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Dunford, Bannigan, Rathmell (2016) Learning to ride a bike: Developing a therapeutic intervention. *Children Young People & Families Occupational Therapy Journal* 20(1) 10-18

Learning to ride a bike: Developing a therapeutic intervention

Carolyn Dunford, Susan Rathmell & Katrina Bannigan

Abstract

A task oriented intervention “Bike Skills Group” (BSG) programme was developed using theoretical/conceptual frameworks from occupational therapy and motor learning literature. Theoretical analysis supported bike riding as a therapeutic intervention. A clinical audit of 53 children (48 boys 5 girls) aged 6-15 years with various difficulties found 47 (89%) children learnt to ride independently and the majority (n=29 63%) learnt to ride in four hours (range two-16 hours). Developing complex interventions like the BSG requires synthesis of conceptual, empirical and experiential evidence which can be evaluated through the clinical audit process. The BSG is a theory-based, successful therapeutic intervention for learning to ride a bike.

Introduction

There is an increasing focus on children’s occupations and this year’s College of Occupational Therapists Specialist Section for Children and Young People’s conference is titled “The Power of Occupation” (Dunford 2015, Rodger 2010). Focusing on occupations requires a shift in emphasis towards meaningful activities and participation (Dunford 2010, Polatajko and Cantin 2006). In this context occupational therapists are developing services around occupations that are significant to children and learning to ride a bike is a rite of passage for many children skills (Mandich, Polatajko, Rodger 2003). Research suggests that the best method of learning to perform a new occupation is by practicing the activity itself (Law 2002). An example of how this manifests itself in practice is a child would be taught how to ride a bike rather than working on improving the component skills of balance or gross motor coordination. Such a move to a task oriented approach is supported in the literature (Mandich et al 2001, Polatajko and Cantin 2006, Wilson 2005). A literature review failed to identify research specifically supporting using learning to ride a bike as a therapeutic, task orientated, intervention for children with disabilities. Many studies found are focused on cycling used for rehabilitative purposes in the physical sense e.g. strength and endurance (Fragala-Pinkham et al 2005, Johnston 2007). There are studies which address participation opportunities for children with disabilities to engage in leisure activities but there is no mention of riding a bike (Heah et al 2007, King et al 2003, Shikako-Thomas et al 2008). It has been acknowledged that children with disabilities may not have as many opportunities as their peers to engage in play and leisure occupations and their first experience may be through a therapeutic intervention (Kramer and Hinojosa 2010). Cycling

clinics are currently being used with children therapeutically, and it is a developing area for occupational therapy practice (Roach 2009). Riding a bike is therefore hypothesized to be a meaningful occupation for children because they often identify it as a therapeutic goal and it has the potential to improve health through enhancing physical and psychosocial skills (Dunford et al 2005, McNeil and Gallagher 2009, Mandich et al 2003, Segal et al 2002). The Medical Research Council (MRC) guidelines for development-evaluation-implementation of a complex intervention were followed (MRC, 2008). The theoretical/conceptual frameworks selected were the Canadian Model of Occupational Performance and Engagement (CMOP-E) (Townsend and Polatajko 2007) and Hammell's schema (Hammell 2004). CMOP-E provided a means by which to view and classify the occupation of learning to ride a bike and assess its relevance as an occupational therapy intervention. However, some aspects of learning to ride a bike may not be captured by CMOP-E alone as recent criticism of CMOP-E's schema of purposeful occupations argued that dividing occupations into the categories of self-care, productivity and leisure focuses attention on the purposefulness of occupations but the emphasis on the meaningfulness of occupations is lost (Hammell 2004). An alternative schema has been proposed to capture the true meaning of occupation, i.e. doing, being, belonging and becoming (Hammell 2004) which originated in Wilcock's (2006) work. Being encompasses the meaning that is translated in the act of doing an occupation and becoming defines who we are, enables expression and is continually evolving (Wilcock 2006). CMOP-E was used to consider the occupational nature of bike riding and Hammell's schema was used to capture the meaningfulness of the occupation. These concepts of occupation and meaning were applied to the literature review (Patton 2002).

Learning to ride a bike involves acquiring new motor skills so, in addition to occupational therapy theory, motor learning theories were consulted to guide practice in terms of the whole task approach, scheduling and design (Schmidt and Lee 2005). This literature supports a whole task approach whenever possible, as there is always the risk that when a task is broken down into component parts they do not relate to the actual task in a meaningful way for the child. For example in designing the Bike Skills Group programme this meant we needed to provide opportunities for children to practice balancing on a bike with support, rather than on a wobble board or one legged stool. The motor learning literature states practice sessions should be as close to each other as possible without fatigue becoming a confounding variable (Schmidt and Lee 2005). This meant the group was scheduled to take place on consecutive days as this was thought to represent the way children typically learn to ride.

The aim of this paper is to report the development and evaluation of an occupation focused therapeutic intervention to enable children to ride a bike called 'The Bike Skills Group programme' (The BSG programme). The paper is reported in two sections; firstly the *development of the intervention* based on a literature review, analysis and theoretical application; secondly the evaluation of the BSG programme via a *clinical audit*.

Development of the intervention: Methods

Literature search

The research question was "Is learning to ride a bike supported by the literature as a therapeutic task orientated, intervention for children with disabilities?" A literature review was conducted using a systematic search strategy developed with a health librarian (see Table 1). An initial search revealed a paucity of literature so no limiters were put on the search. As well as electronic

searching, citation searching, hand searching of the journals which were featured frequently during the search process (i.e. American Journal of Occupational Therapy and the British Journal of Occupational Therapy), author searching (e.g. Mary Law and Sylvia Rodger) and serendipitous searching were also performed. The abstracts of 182 identified papers were read to determine the relevance of the papers. Much of the literature which seemed relevant, based on the paper's title, was not applicable leaving a total of nine. Following the relevance check papers were excluded where

- the content focused on using cycling to address impairments (e.g. Lauer 2008, Johnston 2007)
- the content focused only on the physical benefits of cycling exercise (e.g. Khalili and Elkins 2009)
- the literature was company endorsed (e.g. Hollingsworth 2008)
- the paper concentrated solely on adapted bikes (e.g. Klein et al 2002)
- not published in English (resources were not available for translation).

Table 1: A summary of the electronic search strategy used to identify literature about learning to ride a bike (based on guidance from Aveyard 2007, Greenhalgh 2006, Parahoo 2006)

Databases searched	Search terms used
Amed	Occupation, Bike (Bik*), Intervention, Child (child*) and Disability (disab*) which were used in the following combinations using Boolean operators
Cinahl	
Cochrane library	1. Occup* OR Partic*, leisure, activity, recreation, outdoor activity, play
ESTAR	2. Bike OR bicycl*, bike skills, rid*, cycl*, tricycle
Infotrac	3. Intervention OR therap*
Medline	
OTSeeker	4. Child* OR boy*, girl*
Pedro	5. Disab*
Sport Discus	6. adolescen*, p?diatrics, and teen*.

The findings of the nine articles were summarized and key findings coded. Patterns emerged through an iterative process examining the theoretical review of the literature. Ideas were mapped thematically (Hart 1998) with the recurring themes emerging of proving opportunities for shared occupation with the family, facilitating socialisation with peers, social inclusion,

favoured activity of choice, transportation, builds confidence, positive use of leisure time and importance of a safe environment (see Figure 1). The recurring themes were then grouped into four overarching themes related to learning to ride a bike for children with disabilities, i.e.

- A favourable activity of choice
- Builds confidence
- Facilitates socialisation with peers
- Provides opportunities for shared occupation with the family

These are summarised in Table 2.

Table 2: A summary of the overarching themes that emerged about learning to ride a bike from the nine articles identified in the literature search

Theme	Illustrations from the literature
Favourable activity of choice	<ul style="list-style-type: none"> • a common goal of therapy (Dunford et al 2005, McNeil and Gallagher 2009, Mandich et al 2003, Segal et al 2002). • gross motor activities were the most popular form of play amongst children with and without impairment of the same age group (Hestenes and Carroll 2000). • a popular choice of activity amongst children with disabilities and their families (Dunford et al 2005, Mactavish and Schleien 2004).
Builds confidence	<ul style="list-style-type: none"> • acquiring the skills to learn to ride a bike increases levels of confidence (Mandich et al 2003, McNeil and Gallagher 2009). • gave confidence to try other activities (Mandich et al 2003). • newfound skills also led to increased independence which appears to have occurred simultaneously (Mandich et al 2003). • provides a means of transportation which leads to increased independence (Segal et al 2002, Ulrich and Hornyak 2007).
Facilitates socialisation with peers	<ul style="list-style-type: none"> • reduces social exclusion (Mandich et al 2003) • a means of transportation which enables children to visit their friends (Segal et al 2002, Ulrich and Hornyak 2007) • improves social relationships (Andalo 2008, Mandich et al 2003, Ulrich and Hornyak 2007) • social motivation was reported to be crucial factor for older children to acquire the skills to ride their bikes. (Ulrich and Hornyak 2007)
Provides opportunities for shared occupation with the family	<ul style="list-style-type: none"> • a popular activity amongst families (Mactavish and Schleien 2000, 2004) • enables children with disabilities the opportunity for shared occupation with siblings (Andalo 2008) • provides a unique opportunity to include the whole family in an occupation (Andalo 2008, Ulrich and Hornyak 2007)

The CMOP-E was chosen to classify the occupation of learning to ride a bike as occupations are believed to be therapeutic because they provide meaning to an individual's life; impact upon health, well-being and justice; dictate behaviour; continually develop and change throughout our

lives; impact on the environment and are impacted upon by the surrounding environment (Polatajko et al 2007). Occupations are classified into three dimensions of self-care, productivity, and leisure and occur within an environment with physical, institutional, cultural and social aspects. Within the CMOP-E model (Townsend and Polatajko 2007) the domain of engagement is listed as one of the ten core competencies of enablement and this is fundamental to the BSG programme (Townsend et al 2007).

Whilst the CMOP-E model was useful in analyzing the intervention and identifying the therapeutic elements the *meaning* of learning to ride a bike to children was not entirely represented in this analysis. Hammell's schema of doing, being, belonging and becoming were applied to the literature findings to examine the aspects of *meaning* of bike riding as an occupation. The BSG programme was therefore developed by combining the findings from literature, occupational therapy and motor learning theory. This resulted in selecting a task oriented intervention approach (Schmidt and Lee 2005, Polatajko and Cantin 2006) as indicated in the findings below.

Development of the intervention: Findings

Nine articles were relevant to this study (Dunford et al 2005, Hestenes and Carroll 2000, Mactavish and Schleien 2000, Mactavish and Schleien 2004, Mandich et al 2003, McNeil and Gallagher 2009, Segal et al, 2002, Andalo 2008, Ulrich and Hornyak 2007). Three of the articles were not specifically focused on bike riding (Dunford et al 2005, Hestenes and Carroll 2000 and Mandich et al 2003) but were included because they indicated that learning to ride a bike is an important occupation to children with disabilities. Of the nine articles three were qualitative research studies (Hestenes and Carroll 2000, Mandich et al 2003, Segal et al 2002), two mixed methodology studies (Dunford et al 2005, Mactavish and Schleien 2004), a randomized controlled trial (Ulrich and Hornyak 2007) and two discussion papers (McNeil and Gallagher 2009, Andalo 2008).

<<Insert Figure 1 about here>>

Overall the literature supports the observation that learning to ride a bike for children with disabilities is a popular activity which increases confidence and provides opportunities for shared recreation with families and peers and promotes social inclusion. It also implied benefits other than the skill learned itself. For example, it provides a structure to children's leisure time contributing towards positive use of planned leisure time (Andalo 2008) promotes physical exercise and provides a form of transportation (Ulrich and Hornyak 2007). It is clear from the literature that the children were active participants in choosing their occupational goals (Dunford et al 2005, Mandich et al 2003, Segal et al 2002). Enabling children to ride their bikes illustrates the use of this therapeutic activity.

Hammell's themes were used to establish the meaningfulness of learning to ride a bike for children. The dimension of being includes participating in pleasurable occupations (Hammell 2004); riding a bike was clearly an enjoyable experience for the children as they chose to participate (Dunford et al 2005, McNeil and Gallagher 2009, Mandich et al 2003, Segal et al 2002). Belonging includes the valuable social experience involved in participation in occupation (Hammell 2004). Riding a bike provided these experiences for the children, their friends and family by giving them a sense of social belonging (Andalo 2008, Mactavish and Schleien 2004,

Mandich et al 2003, Segal et al 2002, Ulrich and Hornyak 2007). There was also the effect of the peers who both motivated and supported the children to ride their bikes (Ulrich and Hornyak 2007). Becoming is about the idea that people can envisage opportunities and future prospects (Hammell 2004). By learning to ride a bike it was reported that it led the children to have the confidence to try new activities (Mandich et al 2003).

Bike clinics were referred to in the literature and were a useful therapeutic intervention because they provided a safe environment to learn to ride a bike and practice their newfound skills (Andalo 2008, Segal et al 2002), and the social motivation of peers (Ulrich and Hornyak, 2007). The bike clinics were appreciated by parents who viewed them positively (McNeil and Gallagher 2009, Mandich et al 2003, Segal et al 2002). The use of bike clinics suggested that learning to ride a bike can be provided as a therapeutic intervention. Occupational therapists have been involved which connotes it is a relevant intervention to our profession.

The intervention: BSG programme methods

The BSG programme involves a graded approach, teaching the children how to put on their helmet, steer, brake, balance, push off, pedal and avoid obstacles (see Table 3). Since many of the children had had negative experiences trying to ride a bike the initial tasks were simple and easily achievable. No child was forced to take part but could watch the others until they were ready to participate. Ground rules about behaviour and safety were established.

The group ran on four consecutive mornings with sessions lasting approximately two hours. The environment was safe with plenty of space (a cycling velodrome) with an attitudinal environment that rewarded effort and participation rather than skill level. All children had to wear a helmet and the bikes were given safety checks by the cycling coach. The saddles were set at a height where they could easily put both feet on the ground. Children were taught to stand on the left of the bike (away from the chain) and asked to push the bike in a straight line then brake, to a verbal command initially, then in response to a visual cue e.g. a line on the floor. It was considered important to teach the children how to brake early on before they learnt to ride. Once they could push the bike in a straight line then they practiced sweeping turns followed by a slalom course of cones. In this way the children were learning to steer without having to balance at the same time.

The next stage was scooting the bike whilst sitting on the saddle. The same progression of steering skills was used; straight line, sweeping curve and slalom (see Table 3). The children wore handling belts (thick padded belts with handles) which enabled their helper(s) to facilitate postural adjustments and not let them fall. They needed to have enough speed to balance as cycling slowly requires more control, so the helpers would run alongside giving support until the child got the feel of pedalling and balancing. The children were taught that when they wobbled they must brake and put their feet down on the floor. Once the children were pedalling with intermittent support they could begin to work on starting up without support by preparing the pedal position for push off, pushing off and getting the second foot on the other pedal. Once they were pedalling independently they could work on steering and braking to avoid stationary then moving obstacles.

The BSG programme was run by occupational therapists, physiotherapists, a cycling coach and disability sports officer. Support was also provided from the chair of the local Dyspraxia

Foundation parent support group. Experiences from subsequent bike groups run in other locations and settings are also drawn upon. This intervention aimed to teach children to ride their bike by practicing the specific skills of bike riding rather than working on the component skills such as balance, strength, postural stability or coordination. The BSG was considered effective if the majority of children learned to ride independently. Ethical approval was not deemed necessary as this was a service audit.

Evaluation: Methods

Following the development of the intervention it was implemented in clinical practice and a clinical audit of a bike skills group was conducted to assess whether clinicians were able to deliver the BSG programme as a standard intervention. The BSG programme involves a high level of staff input as the children need 1:1 support throughout with 1:2 support as they start learning to balance and require a handler either side. The service manager required justification of these high levels of staff which motivated the audit to establish the feasibility and outcome of the BSG programme to ensure its continuation if it proved successful. The standard intervention delivery procedure (outlined above) was audited alongside the number of sessions required for the children to achieve their bike riding goal (Øvretveit 1998).

Participants

The sample consisted of 53 children (48 boys 5 girls) aged 6-15 years with a range of difficulties (developmental coordination disorder (20), autistic spectrum disorder (11), no diagnosis (5), cerebral palsy (1 hemiplegia, 1 diplegia, 1 ataxia), general learning difficulties (2), hearing impairment (2), and one child with each of the following diagnoses AD/HD, anxiety, cerebella astrocytoma, encephalitis, hypermobility, Kabuki syndrome, Neidoblastosis, neurofibromatosis type 1, Sprengles deformity, and tibial torsion. They were selected from occupational therapy and physiotherapy caseloads in an area of south east Wales, UK. Any child who had expressed a desire to learn to ride their bike using the Perceived Efficacy and Goal setting Scale (Missiuna et al 2004) was eligible for inclusion.

Data collection

Children's skill achievements were observed and recorded during the group. The data was collected in a notes audit from the children's occupational therapy records about the skills acquired and number of sessions attended. The skills were recorded on the BSG form (see Table 2 for an excerpt, available in full from the first author) based on the activity analysis. Occupational therapists and physiotherapists observed the children during the sessions and recorded on the BSG form whether the skill was observed with a check mark or cross if not achieved. Each parent/carer filled out an evaluation form at the end of the session which included asking them to seek feedback from their child.

Data analysis

The data was entered on to an Excel spreadsheet with each child being given an identifying number and their age noted in years. The number of hours of intervention the child received was calculated from the therapy records and the outcome was recorded as riding or not riding. The child had to pedal independently, consistently, on at least five separate occasions to be recorded as riding.

Evaluation: Findings

Forty seven out of the 53 (89%) children learnt to ride independently at the time the audit was conducted. The majority (n=29 63%) learnt to ride in four hours with a range of two-16 hours. Of the six children who did not learn to ride four chose not to come back, one had surgery and two will attend future sessions. The children's comments at the end included "It was great!", "I learnt to ride" and "I can go out with my friends now." The parents' comments included "He can now ride his bike and this skill has given independence and confidence. Thank you very much", "This is a great course for the children they do not have pressure and the staff are so understanding of all their needs" and "Grew in confidence – learnt to ride. Fantastic!" There were no negative comments. Parents reported their children were tired immediately after the group but seemed recovered by the next day which supported the four consecutive days scheduling.

Discussion

Developing complex interventions such as the BSG requires synthesis of conceptual, empirical and experiential evidence which is translated into an intervention which can be evaluated through the clinical audit process. The literature and clinical audit suggest that bike riding is a favourable activity of choice, builds confidence, facilitates socialisation with peers and provides opportunities for shared occupation with the family and these findings were supported by the clinical audit. Furthermore acquiring the skill of riding a bike is assumed to have many benefits in promoting healthy lifestyles and developing sensorimotor and psychosocial skills. Children with disabilities are at a greater risk of becoming obese (Murphy and Carbone 2008) and engaging them in sports and recreational activities has been reported to substantially improve their physical functioning and well being (Murphy and Carbone 2008). Learning to ride a bike provides opportunities for shared recreation with families and peers and promotes socially inclusive play (Mactavish and Schleien 2004, Andalo 2008, Ulrich and Hornyak 2007). Using the Perceived Efficacy and Goal Setting System (Missiuna et al 2004) the reasons children gave for wanting to learn to ride a bike were "because everyone else can", "so I can go out with my friends" and "to ride my bike without stabilisers". It was also found to increase confidence even if all the skills were not independently mastered and this was supported by some of the parents' comments. The literature suggests there are far reaching benefits other than the learned skill itself (Mandich et al 2003). Establishing whether learning the skill actually results in increased participation requires further research.

Applying CMOP-E to the literature review supported bike riding as a therapeutic intervention but had not delineated the occupational nature of learning to ride a bike. Hammell's themes were needed to establish the meaningfulness of learning to ride a bike for children by considering the dimensions of doing, being, belonging and becoming. Hasselkus (2002) believes that being and becoming are the parts of occupation whereby meaning is derived; being is who we are and becoming is what we aspire to be. They are connected to the individual themselves and to a wider aspect in a social sense. In this sense riding a bike did provide self-esteem and brought new opportunities for the children. In relation to the activity of learning to ride a bike there is an element of doing which Hammell (2004) refers to as the precise goal orientated purposeful activities that are currently the focus of occupational therapy practice. The element of doing also includes a level of structure (Hammell 2004) and riding a bike can structure play time (Andalo 2008). Cycling was clearly an enjoyable experience for the children because they chose to

participate (Dunford et al 2005, McNeil and Gallagher 2009, Mandich et al 2003, Segal et al 2002). It is apparent that Hammell's (2004) categories were closely connected to the themes found within the literature and effectively demonstrated the meaning attributed to learning to ride a bike.

At the initial bike skills group the therapists and coaches were unsure how many of these children could be taught to ride using this method but believed that at least some of them could. The success rate was greater than expected as some children had significant difficulties with motor impairment, scoring below the first percentile on a standardized test of motor impairment (Henderson and Sugden 1992) but still learnt to ride independently. Changes were made to maximise engagement and enable the children to ride their bikes in terms of the person, occupation and environment fit. For example, a supportive environment was provided which would be conducive to learning to ride a bike (McNeil and Gallagher 2009, Segal et al 2002). Training was provided to enable acquisition of the skills required to become proficient at riding a bike (McNeil and Gallagher 2009, Segal et al 2002, Ulrich and Hornyak 2007). Alterations to the bike itself were made to optimise the child's ability to ride a bike (Ulrich and Hornyak 2007). Groups were set up by knowledgeable staff to give the children the best chance of success (McNeil and Gallagher 2009, Segal et al 2002, Ulrich and Hornyak 2007). Peers within the groups provided motivation which had a considerable impact upon the children (Ulrich and Hornyak 2007) and groups were set up with this in mind. The audit identified that initially the intervention should comprise of four sessions on consecutive days as the majority of children learned to ride with this amount of intervention; this is an important finding to guide future interventions.

Conclusion and implications

Cycling has been reported to be a popular activity amongst children with and without disabilities. A prominent feature of the literature about learning to ride a bike was many children with disabilities had chosen riding a bike as a goal of therapy. The fact that all the children had chosen the goal themselves was thought to play a major role in the success of the group. Using learning to ride a bike as a task orientated, therapeutic intervention is supported by theoretical analysis of the literature and the results of the clinical audit. The results indicate that the BSG programme can be used in clinical practice as not only is it acceptable to children and their parents but it delivered the outcome they aspired to achieve, i.e. most children learnt to ride a bike.

The BSG programme is a promising intervention that is focused on an occupational goal that is important to many of the children occupational therapists work with. There is a need for more research and investigation of the BSG programme as a complex intervention to further establish its effectiveness in enabling children to learn to ride a bike compared to an appropriate alternative intervention. Occupational therapists that are enabling children to ride their bikes as part of their clinical interventions need to collect and publish their findings and the first author would welcome dialogue with colleagues about progressing to the next stage in developing this evidence base.

Key learning points

- A clinical practice audit has confirmed that The Bike Skills Group programme can be used in clinical practice enabling 89% of children to learn to ride independently

- Riding a bike is frequently chosen as a goal by children
- The Bike Skills Group programme is a theory-based, successful therapeutic intervention for learning to ride a bike

Acknowledgements

We would like to thank Wendy Williams, Brian Begg and Isabel McGinty for their assistance with the collection of the audit data. We are also very appreciative of John Gray's support in running bike clinics at York St. John University. We would also like to thank the staff in York St. John University library for their support with locating articles. Some aspects of this paper are based on a dissertation submitted in part fulfillment of BSc (Hons) Occupational Therapy at York St John University. The conceptual framework was developed as part of the Students as Co-Researchers (SCoRe) project which is a curriculum development project at York St John University.

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Table 3: BSG FORM: SKILL PROGRESSION	Date	Date	Date	Date
Able to put helmet on independently				
Able to hold both handlebars and push bike <i>in a straight line</i> whilst walking beside it standing on the left hand side. Looking ahead and around to check route is clear.				
Able to hold handlebars and push bike <i>round a corner</i> while walking beside it				
Able to stop bike using both brakes (walking beside it) to sudden verbal command				
Able to mount bike (Placing both hands on the handle bars and brakes if necessary)				
Able to dismount (Keeping both hands on the handlebars, holding the brakes)				
Able to scoot on bike sitting on the saddle, not standing up, taking 'walking steps' <ul style="list-style-type: none"> ◆ In a straight line ◆ Round a corner 				
Able to scoot on bike, lifting 2 feet together, to balance briefly				
Able to scoot on bike, lifting 2 feet together, gaining speed by tapping one or other foot to the ground				
Able to stop bike safely if starting to lose control while scooting (Both Brakes on, Both feet down)				
Able to prepare pedal position ready to push off				
Able to 'push off' using pedal with, support to balance and to keep moving, while placing second foot onto pedal				
Able to pedal bike with constant support to balance				
Able to stop bike safely using both brakes (Both Brakes on, Both feet down)				
Able to pedal bike with intermittent support to balance				
Able to cycle in a straight line without support				

Figure 1: A summary of the recurring themes identified in the literature

