Table S1. The identified correlates and their association with children’s outdoor behaviour

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| COM-B | (sub)component | Share of studies investigating the variable n/N | Significant association with outdoor play | | | Share of studies that find a significant association |
|  |  |  | **+** | **0** | **-** |  |
| Capability | ***Physical and psychological***  **Children's independent playing** |  | | | | |
|  | Unsupervised mobility and playing | 3/33 | (Lee et al., 2019; Moran et al., 2017;Page et al., 2010) |  |  | 3/3 |
|  | Supervised playing | 3/33 |  | (Remmers et al., 2014) | (Moran et al., 2017; Loebach et al., 2021) | 2/3 |
|  | ***Children's perception of the neighborhood*** |  | | | | |
|  | *Positive perception of neighborhood safety* | 5/33 | (Lee et al., 2019; Aarts et al., 2010; Page et al., 2010) | (Kemperman & Timmermans, 2011; Wang et al., 2020) |  | 3/5 |
|  | *Positive perception of the neighborhood as “child-friendly”* | 5/33 | (Lee et al., 2019;Aarts et al., 2010) | (Aarts et al., 2010;Page et al., 2010) |  | 3/5 |
| Opportunity | ***The social and physical environment***  ***Neighborhood***  ***social capital*** |  | | | | |
|  | *The presence of friends, siblings, and other people* | 11/33 | (Page et al., 2010;Lee et al., 2019;  Reimers et al., 2018;Bringolf-Isler et al., 2010;  Aggio et al., 2017;Orr & Caspi, 2020;  Loebach et al., 2021;Veitch et al., 2010;Wang et al., 2020) | (Aarts et al., 2010;  Yoon & Lee, 2019) |  | 9/11 |
|  | *Feeling connected and attached to a group or community* | 3/33 | (Aarts et al., 2010;Remmers et al., 2014) | (Lee et al., 2019) |  | 2/3 |
|  | ***Socio-cultural norms and values*** |  | | | | |
|  | *Restricted norms* | 4/33 |  |  | (Wang et al., 2020*;* Bringolf-Isler et al., 2010; Moran et al., 2017;Reimers et al., 2018) | 4/4 |
|  | ***Parental socioeconomic status*** |  | | | | |
|  | *Low income* | 5/33 | (Aggio et al., 2017) | (Kimbro et al., 2011*;* Yoon & Lee, 2019;Faulkner et al., 2015;Parent et al., 2020) |  | 1/5 |
|  | *High education* | 4/33 |  | (Yoon & Lee, 2019;Aarts et al., 2012) | (Dodd et al., 2021;Mölenberg et al., 2019) | 2/4 |
|  | ***The walkability of the***  ***neighborhood*** | | | | | |
|  | *Walking distance to playing areas and schools* | 7/33 |  | (Aarts et al., 2010;  Mölenberg et al., 2019; Lee et al., 2019) | (Faulkner et al., 2015;Page et al., 2010  ; Bhuyan, 2021  ; Kemperman & Timmermans, 2011) | 4/7 |
|  | *Traffic safety* | 3/33 | (Lee et al., 2019) | (Aarts et al., 2010;Aarts et al., 2012) |  | 1/3 |
|  | *Traffic volume (density)* | 4/33 |  | (Aarts et al., 2012;Nguyen et al., 2018) | (Lee et al., 2016;Bringolf-Isler et al., 2010) | 2/4 |
|  | *The presence of intersections* | 2/33 |  |  | (Yoon & Lee, 2019; Aarts et al., 2012) | 2/2 |
|  | ***The outdoor playing areas*** |  | | | | |
|  | *The availability of formal and informal playing spaces* | 9/33 | (Lee et al., 2019; Aarts et al., 2012; Lee et al., 2016;  Wang et al., 2020;Veitch et al., 2010) | (Aarts et al., 2010;  Yoon & Lee, 2019;Page et al., 2010) | (Nguyen et al., 2018)(Nguyen et al., 2018) | 6/9 |
|  | *Quality, size and layout, and maintenance of playing areas* | 3/33 | (Moran et al., 2017; Sumiya & Nonaka, 2021) | (Aarts et al., 2012) |  | 2/3 |
|  | ***Greenery*** |  | | | | |
|  | *The availability of green (natural) resources* | 6/33 | (Aarts et al., 2010;Luchs & Fikus, 2013;Kemperman & Timmermans, 2011;  Bringolf-Isler et al., 2010) | (Moran et al., 2017;Yoon & Lee, 2019) |  | 4/6 |
| Motivation | ***Reflective*** |  | | | | |
|  | ***Parental perception*** |  | | | | |
|  | *Positive attitudes toward neighborhood attributes and outdoor playing* | 10/33 | (Roberts et al., 2016;Veitch et al., 2010; Carmo et al., 2020;Yoon & Lee, 2019;Remmers et al., 2014;Kimbro et al., 2011*;*Mcfarland et al., 2014;  Dodd et al., 2021;Loebach et al., 2021;Parent et al., 2020) |  |  | 10/10 |
|  | *Safety concerns* | 5/33 |  |  | (Carmo et al., 2020;Veitch et al., 2010*;* Remmers et al., 2014;Bringolf-Isler et al., 2010;Faulkner et al., 2015) | 5/5 |
|  | ***Practices of the family*** |  | | | | |
|  | *Social support and encouragement of family, friends, and others* | 8/33 | (Aarts et al., 2010;Remmers et al., 2014;  Yoon & Lee, 2019; Veitch et al., 2010;  Christian et al., 2014;Xu et al., 2016;  Ferrao & Janssen, 2015; Chen et al., 2019) |  |  | 8/8 |

Table S2. Themes and codes developed for thematic analysis of studies on the roles of digital interventions on children’s outdoor playing

|  |  |  |  |
| --- | --- | --- | --- |
| **Theme** | **Description** | **Deductive code** | **Examples from data** |
| Enablement | increasing the means or reducing the barriers, to increase capability or opportunity | “enable OR “capable”; “physical capability” OR “psychological capability”; “social opportunity” OR “physical opportunity” | Having the controller allows the children to take different roles in play, depending on their interests and abilities, as a way of enabling them to participate on their own terms (Dylan et al., 2019). |
| Environmental restructuring | physical or social modifications to the context | “adding” OR “changing” OR “social environment”; “physical environment” | The interactive play technology was installed as an integral part of a schoolyard environment (Jon Back et al., 2016). |
| Training & Education | imparting skills; increasing knowledge or understanding | “teaching “OR “learning” | Thanks to the proper use of technology through an open-air, activities also become an opportunity to explore and acquire knowledge in the context of a smart and educational setting (Delprino et al., 2018). |
| Incentivization | creating the expectation of reward | “point” OR “score” | When a player finds the opposite team’s device, instead of grabbing it and running (as in traditional games), they press the button, earning their team a point (Ofer, 2019). |
| Coercion | Creating expectation of punishment or cost | “penalty” | - |
| Persuasion | using communication (connection) to induce positive or negative feelings or stimulate action | “motivate” OR “encourage” | FeetUp gives audiovisual feedback whenever children lift their both feet to stimulate free play related to jump activities (Rosales et al., 2011). |
| Restriction | Using rules to reduce the opportunity to engage in the target  behaviour | “limitation” | - |
| Modelling | providing an example for children | “example” OR “follow” | A game takes place on the playground and involves a parent holding their phone with a game open and issuing playful directives that the child is to follow based on the imaginary premise presented (Patten et al., 2017). |

Table S3. Characteristics of the studies on the digital interventions to stimulate children's outdoor playing behavior and the relationships of functions with COM-B model components

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Study Source** | **Aim of the intervention** | **Population's (average) age** | **Research design** | **Intervention type** | **Intervention function** | **COM-B component** | | |
| **Capability** | **Opportunity** | **Motivation** |
| Dylan et al. (2020) | Four IoT prototypes for social and active play in different scenarios of use outdoors, including congregating on a street or in a park to play physical games. | 7-11 | intervention-testing  Intervention-designing | Portable device | Training  Enablement  Incentivization  Environmental restructuring  Persuasion |  |  |  |
| Ofer (2019) | a coding platform enabling children to technologically enhance their outdoor play experiences by inventing game ideas | 9-12 | Intervention-testing | Portable device | Training  Enablement  Persuasion  Incentivization  Persuasion |  |  |  |
| Wood et al. (2019) | the potential of the Internet of Things (IoT) for supporting children's free play that extends outdoors | 5-14 | Intervention-designing | Portable device | Training  Persuasion |  |  |  |
| Delprino et al. (2018) | a pervasive interactive game for children aims to stimulate exploration of outdoor environments | 5–7 | intervention-testing  Intervention-designing | Portable device | Training  Incentivization  Persuasion |  |  |  |
| Hitron et al. (2017) | A sensor-based prototype designed to augment children ‘s social-physical outdoor play | 8-12 | Intervention-designing | Portable device | Training  Incentivization  Persuasion |  |  |  |
| Patten et al. (2017) | a suite of mobile games intended to get children back out to playgrounds | 3-9 | intervention-testing | Portable device | Enablement  Incentivization  Persuasion  Modelling |  |  |  |
| Back et al. (2016)(J Back et al., 2016) | an integrating interactive technology project in outdoor environments contribute to the versatility of children's play activities | Elementary school | intervention-testing | Interactive installation | Training  Persuasion  Environmental restructuring |  |  |  |
| Amores et al. (2015) | a wearable device in the form of a bracelet that turns everyday objects into interactive physical gameplay for children | - | Intervention-designing | Portable device | Enablement  Persuasion  Incentivization  Environmental restructuring |  |  |  |
| Rosales et al. (2011) | an interactive accessory to play anywhere and anytime while encouraging children's free play and practicing social skills | 6-9 | intervention-testing  Intervention-designing | Portable device | Training  Persuasion  Incentivization |  |  |  |
| Soute et al. (2010) | a new genre of pervasive games conceived to merge traditional and digital play | 7-13 | intervention-testing  Intervention-designing | Portable device | Training  Enablement  Persuasion  Incentivization |  |  |  |