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Designing affordances for physical activity and exercise in sedentary individuals

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Abstract

Ideas in ecological dynamics have profound implications for designing environments that afford opportunities for physical activity, exercise and play in humans. They imply how exercise scientists, health professionals, planners, designers and engineers, and psychologists, can collaborate in co-design environments and playscapes that facilitate physical activity and exercise participation in different population sub-groups. Here, we discuss how ideas in ecological dynamics emphasise the person-environment scale of analysis indicating how physical activity environments might be (re)designed into qualitative regions of functional significance (*affordances*) for interactions that invite behaviours from individuals with reciprocal capacities and skills (*effectivities*).

Introduction

Data from existing research in ecological dynamics imply how informational variables emerging during ongoing interpersonal interactions of individuals with their environments (e.g., negotiating gaps, stepping on and off objects, locomoting on different surfaces) provide health-enhancing *affordances* (even invitations for action) which can be perceived and realised by people during sedentary behaviours and during physical activity (PA). In this paper, we discuss how the key concept of affordances can be used to regulate environmental interactions (see Gibson, 1979), providing a basis for (re)designing physical activity and exercise contexts.

Affordances

James Gibson (1979) proposed that *affordances* are available in every performance environment to regulate human behaviours. Affordances are not *material entities* that are perceived, but functional *relationships*, or *relational entities*, formed between an individual and an environment. This definition emphasises the functional, rather than structural, relational, rather than material, properties of a performance environment, i.e., what an object, surface, or another individual, *offers* an individual in terms of opportunities for actions. For example, an icy surface on a mountain walk can afford stepping on or stepping over by young children and adults, depending on what it offers each individual (i.e. melting ice signifies a hole or pool to be avoided, firm ice offers walk-on-ability). This emphasis on an affordance being a relational property between an individual and a performance environment, suggests that it simultaneously has an objective or subjective characteristic (Gibson, 1979; Chemero, 2003).

This implied particularity of affordance utilisation by different individuals was captured by Rietveld and Kiverstein (2014) who proposed that affordances offered by an individual's

relationship with an environment are always predicated on a capacity to *utilise* them.. This perspective emphasises the resourcefulness of different environments and has implications for how they can be (re)designed for different purposes, including for enhancing physical activity and exercise. The suggestion is a rich landscape of affordances, dependent on people's capabilities and expertise, can be designed to invite or attract , physical activity and exercise behaviours. These ideas predicating a 'selective engagement' with a rich landscape of affordances, as a function of learning, experience and development, have implications for health promotion groups, amongst others.

Gibson (1986) focused on the person-environment relationship as the appropriate scale of analysis for understanding human behaviours, advocating that the environment contains qualitative regions of functional significance for interactions that are perceivable to individuals with reciprocal capacities and skills . Following Gibson, Shaw and colleagues (1982) introduced the concept of *effectivities* to complement the concept of affordances. Functionally defined, an effectivity set constitutes those complimentary capabilities of an individual that can realize affordances in coherent forms of behaviour. With a particular effectivity, individuals are more likely to perceive and interact with the world in certain ways—even noticing certain affordances that may be imperceptible to other people. For example, parkour participants or BASE jumpers tend to view urban environments as a means to physical activity, and what would normally be considered barriers to locomotion in other groups, such as walls or fences at the top of high buildings, are perceived as invitations to engage in acts like climbing, balancing and jumping.

A niche is a set of affordances, according to Gibson (1979, p128), which offers an organism a specific *way of life*, an important idea for considering how to encourage people to take up and maintain a physically active lifestyle. Predicated on Gibsonian ideas. Rietveld and Kiverstein (2014) proposed that a 'form of life' is important for implying how human socio-cultural

practices can constrain the emergence of specific behavioural patterns. A 'form of life' comprises patterns of behaviour that become regular and stable over time, and is a significant concept for understanding how to design environments that encourage individuals to regularly partake in physical activity and exercise. Creating affordances for physical activity can help people avoid a sedentary lifestyle, through inviting variations in use of perception and action during behavioural interactions with an environment.

These ideas suggest how experienced behavioural interactions with different exercise environments involves searching for, and picking up affordances, which support interactions with features, objects, materials, surfaces, and other people in the environment, that are relevant for goal-directed behaviours. The role of exercise practitioners is to educate individuals' attention to affordances for physical activity. For example, negotiating environments in nature involves becoming perceptually attuned to affordances for support and locomotion offered by a sand dune, a flat grassy area or a rocky trail. These ideas are supported by research on effects of exercise environments on psychological health, for example. Rogerson et al. (in press) investigated psychological outcomes of people exercising in four different nature-based physical activity environments and reported that all were capable of inducing positive effects such as enhanced self-esteem, reduced stress and elevated mood. They noted that different nature-based environments facilitated psychological health through a range of varied affordances to be utilised by individuals engaged in physical activity.

. Therefore, avoiding sedentary behaviours involves people becoming more attuned to varied aspects of an active form of life. Affordances for physical activity and exercise in different individuals are dependent on their capacities and a form of life which help them utilise these affordances. Their capacities are shaped by the form of life (the social and cultural practices

of the community) and the material aspects of the environment. A form of life only exists because material aspects of an environment offer opportunities for action.

These ideas imply that artists, designers, urban planners, developmental psychologists, pedagogists, exercise scientists and architects, for example, could collaborate to research the invitational characteristic of affordances to design healthier habitats for different people to continuously move around. An affordance can create a readiness for play, exercise and physical activity, or for sedentary behaviours. Relevant affordances can invite these behaviours and their associated psychological and physical responses. This approach could result in an environment overflowing with affordances, allowing people to selectively interact with a relevant few that enhance their functional behaviours. . Accordingly, a form of life that drives different people to accept invitations to be active needs to be better understood.

How Affordances can enhance opportunities for Physical Activity and Exercise

Withagen et al. (2012) also proposed that affordances provide behavioural invitations which are individual-specific and time-based, dependent on past experience, learning and development for their realization. Affordances, therefore, have an objective/public (they exist in a performance environment) and subjective/particular (they need an actor with the specific capabilities to perceive them), dimension. They suggested that the specific motivations and intentions should be seen at the individual-environment level, not specifically generated inside of an individual. And these underlie the utilisation of affordances in a particular environment.

Gibson (1986, p411) conceived that affordances 'do not cause behavior but constrain or control it', laying the foundation for considering affordances as constraints on emergent behaviours (Riccio & Stoffregen, 1988; Davids et al., 2011, 2013, 2014). In fields like

industrial architecture and planning, there has been a strong tradition of understanding how to design affordances into edifice properties to constrain human interactions with built environments (e.g. the width of entrances and exits, the flow of walking areas and properties of objects for pushing and pulling doors) (Withagen et al., 2012). This tradition prompts the notion that exercise scientists, health promotion specialists and physical educators should be considered as *physical activity designers* with the role of creating multiple, specific affordances into different environments such as urban areas, parks, shopping malls, residential complexes, industrial centres, universities and even travel centres such as railway stations and airports to ensure that there are numerous affordances designed into location sites for people with different capacities to utilise. In this way design can consider the needs of different groups such as young children, adults and elderly people, as well those with specific diseases and disabilities, facilitating their capacity to remain active. Socio-cultural constraints such as traditions, customs and practices can also be understood as constraining affordances for physical activity, exemplified by clothing typically worn by specific groups. A landscape of affordances can facilitate the emergence of functional relations between different individuals and a specific environment such as a park area or an urban street (Rietveld & Kiverstein, 2014; Yeh et al., this issue; Brymer & Davids, 2013).

During interactions with an affordance landscape in a park or nature trail, for example, individuals need to be able to explore a surface and its texture, an object or feature and discover invitations for specific behaviours. A manifold of affordances represents a perceptual-motor workspace that physical activity designers could create for different individuals by manipulating task constraints (Davids, et al., 2014). These ideas suggest how schools could be designed to take into account how classrooms, gymnasia, playgrounds and open spaces could facilitate PA in children with different abilities and effectivities. For example, interacting with grass, ledges, surfaces and trees can help children become and

remain active whilst they are engaged in learning, even in subjects like mathematics which have been traditionally associated with classroom-based learning (Abramson & Trninic, 2014; Abramson & Sánchez-Garcia, 2015) .

Variability in a play environment is a key property which can invite adaptive movements, as Withagen and co-workers have pointed out. Yet why are some environments too symmetrical: for example playscapes for children? These exercise and play environments are built by adults in a standardised fashion, despite the evidence from children that they prefer (i.e. will design games incorporating) non-standard, varying environmental features for play (Jongeneel, Withagen & Zaal, 2015). The work of Jongeneel et al. (2015) critiqued the 'omnipresent standardisation of playgrounds' (p 45), which may have been built and designed by adults, to create a 'risk free' area, without consideration of children's developmental needs. Well-designed play environments contain many variable opportunities to achieve the same movement goal, giving people experience in adapting their behaviours to dynamic contexts. To become more skillful in adaptive behaviours, people need to gain experience such as risk management, so that they can experience a 'gradient of risks' when playing and exercising (Cordovil et al., 2015). Cordovil et al. (2015) pointed out that a safe environment is not the same as a risk-free one. A risk-free environment, without any element of danger, is almost impossible to design. But it is also undesirable because there are positive developmental outcomes which can emerge when people actualise affordances that have a certain gradient of risk.

According to insights in ecological psychology: “The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or for ill” (Gibson, 1979/1986, p. 127). Variable environments should seek to allow learners to utilise affordances for action, which have consequences for 'good or ill' to paraphrase Gibson (1979). These Gibsonian ideas suggest that our understanding of what constitute risky play

environments could benefit from analysis of how different individuals (e.g., children, adults, elderly people, people with diabilities) behave in those environments. Cordovil et al. (2015) proposed that "risk" is not an entity in a specific play environment, but an emergent property from continuous interactions between a specific individual (with particular action capabilities) and an environmental context. Gibsonian ideas imply that some affordances may have negative consequences for individuals. People need to be able to utilise these affordances to regulate their behaviours, perhaps in managing or avoiding possible dangers. The environment is not a manifold of *neutral* action possibilities that an active person intentionally chooses from. Rather, affordances can attract or repel an individual and impact on particular behavioural outcomes (Withagen et al., 2012).

To exemplify, people actively exploring an inclined surface or narrow pathway in their behavioural environment, are likely to manage inherent risks through discovering different ways to achieve the task goal of locomoting. Accordingly, exercise designers can provide flexible opportunities for locomotion, perhaps by co-creating affordances for young children, young adults and elderly or disabled people to negotiate a particular environmental feature (e.g., a route across a parkland area), in variable ways. Opportunities for simple transitions of a pathway, can co-exist with challenging negotiations of the trail in the designed area, facilitating physical activity which suits effectivities of each person. Through experience and learning, people can perceive and realise the most functional affordances available in a landscape of opportunities for actions (Bruineberg & Rietveld, 2014). The enormous adaptability of human beings and a large number of affordances inviting action provide a platform for functional negotiation of physical activity landscapes. Facilitating peoples' capacity to explore variable environments can even impact on brain function. Voelcker-Rehage, Godde and Staudinger (2011) found that when older adults were exposed to a period

of cardiovascular training in stable environments, brain changes mainly involved volume in white and grey matter. However, in participants who were asked to undertake coordination training, synaptic connections between different parts of the brain improved significantly. These data suggest that affordances designed for older adults to provide opportunities for physical activities which enhance cardio-respiratory capacity and coordinative skills can result in changes in brain volume as well as synaptic connectivity.

These ideas and data imply that manipulating task constraints in specific environments can co-create affordances to help different population groups gain what they need when regulating their activities. Designing affordances into exercise and physical activity environments can 'nudge' individuals towards particular outcomes. As they emerge, behaviours can underpin each individual's structural (physical conditioning, agility, flexibility, strength and speed) and functional needs (cognitions, emotions and fatigue reduction) in a specific performance environment (e.g., an aquatic environment with different depths, objects and surfaces to climb upon and dive off and slide down from). Some affordances might suit some skilled swimmers, while less skilled swimmers can explore other ways of locomoting through shallow still water areas which are calm and inviting. Although differing, affordances should have a common theme of continually inviting physical interactions, psychological and emotional engagement and dynamic exercise. Even affordances for static or sedentary behaviours should be available for a limited few individuals who need to remain stable in physical activity environments. As Withagen and Caljouw suggest in this issue, even offices can be designed for people to remain static for only temporary periods, with the norm being many opportunities to get up, move around, change posture and location, and engage with different objects, surfaces and environmental features to promote an ongoing, cyclical relationship between action and information.

Conclusions

Ecological dynamics emphasises continuous interactions between an individual and a behavioural environment and is ideally suited to explaining how physical activity and exercise experiences might improve physical and psychological health and wellbeing. Based on these ideas, exercise scientists need to consider themselves as designers who focus on informational constraints or *affordances* constructed into environments by physical activity designers to facilitate exploratory behaviours and interactions of individuals with surfaces, objects, features and terrains, as well as other individuals. They can achieve these aims by:

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