focus on matching task demands to the current capabilities of the learner. According to Thorpe (2015), the originally-devised aim of TGfU was to meet the needs of all children learning to play team games by designing modified games. Similarly, the CLA has its focus on individual differences between learners due to the emphasis on interacting constraints (personal, task and environmental) on behaviours. Both approaches are faced with the challenge of catering for all levels of ability within the same lesson. Chow et al. (2013) and Renshaw et al. (2012) provide some ideas that can be used to address these challenges. Although, the focus is on the individual learner in both approaches, it is important to mention here that as NLP is based on ecological dynamics it is a learner-environment centred approach, not a learner-centred approach.

Role of the teacher:

3) The role of the teacher is to act as a facilitator to guide students’ discovery. Answers will not simply be given, and students are encouraged to explore and take responsibility for their own learning (Butler 2014; Renshaw et al. 2010). This means that in both approaches pedagogues will adopt a more hands-off (Handford et al. 1997) and facilitative role during the session. In fact, Thorpe (2015) highlights that the ideal TGfU lesson would be one where the teacher says absolutely nothing and the ‘game acts as the teacher’. However, important to both models is the role of the practitioner as a facilitator rather than director and sometimes CLA/TGfU teachers would attempt to develop awareness by discussion and questioning (Butler 2014; Storey and Butler 2013). The importance placed on the individual-environment interactions in both approaches means that teachers who wish to implement the CLA/TGfU lessons need to
devote more time to be spent in designing effective self-directed/organising learning environments. This is perhaps one of the main reasons why some PE teachers may be reluctant to use TGfU and the CLA in their lessons as they simply lack the time needed to develop a deep understanding of the approach and invest further time in developing TGfU/CLA based lessons. Adopting new ideas may also threaten their current deeply engrained beliefs about what teaching PE is meant to be (see Moy et al. 2014, 2015) and because of this they might fear loss of control of the learning process. Another key barrier would be that certain key performance indicators need to be met to achieve PE syllabus learning outcomes, inhibiting the implementation of ‘new’ or alternative teaching approaches.

**Learning design:**

4) Practitioners in both approaches emphasise the design of learning tasks based on shaping the game and setting the broadest of goals to emphasise engagement for all learners irrespective of their ability level. Both approaches promote the concept of emergence through self-directed actions, providing learners with opportunities to develop appropriate perception-action couplings. That is, individuals and teams are invited to perceive similar affordances in the learning environment as are available in the performance environment. Learning tasks will, therefore, be based on the common ideas of representation (TGfU), or in CLA terms, Representative Learning Design (see Pinder et al. 2011).

5) Practitioners in both approaches will carefully design learning tasks to match the needs of individuals. Similarly, as learners demonstrate competence within the initial games, teachers will manipulate task constraints to provide new challenging games throughout the lesson and subsequent sessions.
6) The use of game forms matched to the intrinsic dynamics (inherent coordination tendencies at a specific point in time) of learners in TGfU and the CLA allows individuals the opportunity to explore and solve game-based problems. Essential to both approaches is the emergent nature of lessons with teachers prepared to take unexpected detours as learners attempt to solve game problems in unique ways. This common approach highlights the importance of variability of practice and matches the NLP-based idea of 'repetition without repetition' (Bernstein 1967) (i.e., meeting the same task goals with different pathways of solutions).

It is clear that are key similarities between TGfU and the CLA, we now move on to consider the key differences.

**Key Differences between TGfU and the CLA**

In the CLA, there is an important major contrast with TGfU: From a NLP perspective, learners do not need to engage in significant amounts of 'cognitive processing' before they can discover and explore a performance solution to an activity (cf. Kirk and MacPhail 2002; Pigott 1982). Rather, theory and evidence has strongly indicated how functional behaviours can emerge from learners as they seek individualised solutions to a specific performance problem by 'acting' in a learning environment. The mantra behind this characteristic emphasis of the CLA on seeking and utilising information to regulate movements by moving to seek information is: Search, discover and exploit! (Davids et al. 2015).

The key point is that in the CLA, learners' behaviours in PE and coaching contexts need to be channelled by manipulations of interacting constraints (Araújo et al. 2004). In the CLA learners need to act in order to enhance their 'knowledge of' (and therefore understanding of) a performance environment (Araújo and Davids
In the CLA, knowledge of a performance environment is gained through harnessing perception and action to utilise affordances or invitations to act (Handford et al. 1997). It is an important role for a pedagogist to design task constraints which facilitate emergent knowledge of (understanding of) a performance environment through acting and perceiving (Davids et al. 2008; Renshaw et al. 2010). In contrast, in the stage like model of the TGfU approach, perception precedes decision-making, which precedes actions (Kirk and MacPhail 2002).

Understanding before acting may be a special case in human learning where we humans will “do things before we can do them” (Bernstein 1996). It is with no surprise that the ecological psychologist Edward Reed suggested the development of the “field of promoted action” (Reed 1996) for infants and children to learn through their daily activities. NLP, with its rich theoretical framework, conceptualises human beings as highly integrated, complex systems which are continually adapting to surrounding constraints (both internal and external). Humans are 'open' systems which are dynamic and constantly changing (maturing, developing, learning), adapting to all sorts of constraints (physical, psychological, social, emotional) (Davids et al. 1994). In such dynamic neurobiological systems, there is no particular component (e.g., a representation in the mind) leading/controlling the other components (the physical movement, the sport skill). The key point is that the continuous and ongoing interactions of a multitude of constraints facilitate the emergence of functional behaviours (e.g., thoughts, ideas, actions, perceptions, intentions) in each individual. The aim of a pedagogist in the CLA is to create a landscape of affordances or opportunities for action which each individual can learn to utilise to achieve their task goals.
As highlighted by Butler (2014, 467) a key difference between TGfU and the CLA, was that TGfU was “developed by practitioners for practitioners, rather than a broad, theoretically oriented teaching approach grounded in research.” Thus, TGfU is directly focused on application to PE and teaching of games to children. In contrast, the CLA is based on a comprehensive theoretical framework that can explain the processes that underpin learning in humans considered as complex, adaptive, and dynamic at the level of the individual-environment system (see Renshaw et al. 2010 for detailed definitions of these underlying concepts; see also Araújo and Davids 2010; Chow et al. 2007; Davids et al. 2005; Seifert 2010; Seifert et al. 2013). The CLA is more broadly aligned to understanding movement behaviours for many different types of practitioners including those working in health, exercise, disabilities, physical activity, sport performance, training and practice (Davids, Button, and Bennett 2008). In the rest of this section we will address some of the key operational differences between TGfU and the CLA. For brevity we will provide a point by point discussion.

**Pedagogical principles based on motor learning theory:**

1) Whilst the above quote from Butler highlights that the design of TGfU was not explicitly based upon theoretically based motor learning principles, as we discuss earlier it has been retrospectively explained from a range of theoretical perspectives and the pedagogical principles put forward in the model have been tested through empirical and practitioner-referenced studies and is supported by many motor learning principles. For example, the key TGfU pedagogical principle of representation and consequently solving tactical problems within game-related contexts, is very much in line with the ideas of representative learning design, inspired in ecological psychology theorising in the 1950s (Brunswik 1956), that
provides a major tenet in the CLA. In contrast to the focus on the problem of teaching games inherent in the TGfU approach, NLP key pedagogical principles based on multi-disciplinary theories (i.e., theoretical ideas and concepts from multiple disciplines in science including dynamic systems, ecological psychology, complexity sciences, evolutionary biology, non-linear physics to name a few influences) and empirical evidence (e.g., from a significant body of motor learning and performance analysis studies providing the necessary 'muscle of skill acquisition theory' (Stolz and Pill 2014) to learning design in NLP (see work by Araújo, Davids, Seifert, Button and colleagues summarised in publications) that practitioners can adopt.

Goals:

2) According to Thorpe (2015) the goals of TGfU were twofold, with the main aim of providing opportunities to learn games that led to intrinsic motivation towards future sessions and a secondary aim of getting better at playing games. Thorpe’s view is that capturing a love for playing games was his key priority and that carefully designed games where every child could ‘succeed’ was central to this goal. Central to TGfU was therefore a focus on nurturing and development (Butler 2014) and emphasises (at least to these authors) the humanistic focus of the model founders. In terms of learning, inherent in the 6-step model are the aims of developing understanding of how to play to exploit the rules of games and the development of tactical awareness within the context of their own individual capacities. In essence, the overall goal is to develop declarative and procedural knowledge (Butler 2014) creating intelligent players who know what to do and how ‘best’ (our insertion) to do it. Additionally, participating in games should allow the child to appreciate what skills they need to improve to play games.
better. For the CLA, the aim is to achieve the task outcome goal, accepting that there may be many individualised ways of achieving the same performance outcome and many ways to enhance understanding (including acquiring knowledge of a performance environment - vs. knowledge about a performance environment, see Araújo et al. (2009) for an application to sport of this crucial distinction proposed by Gibson (1966).

Explaining learning:

3) The implicit aim in TGfU is to improve performance by developing understanding through changing, constructing or enriching knowledge structures or cognition with understanding being located in the mind (or in the brain). In contrast, the CLA aims to change, adapt or ‘attune’ the nature of the emerging learner-environment system. Here, it is each individual’s relationship to specific environmental properties that changes with learning. Over time this relationship can become more functional, allowing the achievement of task goals, fluently, accurately and energy efficiently. This emphasis on the quality of the individual-environment relationship is exactly why the CLA could never be included under the scope of any framework of constructivism (see Araújo and Davids 2010 for an explanation).

Use of questioning as a pedagogical tool:

4) For TGfU, whilst the optimal goal is to let the game pose the question and therefore be the teacher, as mentioned previously the questioning and the reflective activity of the student form a core part of the learning processes of the teacher (Butler 2014; Thorpe 2015). However, for the CLA, this type of verbal approach merely forms just another possibility, amongst many others, to constrain emergent learning behaviours (including no reflection at all, e.g., how much
reflection does a child need in satisfying the constraints of gravity when changing
from crawling to standing to bipedal walking during upright stance and
locomotion?). This issue of potential negative effects of reflection is aligned with
the key insights of Bernstein (1967) who proposed ideas of how actions (in both
less skilled and skilled performers) can be performed without the need to for
conscious regulation of the movement form (see Davids et al. 2008).

Use of Progressions:

5) TGfU has a progressive-linear like cyclical structure within sessions, in which the
complexity of the games/challenges is increased as learners develop. The key to
progression is the ability of the teacher to make modifications to the starter game
“leading to a careful re-appraisal of the requirements of the new game (Bunker
and Thorpe 1986, 10)”. Interestingly, in their modified, more in-depth version of
the original TGfU model, Kirk and MacPhail (2002) point out that whilst the
model has the appearance of being a linear process, learning to play games is a
complex medium and as such is not linear. The idea that ‘careful re-appraisal’ is
advocated during lessons suggests (at least to us) that session structure is perhaps
more emergent than linear. Perhaps, attempts to draw models on 2-dimensional
papers limits appropriate representation of what operationalisation of the model
looks like in practice? The CLA, inspired by Bernstein’s (1996/1950) and
work on perceptual learning, has developed a 3-stage model of learning to explain
to practitioners how to deal with different perceptual-motor learning rates (Araújo
et al. 2009; Davids et al. 2012). These stages are nested together, not sequentially
where one comes before the other, but as concurrent processes of exploration and
reinforcement (Chow et al. 2007). The stages include:
i) **Search: Exploring system degrees of freedom (i.e. huge number of components and sub-systems of the human body) to achieve a task goal**

Intentional constraints shape emergent perception-action coupling during learning. Different intentions organize perceptual-motor systems in distinct ways. Educating the intentions of learners (helping learners to specify what needs to be achieved in a performance context) might have an important influence on which particular informational variables need to be perceived by learners and when. The education of intention is not just an information-guiding process. Intention directs the attention of a learner and performer, and motivates exploratory behaviours that constrain perception, which further constrains action, and so on (Arzamarski et al. 2010). When the intentions of a performer are aligned with a task goal, learners couple their actions to key information variables in a performance environment. These couplings emerge in the continuous re-organisation of system degrees of freedom as learners (attempt to) achieve the task goals.

ii) **Discover: Exploring task solutions and strengthening them**

Throughout learning the performer identifies tentative performance solutions and attempts to stabilize them during goal-directed behaviour by re-organizing the previously exaggerated constriction of degrees of freedom (Vereijken et al. 1992). New action possibilities start to be identified (e.g. when an informational variable is not useful). In a performance environment, we are surrounded by huge amounts of potential informational variables. **Perceptual attunement** is the process of learning which sources of information to attend to in order to regulate actions, and in which situations. In this phase there is the strengthening of
discovered performance solutions, as well as exploration of the limits of these solutions, and the consequent search for new information-movement couplings (Davids et al. 2012).

iii) **Exploit: Exploiting perceptual-motor degrees of freedom**

An important point at this stage is attunement to a wider range of spatial and temporal variables, and greater sensitivity to the contextual consequences of one’s actions. System degeneracy, or the ability of structurally different body components to perform a similar function or yield a similar output, is available for all learners to exploit. It is an essential feature of skilled behaviour because it enhances the flexibility of athletes in competitive performance environments (Davids et al. 2006). A relevant process is that of calibration, or the scaling of the perceptual-motor system to information. Calibration establishes and updates the mapping between the units in which the relevant properties of the world are perceived, and the units in which the action is realized (Van der Kamp and Renshaw 2015).

**Development of individual and group synergies:**

While both TGfU and the CLA empower learners to actively explore their learning environment to generate specific individual movement solutions, the emphasis on generic tactical concepts within TGfU means that it captures this aspect of games play better than the CLA. However, the CLA can also go beyond individual learning and individual solutions and focusses on the synergies that emerge within and between individual learners, thereby helping them to come up with more functional performance solutions in sport. That is, there are functional solutions that can only emerge in groups or teams following self-organized collective exploration and
discovery under task constraints, which an individual cannot achieve by him/herself.

To explain further, ecological psychologists have demonstrated (see Van der Kamp and Renshaw 2015) that learning is a result of individuals attuning and calibrating their actions to key informational variables and, therefore, allows some similar solutions to emerge for a certain individuals under certain circumstances (Silva, Garganta, Araújo, Davids, and Aguiar 2013). The notion of degeneracy is relevant for understanding collective system behaviours since it signifies that there may exist several performance solutions in team games, for groups of specific individuals (the same individual in another group may not behave in the same way). A good example of this idea exists in badminton, where different opponents afford different movement possibilities, with different game play patterns emerging when challenged to compete against different opponents. The emergent pattern is not dependent just on the tactical preferences of each player but also on the behaviours of his/her opponent: an emergent person-environment relationship.

**Use of skill interjections:**

iv) Whilst the majority of lesson time in TGfU is spent playing carefully designed games and wherever possible technical skills would be developed in context through carefully designed game forms such as 3 vs 1 or 5 v 3 TGfU also advocates taking students out of games to develop skills (Butler 2014; Bunker and Thorpe 1986; Kirk and MacPhail 2002). This could be seen in the practice task interjected between the introductory and final games for a TGfU approach. In the CLA, the focus is on learning skills by using task simplification in environments that are representative of the performance environment. Key information that guides actions is present and the technical skills are made easier to acquire through manipulations.
of key task constraints such as rules, space and time, or importantly, the
equipment that students can use.

Can the CLA help answer the question “does TGfU work?”

A number of articles have examined the claim that the design principles of NLP, that
underpin the CLA, can provide a comprehensive, theoretical framework to support the
principles of TGfU learning design (e.g., Butler, Storey and Robson 2014; Chow,
2013; Chow et al. 2007, 2009; Davids et al. 2005; Stolz and Pill, 2014; Storey and
Butler 2013; Tan, Chow, and Davids 2013). Specifically, Chow (2013) illustrated
how CLA describes the interactions between the different constraints (task, performer
and environment). The principles described above are applied through the
pedagogical channels of practice, modeling, instructions and attunement to
affordances. See Figure 1.

Insert Figure 1 about here

In the concluding section of this commentary we consider the key issues and
limitations of traditional teaching approaches as raised by Bunker and Thorpe in their
1986 article and seek to demonstrate how the CLA can inform TGfU. Earlier we
highlighted that Thorpe (2015) believes that the ‘perfect’ TGfU lesson would not
require any verbal commination to support the learning that occurs through simply
playing the game. However, he adds that “in reality, our games are not well enough
designed to allow this to happen and we need to supplement our teaching with
questioning.” To that end, we suggest that basing TGfU lesson design on the
principles of NLP would potentially lead to the construction of more effective games.

The bolded titles are taken directly from the work of Bunker and Thorpe.

1. **When ‘can we play a game’?** The CLA and TGfU advocate the use of small-sided and conditioned games for facilitating the emergence of functional perception-action couplings in learners (Davids et al. 2012). Additionally, practising movement skills via a technical skill interjection within TGfU should also follow key learning principles commensurate with a NLP approach, through maintaining key environmental information sources in task simplified learning environments. For example, learning the technical skill of travelling with a ball in invasion games could be developed through the design of specific 1 vs. 1 games. An excellent way of designing this learning opportunity is to create 1 vs. 1 sub-phases within the context of a 4 vs. 4 team game, through the partitioning of space and use of ‘artificial rules' as key task constraints (see Renshaw et al. 2012).

2. **The failure to meet and enhance ‘intrinsic interest’ [of children for playing games] and not exploiting [this] intrinsic motivation.** By designing small-sided and conditioned games that meet the basic psychological needs of each member of a class (i.e., competence, relatedness and autonomy), it is much more likely that class members will be intrinsically motivated, or self-determined. Recent work, has outlined how applying the principles of Self Determination Theory (Deci and Ryan 2002), in conjunction with NLP, can enhance the likelihood of learners being intrinsically motivated (Renshaw et al. 2012).
3. [Traditional lessons are] Failing less and most able players. In order to meet the skill acquisition needs of individual learners, game design should be matched to the intrinsic dynamics (existing dispositions and propensities) of each individual in the lesson. In recent work we have demonstrated how teachers may meet these needs by designing a rich range of tasks to match with individual learners or allowing them to self-select (Atencio et al. 2014; Renshaw et al. 2012). However, when teachers use the TGfU concepts of sampling and tactical complexity to provide simplified tasks for learners, they must be careful to ensure that the movement patterns and tactical possibilities remain representative. Adopting NLP principles can provide guidelines on how to use sampling and its impact on representativeness. For example, in line with the early work of Thorpe, the use of modified rackets by providing a greater surface area for contacting a ball may well be a useful strategy for increasing the chances of a young player achieving some success in terms of actually intercepting a ball. However, if the modified racket’s new properties (e.g., mass or handle length) distort the movement information resulting in the emergence of a non-functional movement pattern, its use may lead to the emergence of (adapted) non-representative movements and tactical behaviours. These behaviours, although facilitative during PE lessons, may not transfer to sport performance environments.

4. Missing the whole element of perception and decision-making. By carefully sampling the constraints of specific performance environments when designing TGfU based games, teachers can ensure that perception and action remain coupled and that functional transitions in the course of action (i.e., decisions) emerge. For example, by facing real bowlers in simulated game
scenarios, cricket batters can learn to make decisions to solve game based problems using appropriate information-movement patterns rather than inappropriate ones acquired by playing against ball projection machines (Pinder et al. 2011; Renshaw et al. 2007).

5. **Coach/teacher dependent.** While TGfU is viewed as a student-centred approach, we suggest that the emphasis on providing representative game forms in the approach is more in line with the CLA in terms of its adoption of an individual-environment approach. The ‘hands-off’ approach (de-emphasising use of direct teaching methods) advocated by both frameworks highlights that responsibility for skill learning is given back to the learner, who is empowered to be an ‘active collaborator’ (Thorpe 2005) during practice and learning. However, one key challenge also related to the need for the coach/teacher is the need to be well-versed in the game that is to be taught and in particular has a good understanding of the principles of play. Manipulating appropriate constraints to channel effective exploration on the part of the learner needs to be anchored on the expertise that the coach/teacher possesses (Chow 2013).

**Summary**

In 2005, Rod Thorpe (2005, 243) highlighted that “Teaching Games for Understanding (and Game Sense) is being embraced, adapted and developed”. While we agree with this statement which is consistent with the continued publication by academics, there is still a challenge in terms of the take up by practitioners. Indeed, Almond (2010) suggests that “…the rationale seems to have passed by practitioners without any major effect. TGfU currently thrives in only a few areas where
practitioners are faithful to the original approach. (Almond 2010, vii).” To that end, providing ‘game designers’ responsible for implementing TGfU with a theoretical underpinning for a model of the learner and the learning process can serve to enhance the design of TGfU lessons and strengthen its usage by practitioners. As we indicated earlier, Thorpe (2015) highlights that the ideal TGfU lesson is one where the teacher is not required to say anything and the game is the teacher, but in reality we (teachers and coaches) cannot design good enough games for this to happen. We believe that the CLA may be able to help here. For example, teachers who understand the theoretical concepts of NLP can systematically manipulate key constraints to elicit changes in performance. That is, modifications should be based on an appreciation of the control parameters (variables that lead to change) acting on learners. Essentially, identifying the key rate limiters limiting current performance is a key skill for teachers and coaches to determine what aspect of performance that an individual or a team needs to work on at any specific stage of their development. Essential to this process is the need for teachers and coaches to understand the unique intrinsic dynamics of individuals. Intrinsic dynamics refer to the set of movement capabilities that each individual brings with him/her when learning a new skill (Thelen 1995). A detailed assessment of a performer’s intrinsic dynamics should identify the emergent (contemporaneous) boundary constraints shaping current performance for each individual. Guerin and Kunkle (2004) highlight how task constraints themselves are dynamic and can emerge and decay over time and should not be viewed as permanent. Adopting these principles can underpin the design of a progressive curriculum in TGfU as “the secret to good games skills is the development of progressive games for youngsters (Thorpe 2004, 240).”
A key to the effective implementation of TGfU games underpinned by the CLA, is a need for more engagement of researchers in supporting the application of theory into practice. As highlighted earlier Joy Butler (2014) asked the originators of the model (i.e. Bunker, Thorpe and Almond) what a TGfU lesson looked like, with a similar question being asked of rugby coaches delivering Game Sense sessions (Reid and Harvey 2014); these approaches would be of value to those looking at the implementation of the CLA and other new teaching models into schools.

Additionally, this type of information would be of great value for those responsible for preparing future physical education teachers by identifying the most efficacious ways to develop the knowledge and skills of pre and in-service teachers. Both TGfU and the CLA have a central focus on the nature of learning activities undertaken by each individual learner. This philosophy can be supported by ensuring that the learner is viewed within the context of his or her mutuality with a specific performance environment, a feature strongly embedded within the literature of TGfU. To date there are more empirical studies of TGfU methods published in the literature than there are investigations of the CLA. Indeed a quick Google Scholar search (1970-2014) revealed about 462,000 results for TGfU compared to 271,000 for the CLA (and see Stolz and Pill 2014). The CLA is theoretically richer in motor learning theory than the TGfU approach and it needs a deeper footprint in terms of empirical data to demonstrate its benefits. In order to increase the likelihood of the CLA being adopted in schools (in conjunction with TGfU), more work is required by physical education specialists to ensure the utility of the model in pedagogical settings. We need to clarify that here, the term 'P.E. specialists' refers to those working as researchers and practitioners in the field. In fact, we would argue that it is vitally important in terms of facilitating adoption of pedagogies that researchers and practitioners work
symbiotically in embedding new thinking into practice. As highlighted by Stolz and Pill (2014), Greenwood et al. (2013), Millar et al. (2013) and Renshaw and Gorman (2015) accessing the experiential knowledge of expert pedagogues is essential to capturing expert practice in applied settings such as schools. Practitioners can provide rich data as their ideas and views have been continually tested, day in-day out, over time. Thus, a memetic approach to knowledge generation via the symbiotic relationship of practitioners and researchers is essential to develop understanding of sport pedagogy. To this end, the significant body of work found in the TGfU literature provides a good template for the CLA advocates (see Stolz and Pill 2014). Further developments should include specific applications (i.e., lesson plan templates in contrast to the broadly recognised cyclical structure proposed in the TGfU model) that teachers need, (although see Moy et al. 2014, 2015, for recent exceptions).

In summary, we hope this clarification between TGfU and the CLA acts as a catalyst for more empirical work through symbiotic interactions between researchers and practitioners into these largely complementary pedagogical approaches to learning design.
References


Reid, P. and S. Harvey. 2014. We’re delivering Game Sense…aren’t we? Sports Coach Review, 3 (1), 80-92.


Figure Captions

Figure 1: The TGfU Model (Bunker and Thorpe, 1982).

Figure 2: Figure 2. Nonlinear Pedagogy and its key pedagogical principles. CLA is embedded within the model. (adapted from Chow, 2013). Design principles concerns underpinning the shaping of game forms, selecting game scenarios and creating contexts through consideration of the concepts of representativeness, attentional focus, information-moment couplings and functional variability.
Response to Reviewer’s Comments

Your manuscript entitled "Why the Constraints-led Approach is not Teaching Games for Understanding: A Clarification" which you submitted to Physical Education and Sport Pedagogy, has been reviewed. The reviewer comments are included at the bottom of this letter.

The reviewer(s) would like to see some revisions made to your manuscript before publication. Therefore, I invite you to respond to the reviewer(s)' comments and revise your manuscript.

It is important to note that in this second review the reviewers were not in full agreement in their reading of the paper. I have therefore undertaken to review the paper myself to cast a third eye over the work. I am certainly of the opinion that the paper will make a valuable contribution to the field but also feel that there are some revisions that need to be made before it is ready for publication. Reviewer’s one comments should be straightforward to address and he or she was generally very supportive of your work. Due to a system error only reviewer 1’s comments are shown in the final section of the email. Rather than delay the review process I have sought to extract the relevant points in my comments below and hope that you will consider these as the areas I felt were most pertinent to your work moving forwards (based on both of our reviews).

Reviewer 2’s comments

Page 11 Theories and TGFU line 10 - As Bob Pigott was a member of staff at Loughborough University at the time and a member of the TGFU team his work cannot be described as being retrospective.

This was unknown to the authors. Now Removed.

Page 13 last line. What do you mean by “the conflicting claims on behalf of TGFU”

We have changed this to: the conflicting claims made on behalf of TGFU

Page 14 first line. Reviewer 2 wrote "I do not follow this argument “Only then can Bunker and Thorpe’s question ‘does TGFU work?’ be answered with theoretical arguments”. In the next sentence you suggest that CLA has been proposed as a strong contender to provide an appropriate theoretical framework." Please clarify your point?

We have removed this sentence. The point was that research needed to move beyond dualist approaches and base TGfU design on theory.

Pages 15-16 Holistic skill acquisition - Reviewer 2 suggests that "TGFU did not set out to address learning movement skills. Also, TGFU has a different interpretation of skills than your use. please can you clarify this section."

We have now added text here to develop our point.
Added text: “Through designing modified games based on representativeness, teachers who adopt TGfU and CLA approaches use the concept of task simplification to provide emergent learning environments that guide discovery. Appropriate solutions are therefore emergent in self-organising learning systems, based on the constraints (e.g., rule changes, pitch sizes) put in place by the teacher.” This addition captures the discovery learning that TGfU emphasises as important in the perceptual-motor and tactical skill acquisition process of PE.

Page 16 line 2/3 under Role of the teacher:

Reviewer 2 wrote: "TGfU doesn’t speak of explore movements to find their own performance solutions. The point on page 17 is correct when you use the expression ‘game as teacher’, though this is a much more recent expression by Tim Hopper, the term is spot on and does illustrate games forms as puzzles to solve in outwitting your opponents."

We have revised this section:

Revised text for this point: The role of the teacher is to act as a facilitator to guide students’ discovery. Answers will not simply be given, and students are encouraged to explore and take responsibility for their own learning (Butler, 2012; Renshaw et al., 2010).

Other minor additions are added into this section.

Added text:

Reviewer 2 wrote: "Page 17 line 4. You speak of questioning as a common pedagogical feature yet earlier you say that Rod Thorpe would see TGfU lessons where the teacher says absolutely nothing (line1). This is a common mistake in many papers where they assume that questioning is a main feature of TGfU – I simply disagree – the ‘game as teacher’ is a much more accurate interpretation. In line 5 and 6 you make a good point when you say that teachers need to spend more time designing effective learning environments. I would put it another way, they need to spend more time of developing ‘enabling environments’ with an ‘enabling attitude’. In the new rethinking TGfU approach these points are central and linked closely with the ‘science of shaping games’. There is also a strong focus on self-directed learning."

We agree with the focus on ‘game as teacher’, and an ideal situation occurs where no questioning is needed by the teacher. However, questioning is needed by the teacher to guide the learner in getting the most out of ‘games as a teacher’. Not every learner will immediately pick up on game as a teacher but can be guided towards the benefits through effective questioning. As we note, Rod Thorpe suggests that we often need to use questioning and this is supported by the work of Butler (2012) who explored the thoughts and ideas of the founder members. Questioning is clearly mentioned in this article as being part of TGfU practice. Further support is seen in Storey and Butler (2012). As such, we feel our point here is justified. Your comments in support of our point that teachers need to spend more time designing effective, self-directed learning environments is clearly important and led to us adding material to strengthen and emphasise this message.
Revised text: The importance placed on the individual-environment interactions in both approaches means that teachers who wish to implement CLA/TGfU lessons need to devote more time to be spent in designing effective more self-directed/organising learning environments.

Page 26 Use of Skill interjections

Reviewer 2 wrote: "Whilst I can appreciate the statement in this section, because it attempts to highlight the point that TGfU was seen as an approach with focus on technique: TGfU would not advocate isolated drills. It was always felt that using uneven opposition (5 v 3) in game forms can strengthen technical prowess in context."

While we would not disagree with the general point made here, we note Butler (2012) reports that the founders suggest that where appropriate teachers should take students out of games to develop skills. However, we have revised this section to reflect the fact that, wherever possible, game forms would be utilised to develop skills in context.

Revised text: Whilst the majority of lesson time in TGfU is spent playing carefully designed games and wherever possible technical skills would be developed in context through carefully designed game forms such as 3 vs 1 or 5 v 3, TGfU also advocates isolated drills and instructions common to more traditional approaches to address poor technical skill execution within the game taking students out of games to develop skills (Butler, 2012; Bunker and Thorpe 1986; Kirk and MacPhail 2002).

Reviewer 2 wrote:

"From pages 15 to the end of the article I feel that I am reading an account of CLA with brief references to TGfU.

We have carefully reviewed the paper and have made a number of changes to the structure and language to attempt to alleviate these concerns. With reference to the sections that consider the similarities and differences, it carefully considers the two models equally and does not seek to prioritise one over the other. In the final section where we ask whether CLA helps answer the question “does TGfU work?”, as might be expected, we address the CLA framework here discussing how it may inform the work of TGfU practitioners. We also now add references by Butler and Storey and Butler that support the complementarity of CLA and “Game-Centred” approaches such as TGfU. We also note that this section represents only roughly 3 pages of the total paper.

On page 5 the author makes the point that “the aim of this commentary is to clarify the misconception that CLA and TGfU are one and the same thing”. You make your point quite clearly on the next few lines."
We have chosen to remove “It should be clearly noted that this position paper does not constitute an attempt to discuss the relative merits of the two approaches by arguing that one is better than the other. In fact, we felt that is confusing to the reader. We feel it would be more appropriate that the reader decides on the relative strengths and weaknesses of the two approaches and have added a sentence to this effect.

You then go on to describe TGFU in detail and CLA in less detail but you make up for this from page 15 onwards to the end of the article.

We have revised text at the end of the section on TGfU that introduces CLA to reflect that this section will describe CLA, in the same way we did for TGfU.

On page 19 you say “NLP with its rich theoretical framework” and you go on to explain eloquently the superiority of CLA. Yet on page 6 lines 6/7 you say that “this paper does not constitute an attempt to discuss the relative merits of the two approaches by arguing that one is better than the other”. All the pages from page 15 onwards do just that.”

EDITOR COMMENT: My reading of the paper was similar and I feel that you need to be clearer in your arguments around these points. You have undertaken to write, in my opinion, a much needed clarification paper but in doing so you are under increased scrutiny from the field. Clarity and consistency in this undertaking is important and a tightening up of these arguments is important moving forwards.

The revisions of the paper have attempted to avoid stating the superiority of CLA over TGfU. Rather our revisions have addressed the need for clarification of the relationship between the two approaches. We have attempted to reframe the discussion of the differences to emphasise this. As stated in our goal, and now in the revised text early in the paper (see our earlier comments), our aim is simply to provide the framework for the reader to understand the similarities and differences in TGfU and CLA and to make their own judgements about the relative strengths and weaknesses of each.

In summary, we carefully discuss the similarities followed by the differences between the two approaches. We have carefully considered these sections and made changes throughout.

Finally, in reading the paper I noticed a few syntax and punctuation errors (the odd apostrophe out of place) and advise a final read through.

Addressed.

Reviewer(s)' Comments to Author:

Reviewer: 1

Comments to the Author
Thank you for the opportunity to review the revised paper. It is apparent the authors have undertaken a major revision that has taken into consideration many of the points made by the two reviewers of the original manuscript.

Thank you for these comments. Yes, your comments helped us to strengthen the paper considerably.

I commend the authors for contacting Rod and gaining his personal account. I have a detailed personal account in writing from Len Almond. It is interesting to see where the accounts align and deviate slightly. The authors should also look at the paper by Joy Butler that came from "interviewing" the three TGfU "originators".

Thank you, yes, we read Butler’s paper in our re-working of the paper. We have now referred to this paper when we review Rod Thorpe’s views and included the reference and appropriate content at other stages of the paper in attempts to be ‘balanced’ in line with the wishes of the reviewers and editor.

I commend the authors for the significant work undertaken to improve the paper. I only have issue with the claim that TGfU is chosen as it is the "predominant approach". I am not sure such a grand claim can be evidenced. The Tactical Games approach is arguably predominant in North America, and the Game Sense approach in Australia. Metzler groups them all under the label of the "tactical model". Perhaps TGfU is predominant in the paper authors biography, given at least one of them claims to have been influenced by the TGfU authors while studying at Loughborough. Perhaps as the "root stock" for (e.g.) Tactical Games, Game Sense and Games Competency Model it is relevant to choose TGfU for the comparison. Perhaps also, given previous literature connecting TGfU to non-linear pedagogy and dynamic systems theory (Chow et al 2007) and CLA (Chow et al 2009) as a suitable explanation for TGfU’s effectiveness as a strategy in physical education teaching. Indeed, it would be useful for the authors to explain briefly in the Introduction how the contents of their manuscript extend, and/or elaborate and/or deviate from the arguments made in those two papers particularly, so it is clearer what this paper adds to the literature.

We thank the reviewer for this comment and have now revised this section:

Revised text: TGfU has been selected for our clarification first because it is the ‘founding’ approach that led to the emergence of the various games-based approaches mentioned in the previous section and as such has a richer research base than other similar approaches. Second, some previous literature has attempted to demonstrate the connections between TGfU and Non-Linear Pedagogy (e.g., Chow et al., 2007; 2009; Storey and Butler 2012). However, it is clear from our previous discussion, that despite the excellent coverage of the potential links between TGfU and NLP in previous work, some practitioners (and some academics) are still unclear about the similarities and differences between the two models. Our paper seeks to address their confusion.

Comments in reply to authors response:

How can the authors state; "We agree and thank the reviewer for capturing these ideas so succinctly. We have taken the liberty of including the words in our text" unless referencing
"Reviewer 1" is not taking "the liberty of including the words in our text" a form of plagiarism? It would be much "fairer and honest" to write something like - "As one of the reviewers of the manuscript noted, ......"

This is a fair point. We apologise and have made the appropriate adjustment to the text.

With regard to this reply regarding a comment about references; "While we take the reviewer’s point here, we wish to provide the reader with the most recent references on these models. (p.4)." -this does not justify the inconsistency.

We now reference the originals.

Comments on the manuscript

The abstract is not structured using sub-headings as directed in the instructions to authors

Revised. We have attempted to fit the guidelines, but we do not have participants or undertake any data collection. We have added a Background section to the Shortened Abstract.

P4

Line 27-28: " Some published work in education journals has led to some educationists wrongly categorising CLA as 'just another game-centred pedagogy': where is your evidence for this assertion? No references to support evidence of the assertion of "some published work"

We have revised this text. See response to reviewer 2.

Line 43: " This re-alignment" - what re-alignment are you referring to? The start of this sentence seems out of sorts with the information before it.

This sentence has been removed.

Line 48: "some much-needed" - Has anyone else called for this need? On what basis are you making the claim "much needed"? Is it coming from the teachers you are undertaking your research with, a position you have come to from reviewing the literature and revealing the need. The claim to be "much needed" seems "over-blown" at present.

We have removed much needed.

Revised text: To that end, given the view of the teachers and coaches who we work with in our teacher and coach education sessions and the comments of the academic reviewers we cite in our introductory paragraph, our aim here is to provide clarifications for physical educators and sport pedagogists on the nature of the relationship between CLA and TGfU.
Line 3-13: Not your words or idea! See comment above and suggestion for wording, or see if there is a similar claim already "out there" the authors can reference.

Addressed. See earlier comment.

P6

Line 5-10: "TGfU has been selected for our clarification because it is the predominant games-based approach with status as a Special Interest group in AISEP" TGfU SIG 2013 decided to begin using the more generic term "game-centered" approaches, acknowledging TGfU is not "predominant". The authors should contact their regions "TGfU SIG" representative for clarification.

We have now revised this section to acknowledge the place of TGfU as the founding model upon which the game-centred approaches have been based.

Line 54: "(p.5)" - what is the reference for the page?

Reference added

Line 43 - paragraph starts here on P6 that ends P10 Line 7 - break it up.

Done.

P9

Line 50-52: “It has been argued that...” By who/whom? No references.

Reference added: Butler (2012).

P12

Line 3: ".(P.17)." - should that be (p.17) ~ lower case 'p'

Yes, Changed.

P13

Line 41: remove 'as'

Removed

p14

Line 7: Why is this underlined? "the CLA approach has been proposed as"

Good question. Removed 😊

P19

Line 52-56: "the CLA is more broadly aligned to understanding movement behaviours for many different types of practitioners including those working in health, exercise, disabilities,
physical activity, sport performance, training and practice.” - Where are the examples of CLA applied to health, exercise and disabilities? - references needed

Reference to Davids, Button and Bennett, 2008) added.

P21


Changed.

P37

Line 36: " & Renshaw, I." Why is Renshaw, I bold font?

Bold font removed.

Check each reference in the reference list for compliance with The Chicago Manual of Style (16th edn) required for the journal
http://www.tandf.co.uk/journals/authors/style/reference/tf_ChicagoAD.pdf Changed.
Shortened PE teachers abstract (150 words max)

**Background:** There is some apparent confusion regarding similarities and differences between the Constraints-Led Approach (CLA) and Teaching Games for Understanding (TGfU).

**Aim:** Our aim is to detail important theoretical and pedagogical concepts that distinguish the approaches, as well as to recognise commonalities.

**Findings:** We observe that TGfU emerged from operational principles of practice, in the absence of a theoretical framework, although retrospectively scaffolded theories have occurred. TGfU is a learner-centred approach which encourages teachers to design modified games to develop the learner’s understanding of tactical concepts. In contrast, the CLA has arisen within the umbrella of Nonlinear Pedagogy (NLP) based on the theoretical framework of ecological dynamics. The CLA is a ‘learner-environment’ centred approach which encourages practitioners to identify and modify constraints to develop perception-action couplings.

**Conclusions:** Although there are several other distinctions, importantly both TGfU and the CLA have a powerful central focus on the nature of learning activities undertaken by individual learners.