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Three Essays on Playing at Work and Organisational Creativity

By

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Table of Contents

List of Tables

List of Figures

Acknowledgements

Declarations

This thesis is submitted to the University of Warwick for the degree of Doctor of Philosophy. I declare that I have not submitted this thesis for a degree to any other university.

I confirm that the work presented in this thesis is my own and has been generated by me as the result of my own original research. The writing of this thesis and the research reported in it have been conducted by me but have benefited immensely from feedback from my supervisor, Dr Tamara Friedrich. Essay 1 has also benefited from feedback from Dr Jonothan Neelands. Essay 2 has also benefited from feedback from Dr Jonothan Neelands and Dr Leroy White. Essay 3 has also benefited from feedback from Dr Dawn Eubanks and Dr Leroy White.

My intention is to submit Essays 1, 2, and 3 to leading management journals with me as the first author and other contributors as co-authors. For this reason, I have written the three essays as well as the Abstract, Introduction, and Conclusion of this thesis in the first-person plural pronoun ("we") instead of the first-person singular pronoun ("I").

Abstract

This thesis is a collection of three independent but related essays on playing at work and organisational creativity. In the first essay, we focus on an emerging type of play activities purposefully designed to improve organisational creativity (Kirsten & Du Preez, 2010; Nisula & Kianto, 2018; West, Hoff & Carlsson, 2017), which we call *serious play for organisational creativity (SPOC)*. Recognising the potential of SPOC in the business environment, we review the available theoretical and empirical literature on play, serious play, and creativity in the developmental psychology and management literatures and provide an agenda for future research on SPOC design and implementation.

In the second essay, we recognise that while multiple mechanisms explaining how play can stimulate creativity inside and outside the workplace have been proposed (Kirsten & Du Preez, 2010; Mainemelis & Ronson, 2006; Mellou, 1994, 1995; Saracho, 2017; West, 2014), most of these mechanisms have not been clearly communicated (Petelczyc, Capezio, Wang, Restubog & Aquino, 2018; Russ & Wallace, 2013) and robust research linking play design characteristics (e.g., materials, dosage, content), mechanisms, and outcomes is lacking. To address this limitation and help develop rigorous research in this area, we focus on play as an activity and describe in greater detail one of the possible mechanisms by which play can promote ideational fluency, originality, and flexibility – three cognitive abilities important to creativity (Runco, 2011; Russ, 2018). We also consider how five important play design characteristics – materials, cognitive content, social content, freedom, and dosage – might facilitate the mechanism we describe.

In the third essay, we develop hypotheses based on the mechanism we describe in the second essay and test these hypotheses using data from a pre-test-post-test experimental design. While the play intervention we administered did not activate the mediating mechanism we describe, the findings suggest that the mechanism merits further exploration. We provide research design and play design recommendations for future research.

Abbreviations

Essay 1	
SPC	Serious Play for Creativity: Play activity (or set of activities) purposefully designed to stimulate creativity outside the organisational context.
SPOC	Serious Play for Organisational Creativity: Play activity (or set of activities) purposefully designed to stimulate creativity inside the organisational context.
HR	Human Resources: The people in an organisation.
HRM	Human Resource Management: The strategic management of people in an organisation (through practices such as hiring, training and development, and appraising and rewarding) in such a way that the organisation achieves its objectives.

Essays 1 and 3	
DTT	Divergent Thinking Test: A type of measure that measures divergent thinking abilities.

Essays 2 and 3	
AF	Associative Fluency: An individual's ability to create and use associations for any given concept.
SAF	Stereotypical Associative Fluency: An individual's ability to create and use stereotypical associations for any given concept.
NSAF	Non-stereotypical Associative Fluency: An individual's ability to create and use non-stereotypical associations for any given concept.
R&D	Research and Development: Activities undertaken to develop new services and products.
CFWAT	Continuous Free Word-Association Task: A measure of associative fluency.
AUT	Alternate Uses Test: A measure of divergent thinking abilities.

Essay 3	

RAT	Remote Associates Test: A measure of creativity.
IF	Ideational Fluency: An individual's ability to provide solutions to an open-ended problem.
SIF	Stereotypical Ideational Fluency: An individual's ability to provide stereotypical solutions to an open-ended problem.
NSIF	Non-stereotypical Ideational Fluency: An individual's ability to provide non-stereotypical solutions to an open-ended problem.
TTCT	Torrance Tests of Creative Thinking: A measure of divergent thinking abilities.

Introduction

"When you play, play hard; when you work, don't play at all". This famous quote, widely attributed to Theodore Roosevelt, reflects the notion that play is a frivolous activity that does not belong in the workplace – a place where activity leading to important business outcomes is carried out (Petelczyc et al., 2018). This negative belief about the seriousness and purposefulness of play dates back to the industrial revolution (West, 2014) and is held by many in organisations around the world (Kristiansen & Rasmussen, 2014; Petelczyc et al., 2018). However, the last 30 years have witnessed a significant shift in the opposite direction (Mainemelis & Dionysiou, 2015; West, 2014). An increasing number of management scholars and business leaders are discussing the positive effects of playing at work on important performance indicators (Petelczyc et al., 2018). Among these performance indicators is organisational creativity (Hjorth, Strati, Drakopoulou Dodd & Weik, 2018; Kirsten & Du Preez, 2010; Mainemelis & Dionysiou, 2015; Mainemelis & Ronson, 2006; Nisula & Kianto, 2018; Petelczyc et al., 2018; West, 2014; West et al., 2017). Creativity at work is considered an important dimension of job performance at the individual level and business performance at the organisational level (Harari, Reaves & Viswesvaran, 2016). And in recent years, management scholars have highlighted the critical role of creativity in organisational competitiveness and viability (Anderson, Potočnik & Zhou, 2014; Harari et al., 2016; Ligon, Graham, Edwards, Osburn & Hunter, 2012; Madden, 2017).

Considering the importance of creativity in organisational competitiveness and viability, we believe that there is value in considering all the possible ways of stimulating creativity at work. In this context, play appears to be a promising yet understudied way of promoting creativity in the workplace (Petelczyc et al., 2018). To address this limitation and advance research on play and organisational creativity, we write three independent but linked essays that further explore the use of play activities as a way to stimulate creativity in the organisational context. We demonstrate the way in which the three essays are related in Figure 1.

In Essay 1, we focus on an emerging type of play activities purposefully designed to improve organisational creativity (Kirsten & Du Preez, 2010; Nisula & Kianto, 2018; West et al., 2017). We call this type of play activities *serious play for organisational creativity (SPOC)*. Considering the recent calls for more research on play at work (Hjorth et al., 2018; Petelczyc et al., 2018) and the encouraging findings on the effectiveness of SPOC (Kirsten & Du Preez, 2010; Nisula & Kianto, 2018; West et al., 2017), we anticipate that more future studies will be exploring the successful design and implementation of SPOC. With this in mind, we acknowledge the need for a review and an agenda to guide these future research efforts. To address this need, we synthesise the current state of knowledge on play, serious play, and creativity in two literatures – the developmental psychology literature and the management literature. Based on the issues that emerge from our review, we propose an agenda for future research.

We organise our research agenda in three sections. In the first section, we highlight the need to clearly communicate (Petelczyc et al., 2018; Russ & Wallace, 2013) and empirically test the play-creativity mechanisms proposed in the literature. We also underline that robust research linking play design characteristics (e.g., materials, dosage, content), mechanisms, and outcomes is currently lacking. Then, we focus on five play design characteristics that can influence the effects of play on creativity – dosage, materials, social content, cognitive content, and freedom (Dansky, 1999; Mellou, 1995; Wyver & Spence, 1999). For each of these play design characteristics, we review its relationship with creativity and the mechanisms proposed in the literature and provide directions for future research exploring it in the context of the play-creativity relationship. We also review the central role of affect in play and provide directions for future research exploring (a) the affect-related (i.e., affective and cognitive-affective) mechanisms of the play-creativity relationship and (b) the design of SPOC that is enjoyable and facilitative of the affect-related mechanisms of the relationship.

In the second section, we expand on the organisational factors that can influence the successful design and implementation of SPOC in the workplace. Specifically, we discuss the actions by leadership that could influence the successful design and implementation of SPOC; the issues that might arise when implementing SPOC, which could be addressed through human resource management (HRM)

practices; and the medium through which SPOC is carried out (i.e., face-to-face and online). In the third section, we detail the methodological considerations that need to be taken into account in future studies exploring the effectiveness of SPOC.

In Essay 2, we follow one of the research directions we suggest in Essay 1. We recognise that while scholars have proposed multiple mechanisms explaining how play can stimulate creativity inside and outside organisations (Kirsten & Du Preez, 2010; Mainemelis & Ronson, 2006; Mellou, 1994, 1995; Saracho, 2017; West, 2014), most of these mechanisms have not been clearly communicated (Petelczyc et al., 2018; Russ & Wallace, 2013) and robust research linking play design characteristics, mechanisms, and outcomes is lacking. As a result, the design of play that can stimulate organisational creativity remains challenging and without evidence-based guidance. To address this limitation and help develop rigorous research in this area, we focus on play as an activity and scrutinise one of the possible mechanisms of the play-creativity relationship. We draw from the theory of associative hierarchies (Mednick, 1962) and build on the idea that, during play, individuals form associations between remote concepts they engage with (Dansky & Silverman, 1973) to describe how play can promote ideational fluency, originality, and flexibility – three cognitive abilities important to creativity (Runco, 2011; Russ, 2018). Specifically, we describe in greater detail how play can lead to improvements in non-stereotypical associative fluency (NSAF), which in turn can lead to improvements in ideational fluency, originality, and flexibility. We develop propositions based on the mechanism we describe and provide directions for how to examine these propositions in future research.

In Essay 2, we also consider how the five important play design characteristics – materials, cognitive content, social content, freedom, and dosage (Dansky, 1999; Mellou, 1995; Wyver & Spence, 1999) – might facilitate the mechanism we describe and provide recommendations for how to explore these considerations in the future. Essay 2 is different from Essay 1 in that it focuses and elaborates on a specific mechanism proposed in the literature. It is also different from Essay 1 in that it takes a deeper look into how the five play design characteristics might specifically facilitate the mechanism under consideration by introducing remote concepts into play, enabling the formation of both cognitive and affect-laden associations between remote concepts, and allowing enough time for the participants to engage with remote concepts.

In Essay 3, we recognise that the play-creativity mechanisms proposed in the literature and the mechanism we propose in Essay 2 have not been experimentally tested. To address this limitation, we develop hypotheses around ideational fluency and originality based on the mechanism we propose in Essay 2 and test these hypotheses using data from a pre-test-post-test experimental design. The 20-minute play intervention we administered did not have a positive indirect effect on ideational fluency and originality through its positive direct effect on NSAF. However, the results of the experiment support the proposition that stereotypical associative fluency (SAF) on some concepts facilitates ideational fluency related to these concepts as well as the proposition that NSAF on some concepts facilitates ideational fluency and originality related to these concepts. This suggests that the mechanism we describe in Essay 2 and test in Essay 3 merits further exploration. To assist in future empirical research exploring the mechanism, we provide research design and play design recommendations.

The mechanism we describe, explore, and experimentally test in Essays 2 and 3 is a significant one because it relates to the recall and use of concept associations to generate solutions – an important cognitive process of creativity (Runco, 2011). And even though the mechanism is described and discussed in both essays, the two essays address different gaps in the literature, follow different approaches, and make distinct contributions. On the one hand, Essay 2 follows a theoretical approach to create a direct link between play design characteristics, the possible mechanism of the relationship, and creativity-related outcomes. On the other hand, Essay 3 follows an empirical approach to develop hypotheses for the mechanism, experimentally test the mechanism, and provide practical research design and play design recommendations for empirical research exploring the mechanism in the future.

Figure 1. The Relationship Between Essays 1, 2, and 3

Gap: Mechanisms proposed in the literature have not been clearly communicated and robust research linking play design characteristics, mechanisms, and outcomes is lacking.

Gap: Mechanisms proposed in the literature and the mechanism proposed in Essay 2 have not been experimentally tested.

Essay 1
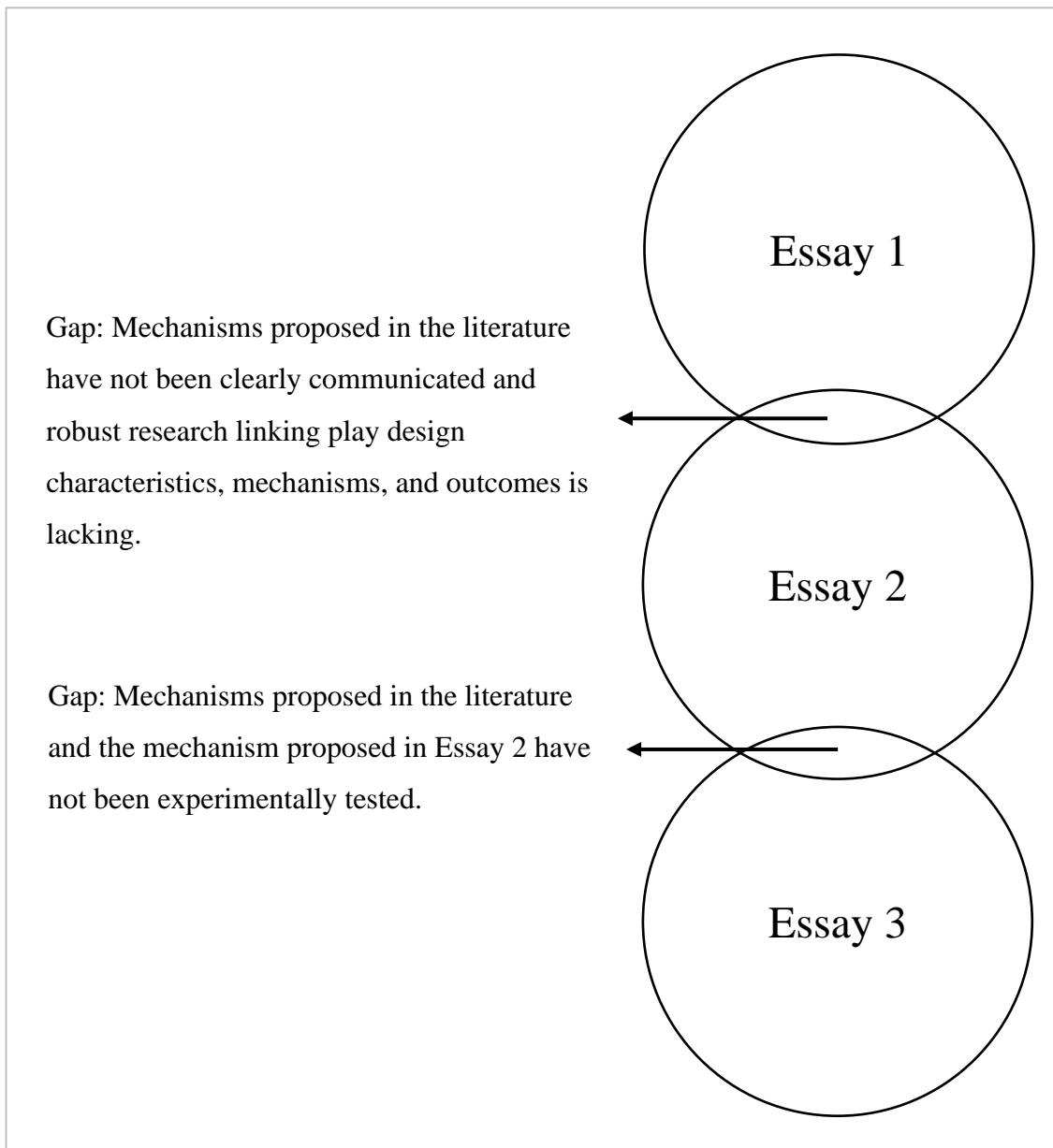
Essay 2

Essay 3

Essay 1

Serious Play and Organisational Creativity: A Review and an Agenda for Future Research

1.1. Introduction

Five months ago, your days as a drone engineer in the construction industry became more enjoyable with the launch of the monthly drone racing challenge. Since the launch, you and your team have been encouraged to spend up to 20% of your time at work to play around with different drone designs and assemble drones that can navigate the dangerous courses of the challenge. The races take place on the last Friday of the month. At the beginning of each race, you can check your inventory and select the drone with the highest potential to travel the terrain without issues. For the last three weeks, you have been working on improving the manoeuvring speed of one of your drones and you are looking forward to using it in the next race.

In many innovative organisations around the world, working and playing as described in the scenario above are harmoniously intertwined (Mainemelis & Ronson, 2006; Petelczyc et al., 2018). In recent years, this blend of work and play at prominent organisations has captured the attention of scholars interested in the effects of play on creativity, which is vital for organisational competitiveness and viability (Anderson et al., 2014; Harari et al., 2016; Ligon et al., 2012; Madden, 2017). The *Journal of Management* recently published a research agenda on play in organisations (Petelczyc et al., 2018), *Organization Studies* dedicated a special issue to organisational creativity, play, and entrepreneurship (Hjorth et al., 2018), and an increasing number of articles discuss how play can stimulate creativity in the workplace (Hunter, Jemielniak & Postuła, 2010; Mainemelis & Ronson, 2006; West, 2014). However, this

body of literature views play as a voluntary, absorbing, and interactive activity that is carried out for enjoyment (Petelczyc et al., 2018).

The fact that play is thought to be carried out for enjoyment creates the notion that it is a frivolous activity – an activity through which achieving business objectives, including improving organisational creativity, is at best a secondary or distal objective. For this reason, play is often rejected from the workplace where activities that directly lead to business outcomes are considered more important (Kristiansen & Rasmussen, 2014; Petelczyc et al., 2018; West, 2014). Authors providing examples of play leading to improvements in organisational creativity make a significant contribution in reversing this negative notion (Mainemelis & Dionysiou, 2015; Mainemelis & Ronson, 2006). However, because the type of play they advocate for is carried out for enjoyment rather than directly achieving business objectives, their efforts fall short of softening the contrast between the perceived frivolousness of play and the perceived importance of work in the organisational context. As a result, the negative notion remains and continues to hinder both business leaders and management scholars from appreciating play as a useful part of work that deserves further consideration (see Kristiansen & Rasmussen, 2014).

A new type of play that addresses the notion of frivolousness is now emerging in the management literature as one that can stimulate organisational creativity in a more direct way (Kirsten & Du Preez, 2010; Nisula & Kianto, 2018; West et al., 2017). We call this emerging type of play *serious play for organisational creativity (SPOC)*. SPOC addresses the notion of frivolousness through the thoughtful design of play activities that are focused on stimulating organisational creativity. Unlike play in which improving organisational creativity is a secondary or distal objective, SPOC consists of play activities purposefully designed to promote organisational creativity. And, unlike play in which participation is a choice, the understanding is that participation in SPOC will be at the request of the organisation.

The phrase "serious play" included in our term is frequently used in the management literature to describe play purposefully designed to primarily achieve important organisational objectives rather than enjoyment (see Kristiansen & Rasmussen, 2014; Statler, Heracleous & Jacobs, 2011). We include the phrase in our term not because we do not consider enjoyment to be an important objective or because SPOC is not enjoyable, but to convey that activities involved in SPOC are

designed to chiefly and directly achieve an organisational objective – to stimulate organisational creativity. While the topic of SPOC is developing and reporting on real-world implementations is lacking, we can find good examples of serious play designed to achieve other important business objectives, such as strategy development and new product design (Kristiansen & Rasmussen, 2014; Statler et al., 2011).

The calls for more research on play at work made in leading management journals (Hjorth et al., 2018; Petelczyc et al., 2018), together with the encouraging early findings on the effectiveness of SPOC (Kirsten & Du Preez, 2010; Nisula & Kianto, 2018; West et al., 2017), will likely lead to more studies investigating the effects of SPOC in the workplace. It will also likely lead to more studies investigating the successful design and implementation of SPOC. The findings of these research efforts would be valuable to those interested in designing or selecting SPOC that meets their business objectives within their specific business environments. Since the relationship between play, serious play, and organisational creativity is an emerging topic in the management literature, reviews and research agendas on the topic are currently lacking. For this reason, we believe that a review and an agenda that guides research around SPOC design and implementation is both necessary and timely.

In this work, we propose an agenda with directions for future research by focusing on issues around SPOC design, organisational factors expected to influence the successful design and implementation of SPOC, and the design of rigorous research examining the effectiveness of SPOC. To propose the research agenda, we review theoretical and empirical work on play, serious play, and creativity. The relationship between play, serious play, and creativity might be reciprocal (Russ & Lee, 2017; Wyver & Spence, 1999). This means that, compared to other types of research, experimental research examining the effects of play interventions can help paint a clearer picture of the possible causal relationships between the design characteristics of play (e.g., materials) and creative outcomes. To ensure that we capture the insights of experimental research, we also carry out a systematic review of the available experimental studies on the topic. We believe that this systematic review informs our research agenda in three important ways. First, it highlights which propositions made in theoretical and empirical work about the effects of play on creativity have been experimentally tested and which require further investigation. Second, it reveals promising, not so promising, and underexplored play design

characteristics. And third, it points out methodological issues that need to be considered in future empirical research in this area.

We recognise that the discussion around serious play and creativity is relatively new in the management literature (Petelczyc et al., 2018) and, hence, the available research in this context is scarce. However, this does not necessarily mean that the discussion is new in other literatures and that research on the topic is limited in general. In fact, we find that the discussion began in the development psychology literature in the 1960s with scholars publishing theoretical and empirical work on the relationship between play and creativity in children (e.g., Sutton-Smith, 1967). Soon after, researchers reported the first experimental studies examining the effects of play on creativity in children (e.g., Dansky & Silverman, 1973) as well as the effects of play designed to promote creativity in children (e.g., Rosen, 1974). More recently, scholars in the developmental psychology literature have extended this line of research to examine the effects of play on creativity in adults (e.g., Campion & Levita, 2014) and the effects of play designed to stimulate creativity in adults (e.g., Dyson, Chang, Chen, Hsiung, Tseng & Chang, 2016; Karakelle, 2009; Karwowski & Soszynski, 2008). We call play designed to enhance creativity in children and adults outside the organisational context (e.g., play designed to stimulate student creativity in an educational setting) *serious play for creativity (SPC)*. We use this different term in order to highlight that SPOC is designed to promote creativity *inside* the organisational context while SPC is designed to stimulate creativity *outside* the organisational context.

Research on childhood play, serious play, and creativity in the developmental psychology literature had a significant influence on more recent developments in the management literature (e.g., Mainemelis & Ronson, 2006; West, 2014). The contexts discussed in the developmental psychology literature (e.g., education) might be different from the organisational context. Nevertheless, we believe that there is value in reviewing influential research in developmental psychology in addition to reviewing the literature on play, serious play, and creativity in the workplace. This is because reviewing the developmental psychology literature can highlight promising directions on SPOC design and provide valuable lessons on how to conduct rigorous research on the topic. With this in mind, we begin our review by examining the characteristics of play in childhood and the proposed mechanisms by which play can

promote creativity in children. Then, we look at the characteristics of play in adulthood and the workplace, discuss the proposed mechanisms by which play can stimulate creativity in the workplace, and provide our own definition of play at work.

Next, we turn our attention to serious play and creativity. First, we look at the characteristics of SPC designed to stimulate creativity in children. Then, we scrutinise the characteristics of SPOC designed to promote creativity in the workplace and develop our own definition of SPOC. We also clarify the differences between SPOC and play at work that stimulates creativity, serious play designed to promote other business objectives, educational serious games, and gamification. Immediately after, we describe the search and review strategies we followed to conduct the systematic review of the experimental research. Finally, based on the issues that emerge from our review, we propose an agenda for future research on SPOC design centring around play design characteristics, the organisational factors expected to affect the successful design and implementation of SPOC, and the design of robust research examining the effectiveness of SPOC.

1.2. Play, Serious Play, and Creativity

1.2.1. Play and Creativity in Childhood

Discussions about play and creativity in the developmental psychology literature and the management literature tend to revolve around the relationship between voluntary play carried out for enjoyment and creativity. This is reflected in the way play is viewed in these literatures. In the developmental psychology literature, childhood play is often defined as a voluntary activity that is absorbing and enjoyable (Dansky, 1999; Russ & Wallace, 2017). Cognitively, it involves exploring objects or the environment (i.e., physical exploration); moving around and playing with large toys or dancing (i.e., physical play); constructing something (i.e., constructive play); engaging in pretend play with non-proximal objects not designed to be used in a specific way (e.g., building blocks) and proximal objects designed to be used in a specific way (e.g., dolls) and using proximal objects in their intended use (i.e., object-dependent play); enacting situations from everyday life in pretend play, such as shopping at the grocery store (i.e., sociodramatic play); enacting situations remote from everyday life in pretend play, such as visiting the moon (i.e., thematic play); or any combinations of the above (Wyver & Spence, 1999).

More broadly, play with the above types of cognitive content involves exploring ideas, objects, or the environment as well as combining ideas, past experiences, concepts, actions, objects, and behaviours in new ways (i.e., imagination) (Dansky, 1999; Vygotsky, 2004). In the course of their cognitive development, children are expected to move from object-dependent to sociodramatic to thematic play as their ability to engage in more advanced forms of pretend play increases and their dependence on proximal objects decreases (Wyver & Spence, 1999).

Socially, childhood play involves participants playing alone (i.e., solitary play) or playing in groups with common goals but with or without clear social hierarchies (i.e., cooperative or associative play) (Wyver & Spence, 1999). It begins when the participant or participants reach an agreement about a broad context (e.g., "I will build a car using these building blocks" or "I will pretend to be your mommy and you will pretend to be my baby") and continues with the participant or participants making decisions and performing actions without prior preparation (i.e., improvising) and without aiming for predetermined and fixed means (paths) and ends (goals) (Bruner, 1983; Feitelson & Ross, 1973; Russ & Wallace, 2017). For example, a child might begin with the goal to build a tall tower using building blocks but change that goal and means to that goal along the way to build a house instead. In this regard, childhood play is different from other activities that might be categorised as play but have less flexible means and ends, such as sports (e.g., soccer) and games (e.g., chess) in which the goal to win usually remains unchanged and the paths to victory are less flexible (Feitelson & Ross, 1973).

The argument in the developmental psychology literature has been that play, and especially thematic and sociodramatic play (Dansky, 1999; Wyver & Spence, 1999), facilitates creativity, creative problem-solving, and creative behaviour by offering a safer environment for individuals to (a) develop knowledge, schemas, abilities, and associations that are considered essential for creativity and (b) learn and practise several processes involved in creativity (Dansky, 1999; Mellou, 1994, 1995; Russ & Wallace, 2013, 2017; Saracho, 2017). The implication is that the individuals will later use what they have gained while playing to generate solutions after the play activity itself. Play offers a "safer environment" in the sense that it is distinct from ordinary life and, thus, shielded from the risks and consequences of many, but not all, actions, mistakes, and setbacks occurring in it (Bruner, 1983; Mainemelis & Ronson,

11

2006). For example, constructing a toy skyscraper with a defective base will not have as severe consequences as constructing a real skyscraper with a defective base. On the other hand, damaging a social relationship during play can have similar consequences as damaging the relationship outside play.

We use the term "creativity" to refer to the process of generating novel and useful ideas (solutions) that solve an open-ended problem (Amabile, 1988; Sawyer, 2012). The process involves having little awareness of the direction the individual needs to follow to reach the idea (i.e., open path) and little awareness of what the idea will be (i.e., open target). An example of creativity would involve generating ideas to reduce marine pollution. With the term "creative problem-solving" we refer to the type of creativity that involves an awareness of the final solution of the problem (i.e., specific target) and some awareness of the direction the individual needs to follow to reach the solution (i.e., semi-open path). An instance of creative problem-solving would involve retrieving a marble hidden inside a small box by using five sticks that vary in their length. Finally, we use the term "creative behaviour" to refer to the set of actions that can lead to creativity, such as persisting when solving a problem (Garaigordobil & Berrueco, 2011).

Developmental psychology scholars theorise that, in play, participants develop knowledge, schemas, abilities, and associations that are essential for creativity, including knowledge and schemas about objects they play with (Barnett, 1985; Piaget, 1999; Vandenberg, 1981); knowledge through the sharing of ideas with others (Karakelle, 2009; Robson, 2017); knowledge through imagination (Bruner, 1972; Sutton-Smith, 1967; Vygotsky, 2004), abstract and symbolic thinking (Sutton-Smith, 1967; Vygotsky, 2004); remote associations between objects, actions, and concepts they engage with (Dansky & Silverman, 1973; Sutton-Smith, 1967); affect-laden associations (Russ, 2003); and mental flexibility, behavioural flexibility, and divergent thinking (Bruner, 1972; Mellou, 1995; Saracho, 2017; Sutton-Smith, 1967). Divergent thinking consists of cognitive abilities important to creativity (Runco, 2011; Russ, 2018), and it is among the most studied sets of abilities in the play-creativity literature (Russ & Wallace, 2013). It involves cognitive abilities used to produce a diverse set of possible solutions to an open-ended problem, including ideational fluency – the ability to provide solutions; ideational originality – the ability to provide non-

stereotypical (original) solutions; and ideational flexibility – the ability to provide solutions that belong to distinct categories (Runco, 2011).

In terms of processes, developmental psychology scholars argue that, in play, individuals learn and exercise processes involved in creativity, including breaking from existing knowledge and ideas, imagination (Bruner, 1972; Mellou, 1994, 1995; Sutton-Smith, 1967; Vygotsky, 2004), exploration, problem finding, conflict negotiation, idea evaluation, idea sharing (Dansky, 1999; Robson, 2017; Russ & Wallace, 2017), and processing, regulating, expressing, and experiencing emotions (Russ & Wallace, 2013, 2017).

It has also been proposed that play can promote creativity by allowing individuals to access and use their affect-laden associations (Russ & Wallace, 2013) and by altering cognitive and affective states in ways that are favourable to creativity. For example, it has been suggested that, in play, participants can experience breaks from existing ideas (Lewis & Lovatt, 2013; Sowden, Clements, Redlich & Lewis, 2015), increased positive affect and playfulness (i.e., a predisposition to engage in play (Proyer & Ruch, 2011)) (Dansky, 1999; Sowden et al., 2015), elevated intrinsic motivation (Dansky, 1999; Howard-Jones, Taylor & Sutton, 2002), prompted active search for cues (Dansky & Silverman, 1973), loosened old associations (Dansky, 1980b), reduced stress (Sylva, Bruner & Genova, 1976), and lowered self-censure (Chatoupis, 2013; Zabelina & Robinson, 2010).

1.2.2. Play and Creativity in Adulthood and the Workplace

Scholars developing definitions of play in adulthood and the workplace have drawn from definitions and descriptions of play reported in the developmental psychology literature. For example, Van Vleet and Feeney (2015) define play in adulthood as an activity that is voluntary, absorbing, interactive as opposed to passive (e.g., reading a book, watching a movie), and carried out with the goal of enjoyment. Petelczyc et al. (2018) argue that this definition is flexible and inclusive enough to guide future research examining different types of play at work (p. 168). Mainemelis and Ronson (2006) conceptualise play in the workplace as a behavioural orientation toward performing an activity. It manifests when employees explore ideas and engage in imagination without aiming for fixed means and ends as part of completing their main work tasks ("play as engagement") or personal and leisure activities ("play as

diversion"). Examples of play as engagement can be found in hospitals where doctors use playful interactions to introduce themselves to critically ill children. Examples of play as diversion can be found in settings where employees spend time to play games or to explore ideas not directly related to their work. According to Mainemelis and Ronson (2006), these manifestations have led to a number of inventions at organisations like DuPont, Gore, and Google. As an example, the invention of the Elixir guitar string at Gore was the result of three engineers exploring the idea of using guitar strings to move large puppets – an idea that was not directly related to their main work tasks (Mainemelis & Ronson, 2006).

Mainemelis and Ronson's (2006) conceptualisation of play as a behavioural orientation is not unique (e.g., Bruner, 1983). Nevertheless, it is less common in both the developmental psychology literature (Burghardt, 2012) and the management literature (Petelczyc et al., 2018). The two authors recognise that the characteristics of the activity being performed have a decisive role in determining whether the behaviour will manifest or not (Mainemelis & Ronson, 2006). Specifically, they explain that play is more likely to manifest when the activity being performed involves flexible means and ends and allows for the exploration of different ideas (e.g., complex tasks) and less likely to manifest when the activity is rigidly structured and streamlined (e.g., routine tasks). As some scholars of developmental psychology would argue, idea exploration and flexible means and ends are important elements of play as an activity (e.g., Feitelson & Ross, 1973; Russ & Wallace, 2017). This highlights that, even when conceptualising play as a behavioural orientation, the characteristics of the activity being performed have a decisive role in defining play and determining whether it will manifest.

Keeping in mind the important role of the activity being performed in defining play, we follow the approach of many scholars on the topic (Burghardt, 2012; Petelczyc et al., 2018) and conceptualise play as an activity. This conceptualisation also allows us to draw a clearer distinction between play and SPOC, which we define later in this section. We draw from definitions of play in developmental psychology and build on Van Vleet and Feeney's (2015) definition to define play in the workplace as

an activity (or set of activities) that (1) is carried out voluntarily, (2) is absorbing, (3) involves exploration of ideas, objects, or the environment as

well as imagination, (4) has flexible means (paths) and ends (goals), (5) is distinct from ordinary life and, thus, offers a safer environment for exploration and imagination, and (6) is carried out for enjoyment.

We extend Van Vleet and Feeney's (2015) definition to include three characteristics that scholars of play and creativity believe are necessary for play that stimulates creativity. The three characteristics are play's cognitive content, flexibility of means and ends, and separation from ordinary life. In terms of cognitive content, play involves individuals exploring ideas, objects, or the environment and exercising their imagination (Dansky, 1999; Vygotsky, 2004). The flexibility of means and ends of play allows individuals to spend time to define and re-define problems and to explore and combine ideas, objects, and behaviours in new ways (Feitelson & Ross, 1973; Mainemelis & Ronson, 2006). The separation from ordinary life and the relative safety that comes with it allow participants to engage in exploration and imagination without worrying about transferring all the risks and consequences of their actions and inactions outside the activity (Bruner, 1983; Mainemelis & Ronson, 2006). Together, these three characteristics are key for play in which participants can develop the resources (e.g., knowledge, associations, abilities) and practise the processes (e.g., imagination, idea evaluation, conflict negotiation) that are necessary for creativity.

In line with many definitions of play in the developmental psychology literature (Dansky, 1999; Feitelson & Ross, 1973), play in the workplace as we define it above does not include activities that leave little to no room for imagination and for shifts in means and ends (e.g., competitive sports and games).

In addition to drawing from definitions put furth in the developmental psychology literature, management scholars have also drawn from theories put forth in the developmental psychology literature to make propositions about how play can stimulate organisational creativity. Mainemelis and Ronson (2006) argue that play as engagement promotes creativity directly because it facilitates the cognitive processes and abilities of problem framing, divergent thinking, imagination, exploration, and idea evaluation; it allows individuals to express and experience their emotions; it allows individuals to access and use their affect-laden associations; it stimulates intrinsic motivation in main work tasks; and it allows individuals to practise and improve their expertise and creativity skills. Expertise includes domain knowledge, technical proficiency, and special talents while creativity skills involve cognitive

styles that allow for new perspectives to be taken, application of heuristics, persistence, energetic pursuit of the task, tolerance for ambiguity, and the ability to suspend judgement (Amabile, 1997).

Mainemelis and Ronson (2006) also suggest that play as diversion can promote creativity in two indirect ways. First, it can allow individuals to psychologically adjust to their work through restoratory functions (e.g., physical or mental breaks) and compensatory functions (e.g., introduce fun and excitement into routine tasks) (Mainemelis & Ronson, 2006). And second, it can increase the individuals' willingness to engage in the creative process and share and explore ideas with their colleagues once hierarchies are blurred and trusting relationships are developed in the course of play (Mainemelis & Ronson, 2006). It has also been proposed that play as an activity can improve organisational creativity by allowing individuals to explore and make mistakes as a group in a safer environment and by inducing playfulness, positive emotions, feelings, and mood (Mainemelis & Ronson, 2006; Nisula & Kianto, 2018; West, 2014). Finally, it has been suggested that play as an activity can promote a climate for creativity by fostering an environment that welcomes new ideas and encourages autonomy, trust, support, and acceptance (Kirsten & Du Preez, 2010; Nisula & Kianto, 2018). An organisation's climate for creativity refers to the set of perceptions employees hold about the conditions of their work environments and, according to management scholars, it facilitates the intrinsic motivation of employees to engage in the creative process (Amabile, 1997). It includes views about one's relationships with peers and supervisors; clarity and autonomy in one's work; and support from peers and business leaders throughout the creative process (Hunter, Bedell & Mumford, 2007).

1.2.3. Serious Play and Creativity in Childhood

The early theories on how play can stimulate creativity in children and empirical research supporting the link between play and creativity (Russ & Lee, 2017; Russ & Wallace, 2013) led to experimental research examining the effects of play interventions on creativity in children. The aim was for play involved in these interventions to, like play carried out for enjoyment, be absorbing, involve exploration and imagination, be unrestricted from fixed paths and ends, and be enjoyable. However, by design, play involved in these interventions was no longer voluntary but

required, as participants were asked to play. These interventions differed in five play design characteristics that can affect the impact of play on creativity and creativity-related abilities and behaviours. The five play design characteristics are freedom, materials, social content, cognitive content, and dosage (Dansky, 1999; Mellou, 1995; Wyver & Spence, 1999). We present a summary of these characteristics in Table 1.1.

With regard to freedom, participants were either instructed to play as they pleased (i.e., free play) (e.g., Dansky, 1980b) or were guided in their play by instructions delivered by facilitators (i.e., guided play) (e.g., Hui & Lau, 2006). In free play interventions, participants were asked to play as they pleased alone or in groups and were not provided with any instructions on the cognitive content of their activities. The major objective of studies administering free play interventions (e.g., Dansky & Silverman, 1973, 1975) was to examine the impact of play that occurs naturally when participants are left to play alone.

Guided play interventions involved facilitators who engaged in and guided participants through activities designed to promote the participants' creativity. The facilitators were often asked to act as role-models of engagement with the activities (Dansky, 1999; Hoffmann & Russ, 2016; Robson, 2017) and to ensure that the desired dosage, engagement with materials, social content, and cognitive content were maintained as best as possible. As such, these facilitators can be described as tutors of play that leads to creativity but not as tutors of creativity per se. While rules around materials, social content, and cognitive content existed (e.g., "Let's use these grocery items and pretend that we are a family visiting the grocery store"), those rules were flexible and did not dictate the paths or ends of play.

Many of these guided interventions took the form of improvisational theatre training and role-playing that included physical, object/concept-dependent, sociodramatic, and thematic play in groups (e.g., Hainselin, Aubry & Bourdin, 2018; Hui & Lau, 2006; Sowden et al., 2015). One of the core activities of improvisational theatre training and role-playing is pretend play. The activities often involve a group of individuals assuming the roles of imaginary characters trying to solve an imaginary problem (Karwowski & Soszynski, 2008; Kirsten & Du Preez, 2010; Lewis & Lovatt, 2013). They start with the participants agreeing on a broad description of the problem (e.g., "I will pretend to be the customer ordering a hot dog at a restaurant that does not serve hot dogs and you will pretend to be the server at the restaurant") and continue

with the participants enacting unscripted events in their efforts to solve the problem (Lewis & Lovatt, 2013; Nisula & Kianto, 2018; Sawyer, 2012; Vera & Crossan, 2004). They are guided by the principles of listening closely to the other participants, accepting and building on their ideas, and trusting and supporting them as the events unfold (Hainselin et al., 2018; Kirsten & Du Preez, 2010; Nisula & Kianto, 2018).

The objective of studies administering guided play interventions was to investigate the impact of play activities designed to promote creativity; and the type of designed, guided play they administered is the one we refer to as *serious play for creativity (SPC)*.

1.2.4. Serious Play and Creativity in Adulthood and the Workplace

The theoretical and empirical research with children in the developmental psychology literature led scholars in adult psychology and adult education to begin examining the effects of SPC in the context of adult creativity (e.g., Karakelle, 2009; Karwowski & Soszynski, 2008). More recently, following further developments in the management literature (e.g., Mainemelis & Ronson, 2006; Vera & Crossan, 2004), management scholars have also began investigating the effects of serious play for creativity in the workplace (Kirsten & Du Preez, 2010; Nisula & Kianto, 2018; West et al., 2017). As we mention earlier, we use the term *serious play for organisational creativity (SPOC)* to refer to play designed to promote organisational creativity. We use a different term in order to highlight that SPC is administered outside organisational contexts while SPOC is administered inside organisational contexts.

SPOC reported in the literature primarily takes the form of improvisational theatre training that involves guided sociodramatic and thematic play in groups (e.g., Kirsten & Du Preez, 2010; Nisula & Kianto, 2018; West et al., 2017). It has a lot in common with play that stimulates creativity as we define it earlier but differs from play in three ways. First, SPOC is carried out at the request of the organisation rather than being voluntary. Second, it is designed and carried out to stimulate organisational creativity in addition to being enjoyable rather than being carried out purely for enjoyment. Finally, because it is designed and carried out at the request of the organisation, SPOC participants are likely to receive the appropriate environmental conditions, space, time, and permission for participation. This is not necessarily the case for participants who engage in play not requested by the organisation.

Due to their differences in context, SPOC is also different from SPC in three ways. First, SPOC is implemented in organisations rather than, say, school classrooms. Second, participation in SPOC is requested by the organisation employing the participants rather than, say, a teacher of the participants. Finally, the aim of SPOC is to stimulate organisational creativity rather than, say, student creativity.

SPOC has many similarities with other serious play interventions designed to achieve important business objectives (see Kristiansen & Rasmussen, 2014), with "educational serious games" designed to educate (see Michael & Chen, 2006), and with "gamification" that incentivises behaviours in order to achieve the desired business outcomes (see Deterding, Dixon, Khaled & Nacke, 2011). First, it is purposefully designed to achieve an important business objective – to stimulate organisational creativity. Second, it is carried out at the request of the organisation. Third, it is an absorbing and enjoyable activity (or set of activities). Finally, the organisations employing the participants typically provide the appropriate environmental conditions, space, time, and permission for participation. For example, in West et al. (2017), participating teams and their managers completed a SPOC intervention on business property during working hours.

Like other serious play interventions and educational serious games, SPOC is also considered distinct from everyday life. Due to that, it provides participants with the safety to explore and play out scenarios in an imagined world without transferring or worrying about transferring all the risks and consequences of those scenarios outside the activities involved. For example, a well-known activity included in SPOC interventions (e.g., Kirsten & Du Preez, 2010; Nisula & Kianto, 2018) begins with one participant saying whatever they want and continues with another participant responding with a sentence that starts with "Yes, and…" (Mourey, 2020).

However, SPOC is different from other serious play interventions in three ways. First, while such serious play interventions are designed to deliver an immediate, tangible output (e.g., a new strategy, a new product design (Statler et al., 2011)), SPOC is designed to improve the participants' capacity to be creative in their work after the intervention. To demonstrate this difference with an example, consider a typical Lego serious play intervention. The facilitator of such an intervention asks participants to build Lego models of their individual and shared understandings about a problem, and uses these models as "the basis for group discussion, knowledge

sharing, problem solving, and decision making" (Kristiansen & Rasmussen, 2014: 27). The objective of the intervention is for the participants to use their knowledge and imagination in order to address a problem, develop a strategy that will guide their future decision making, and build commitment to following that strategy (Kristiansen & Rasmussen, 2014). On the other hand, the objective of SPOC is to improve the conditions for creativity (e.g., the climate for creativity of a work-team (Kirsten & Du Preez, 2010)) and creativity (e.g., team creativity (West et al., 2017)) in the workplace.

The second difference between SPOC and other serious play interventions relates to the flexibility of their goals. As we mention above, other serious play interventions necessitate a perceptible output (e.g., a new product design) while SPOC does not. Because of this, SPOC is characterised by more flexibility of goals compared to other serious play interventions. However, since the required outputs of other serious play interventions are not specific, these interventions maintain flexible paths to those outputs. Finally, the third difference between SPOC and other serious play interventions relates to the degree of imagination they involve. Even though imagination is present in other serious play interventions, these interventions involve less imagination than SPOC in which participants engage in thematic play. This is because, in other serious play interventions, individuals usually represent themselves or other existing entities (e.g., individuals, groups, organisations, governments) and play out scenarios closer to real-life situations. On the other hand, in SPOC involving thematic play, participants can assume the roles of imaginary characters and can enact situations remote from everyday life, which encourage more imagination.

SPOC is also different from educational serious games (see Michael & Chen, 2006) in three ways. First, these games are designed to provide a predetermined learning experience and deliver specific learning points (e.g., to provide additional geriatric education (Lagro, Van de Pol, Laan, Huijbregts-Verheyden, Fluit & Olde Rikkert, 2014)). Such games could stimulate organisational creativity by educating participants on organisational creativity and/or delivering important learning points on how to be creative at work. On the other hand, SPOC can stimulate organisational creativity by giving participants a safer environment to develop the resources (e.g., knowledge, abilities) and practise the processes (e.g., imagination, conflict negotiation) necessary for creativity. The second difference between SPOC and educational serious games relates to the flexibility of their means and ends. Like play

that stimulates creativity, SPOC is characterised by flexible means and ends and involves exploration and imagination. On the other hand, educational serious games are designed to deliver specific outcomes in specific ways and, due to that, they are characterised by both fixed goals and inflexible paths to those goals. Finally, the inflexibility of means and ends of educational serious games limits the amount of exploration and imagination they involve, especially when compared to the amount of exploration and imagination involved in SPOC and other serious play interventions.

Similarly, SPOC is different from gamification in four ways. First, gamification uses specific game design elements (e.g., reward systems, challenge, fantasy) to incentivise specific behaviours that are expected to lead to important business outcomes. On the other hand, SPOC is not designed to encourage any behaviours but rather to give participants a safer environment to exercise and benefit from those behaviours. As an example, a gamification could stimulate organisational creativity by rewarding collaboration using points, badges, and prizes in order to incentivise collaboration (e.g., Leeson, 2013). A SPOC intervention with the same objective could include activities like "Yes, and…" for participants to exercise and benefit from collaboration (e.g., Mourey, 2020). The second difference between SPOC and gamification relates to the flexibility of their means and ends. Gamification uses specific game design elements in order to incentivise specific behaviours. Because of that, it is characterised by inflexible means and ends. Due to this inflexibility of means and ends, gamification also involves less exploration and imagination compared to SPOC and other serious play interventions.

Another important difference between SPOC and gamification is that gamification is not considered to be distinct from ordinary life. On the contrary, gamification incentivises specific behaviours in ordinary life in order to achieve desired organisational objectives. For example, gamification can been used to incentivise collaboration among employees in order to promote communication and collaboration in large organisations (e.g., Leeson, 2013). It can also be used to incentivise software testing in order to prevent software defects (e.g., McDonald, Musson & Smith, 2008). The fact that it is not considered separate from ordinary life means that gamification does not provide the relative safety for exploration and imagination provided in SPOC, other serous play interventions, and educational serious games.

We summarise the characteristics of play that stimulates creativity, SPOC, other serious play interventions, educational serious games, and gamification in Table 1.2. Based on the descriptions of play for creativity, serious play for creativity, and SPOC we have reviewed thus far, we would define SPOC as

> an activity (or set of activities) that (1) is carried out at the request of the organisation, (2) is absorbing, (3) involves exploration of ideas, objects, or the environment as well as imagination, (4) has flexible means (paths) and ends (goals), (5) is distinct from ordinary life and, thus, offers a safer environment for exploration and imagination, (6) is designed and carried out to stimulate organisational creativity, and (7) is enjoyable.

Experimental research on SPC and SPOC suggests that, in general, higher doses (160 minutes or more) of serious play involving guided thematic play in groups can be effective in promoting creativity and creativity-related abilities in children, adults, and the workplace (e.g., Garaigordobil & Berrueco, 2011; Hui & Lau, 2006; Karakelle, 2009; Kirsten & Du Preez, 2010; West et al., 2017). However, not all the experimental studies we could identify generated positive results. For example, studies that investigated the effects of solitary SPC (e.g., Fehr & Russ, 2016) or involved relatively lower doses of SPC (e.g., Felsman, Gunawardena & Seifert, 2020; Hoffmann & Russ, 2016) did not yield positive results. This suggests that play (Lillard, Lerner, Hopkins, Dore, Smith & Palmquist, 2013; c.f. Russ & Wallace, 2013; Silverman, 2016), or at least play with specific play design characteristics, might not be effective in promoting creativity and creativity-related abilities and behaviours. Failing to design methodologically sound experimental studies, such as studies that control for experimenter bias, could be another reason why some of the interventions were found to be effective while others were not (Lillard et al., 2013).

Taken together, the experimental research suggests that thoughtfully selecting the appropriate play design characteristics and designing methodologically sound studies will play an important role in the efforts of management scholars to identify the play design characteristics that can make SPOC effective. In the next section, we detail the strategies we followed to gather, organise, and review the published experimental studies in a way that would reveal (a) which propositions about the effects of play on creativity have been experimentally tested and which require further

investigation, (b) which play design characteristics are promising, not so promising, or underexplored, and (c) which methodological considerations need to be taken into account when exploring the effectiveness of SPOC.

1.3. Method of Systematic Review

1.3.1. Search Strategy

To find relevant publications for the systematic review of the experimental studies, we formed search phrases by combining the key words "play" and "improvisation" with the key phrases "divergent thinking", "creativity", "problem solving", "creative behavior", and "creative behaviour" (e.g., "play divergent thinking", "improvisation creativity"). We included "improvisation" in our search phrases because SPC and SPOC often took the form of improvisational theatre training. Then, we conducted an independent search for each of the search phrases we created on (a) the search platform of a university in the UK and (b) Google Scholar (excluding patents and citations). These searches were conducted in October 2020. The results were not restricted in terms of year of publication or database. The search on the university's platform drew from Complementary Index, Education Research Complete, ERIC, British Education Index, Business Source Complete, Science Direct, Directory of Open Access Journals, JSTOR, and other databases. The results on both search platforms were restricted to publications that were (a) peer-reviewed, (b) written in the English language, and (c) included the search phrases in their titles. This process generated 993 results: 267 on the university's platform and 726 on Google Scholar. For more details on the number of studies found for each search phrase see Section A of the supplementary materials.

To ensure that as many experimental studies as possible were included in our systematic review, we also examined the work referenced in earlier reviews of the developmental psychology literature (e.g., Dansky, 1999; Lillard et al., 2013; Mellou, 1994, 1995; Russ & Lee, 2017; Russ & Wallace, 2013; Silverman, 2016) and the work referenced in the experimental studies we identified. We also found four more publications in other articles in the play-creativity literature (i.e., Dyson et al., 2016; Felsman et al., 2020; Hainselin et al., 2018; Tsai, 2012). The relationship between play, serious play, and organisational creativity is an emerging topic in the management literature and, thus, reviews on the topic are currently lacking.

We examined the titles of all the publications we identified to select literature that discussed the play-creativity relationship. Then, we looked at the abstracts and methodologies of the studies discussing the play-creativity relationship to identify experimental studies on the topic. Experimental studies were included in our systematic review only if they met the following criteria:

1. They were peer-reviewed book chapters or journal articles.
2. They administered play activities that were either free play activities or involved at least one type of cognitive content identified by Wyver and Spence (1999) – physical exploration, physical play, constructive play, object/concept-dependent play, sociodramatic play, and thematic play.
3. They investigated the effects of the play activities on divergent thinking, creativity, creative problem-solving, or creative behaviour as we define them in the previous section.

Overall, 54 publications reporting 59 independent experimental studies met the selection criteria and were included in our systematic review. Of those studies, 44 involved children, 13 involved adults outside organisational contexts, and two involved adults inside organisational contexts.

1.3.2. Review Strategy

To get a broad understanding of the experimental research we identified, we reviewed the experimental studies in full. For each study, we collected information about the theoretical basis of the study, the abilities and behaviours examined, the measures used, the research design of the study, the play design characteristics of the administered play interventions, the characteristics of other administered interventions, and the effects of the administered interventions. To get an overview of the findings, we categorised each study first by statistical power (minimally powered vs underpowered) and then by freedom (free play vs guided play). Of the 59 experimental studies, 16 involved free play and 43 involved guided play (41 SPC and two SPOC). For statistical power, we followed Silverman's (2016) approach and grouped the studies based on their statistical power using sample sizes (Cohen, 1992). For example, studies with two condition groups with 26 or more participants per group were categorised as minimally powered while studies with two condition groups with

less than 26 participants per group were categorised as underpowered. Of the 59 studies we identified, 24 were minimally powered and 35 were underpowered. With this categorisation we were able to identify which studies had a large enough sample size to detect even a large effect (i.e., minimally powered) and which studies did not (i.e., underpowered). All but four of the minimally powered and seven of the underpowered studies found positive effects. Of the 13 studies with adult participants outside organisational contexts, all but two reported positive results. Both studies with adults inside organisational contexts reported positive results. We present an overview of the results in Table 1.3.

To develop directions for future research on SPOC design, we looked at the mechanisms examined and the materials, cognitive content, social content, freedom, dosage, and total dose of the administered play interventions. To get a better understanding of how the play design characteristics of each play intervention related to the effects of the intervention, we organised the 59 experimental studies based on (a) the creativity-related variables they treated as the dependent variables, (b) freedom, total dose, social content, and cognitive content, and (c) the effects of the play interventions on the dependent variables. Organising the studies in terms of total dose was challenging, as consensus on the least amount of time needed for the interventions to be effective is lacking and the studies differed substantially on this design characteristic (from five minutes to 80 hours). In an earlier review of the literature with children, Dansky (1999) identified that 160 - 360 minutes of guided play that involves sociodramatic and thematic play in small groups can be effective in promoting creativity-related outcomes. Using Dansky's (1999) observations, we organised the 59 experimental studies as "short" if the administered interventions were shorter than 160 minutes in total dose and as "long" if the administered interventions were 160 minutes or longer in total dose. We used this visual mapping, which we present in Section C of the supplementary materials, together with the discussion of each experimental study to develop research agenda items relating to SPOC design.

For research design directions we looked at a number of research design characteristics that could reveal methodological considerations for future research, including sampling; assignment to condition groups (e.g., random, convenience); measures used; assessment level (e.g., individually, in groups); testing timing (e.g., pre-tests, post-tests, and follow-up tests); activities involved in the condition groups;

attempts to minimise experimenter bias (e.g., control for rater awareness of hypotheses and condition groups); and suggested moderators and covariates. We present this information in Section B of the supplementary materials.

1.4. Directions for Future Research

In line with Dansky's (1999) observations with children, the results of the 59 experimental studies suggest that SPC and SPOC that last 160 minutes or more and involve guided thematic play conducted in groups can be effective in promoting divergent thinking and creativity in children (Garaigordobil, 2006; Garaigordobil & Berrueco, 2011; Hui & Lau, 2006; Russ & Wallace, 2013; Silverman, 2016; Udwin, 1983), divergent thinking and creativity in adults (Dyson et al., 2016; Karakelle, 2009; Karwowski & Soszynski, 2008; West et al., 2017), and a climate for creativity in the workplace (Kirsten & Du Preez, 2010). We should note that more attention is given to divergent thinking abilities (e.g., Garaigordobil, 2006; Garaigordobil & Berrueco, 2011; Karakelle, 2009; Karwowski & Soszynski, 2008) than creativity more broadly and other important abilities (e.g., the ability to suspend judgement) and processes (e.g., idea evaluation). The encouraging findings reported by the small number of studies that focused on creativity (e.g., Hui & Lau, 2006; Karwowski & Soszynski, 2008; Shmukler & Naveh, 1985; Sowden et al., 2015; Udwin, 1983; West et al., 2017) suggest that exploring the effects of SPOC on other abilities and processes as well as creative outcomes (e.g., patentability and competitiveness of products (Ligon et al., 2012)) is both an important and promising direction for future research.

Exploring the effects of SPOC on creative problem-solving in the workplace is another promising direction for future research. Research with children suggests that playing with a set of objects can improve the players' ability to subsequently solve a creative problem using those objects (Barnett, 1985; Rosen, 1974; Smith & Dutton, 1979; Smith, Simon & Emberton, 1985; Sylva et al., 1976; Vandenberg, 1981). Since this might also be the case in the organisational context, future studies could examine the effect of SPOC on creative problem-solving in the business environment (e.g., improving features of existing products, improving routine processes).

Finally, there is some evidence to suggest that play can promote creative behaviour in children (Garaigordobil & Berrueco, 2011) and group level creativity in children and adults (Rosen, 1974; West et al., 2017). Nevertheless, these two areas

remain underexplored. Considering that creative work in organisations often happens in teams (Kirsten & Du Preez, 2010; Nisula & Kianto, 2018), we believe that there is value in exploring the effects of SPOC on direct (e.g., number of team creative projects introduced (Vera & Crossan, 2005)) and distal (e.g., climate for creativity) team outcomes. We provide examples of more business-specific creative outputs later in this section under "Research Design".

In what follows, we focus on the issues emerging from our review of the available research to propose an agenda for future study. We organise the research directions in three sections: (a) the design of SPOC with a focus on play design characteristics, (b) the organisational factors that can influence the successful design and implementation of SPOC, and (c) the research design of studies examining the effectiveness of SPOC. We provide a summary of these directions in Table 1.4.

1.4.1. Design of Serious Play for Organisational Creativity

Mechanisms. A crucial part of identifying the play design characteristics that can make SPOC effective would involve understanding the mechanisms by which play promotes creativity, the ways in which play design characteristics facilitate these mechanisms, and the outcomes delivered by these mechanisms. It is possible that some of the mechanisms will have short-term effects, such as increased positive affect and playfulness (Dansky, 1999; Sowden et al., 2015; West, 2014) and elevated intrinsic motivation (Howard-Jones et al., 2002; Mainemelis & Ronson, 2006). As demonstrated by studies with delayed post-intervention measurements, it is also likely that some of the mechanisms will have long-term effects, such as obtaining and organising knowledge (Cleland, 1994; Vandenberg, 1981) and fostering a climate for creativity (Kirsten & Du Preez, 2010).

While many mechanisms have been proposed, most have not been clearly communicated (Petelczyc et al., 2018; Russ & Wallace, 2013) and none have been experimentally tested in the literature we identified. In fact, even though all the experimental studies we identified discussed some of the possible mechanisms behind the play-creativity relationship, they eventually focused on *whether* play is effective and not on *how* it delivers any potential benefits. Because of that, robust research linking play design characteristics, mechanisms, and outcomes is currently lacking. Thus, the development of effective SPOC heavily relies on successful play

interventions reported in the literature rather than rigorous research. However, as these interventions are so diverse in their play design characteristics, relying on them to design effective SPOC is not only challenging but also misguided. This is because different play design characteristics will likely facilitate different mechanisms and, thus, different outcomes. For this reason, we believe that clearly communicating and empirically testing the mechanisms put forth in the literature, examining the longevity of the effects delivered by these mechanisms, and understanding how play design characteristics and their interactions can facilitate these mechanisms will be a fundamental component of this research effort. Using mediation analysis (Hayes, 2018) to explore empirical data and test hypotheses could play an important role in understanding these mechanisms.

In the following paragraphs, we look at the five play design characteristics that can influence the effects of play on creativity-related outcomes – materials, social content, cognitive content, freedom, and dosage (Dansky, 1999; Mellou, 1995; Wyver & Spence, 1999). We discuss the mechanisms related to each play design characteristic, consider some of the interactions between them, and propose directions for future research in the management literature. We also look at the central role of affect in play that stimulates creativity. We consider the affective and cognitive-affective mechanisms of the play-creativity relationship, discuss the role of play design characteristics in creating an enjoyable play experience and facilitating the affect-related mechanisms of the relationship, and provide directions for future research.

Materials. A number of studies on play materials indicate that, for older children, playing with non-proximal objects (i.e., not designed to be used in a specific way, such as building blocks) can promote sociodramatic and thematic play and stimulate creativity, while playing with proximal objects (i.e., designed to be use in a specific way, such as toy cars) can inhibit both (Mellou, 1995). It is argued that this is because proximal objects are typically used for what they were intended whereas non-proximal objects can be used in a variety of ways and, thus, facilitate creativity (Mellou, 1995). However, some research also suggests that proximal objects are better than non-proximal objects at encouraging sociodramatic and thematic play (Mellou, 1995), which in turn can promote creativity (Dansky, 1999; Russ & Wallace, 2013).

Experimental research with children has found that playing with proximal objects can improve the children's subsequent ability to use those same objects in order to solve a creative problem (Barnett, 1985; Rosen, 1974; Smith & Dutton, 1979; Smith et al., 1985; Sylva et al., 1976; Vandenberg, 1981). These findings suggest that positive outcomes might be achieved through mechanisms directly related to the proximal objects used in play. Experimental studies with children have also found that play can improve divergent thinking on proximal objects not used during the play sessions (Dansky, 1980a, b; Dansky & Silverman, 1975; Li, 1978, 1985; Shmukler & Naveh, 1985; Udwin, 1983). This means that positive outcomes might also be achieved through mechanisms not directly related to the proximal objects being used. This could be one of the reasons why little attention was given to this play design characteristic in the studies we identified and, particularly, the studies with adult participants inside and outside the organisational context.

Future research could shed a light on the effects of SPOC with proximal and non-proximal objects/concepts on creativity-related outcomes in organisations as well as the mechanisms behind these effects. We believe that there are at least two mechanisms specifically concerning play materials that deserve further consideration. The first mechanism proposes that, in play, individuals obtain and organise knowledge about the objects they play with (Barnett, 1985; Piaget, 1999; Vandenberg, 1981). The second suggests that, in play, individuals form associations between remotely associated objects and concepts they engage with (Dansky & Silverman, 1973; Sutton-Smith, 1967). The implication for both mechanisms is that the individuals will later use the knowledge or the remote associations they obtained to generate solutions. Studies exploring these mechanisms as well as how materials interact with other play design characteristics to influence divergent thinking, creativity, and creative problem-solving would add insight around the role of materials in promoting creativity at work. As an example, studies could explore whether and how playing with the same materials for longer periods can lead to developing more knowledge about those materials and, ultimately, to using that knowledge to generate ideas.

Social content. Play may involve playing alone or playing in groups (Wyver & Spence, 1999). The findings of the experimental studies we reviewed indicate that solitary play can stimulate divergent thinking and creative problem-solving in children (Barnett, 1985; Dansky & Silverman, 1973, 1975; Li, 1978; Smith & Dutton, 1979;

Smith et al., 1985; Sylva et al., 1976; Vandenberg, 1981) and divergent thinking and creativity in adults (Tsai, 2012; Zabelina & Robinson, 2010). This suggests that some positive effects can be achieved through mechanisms not directly related to the social interactions that might occur during play. The findings also indicate that group play can promote divergent thinking and creativity in children (Dansky, 1980b; Howard-Jones et al., 2002), divergent thinking and creativity in adults (Dyson et al., 2016; Felsman et al., 2020; Karakelle, 2009; Karwowski & Soszynski, 2008; Lewis & Lovatt, 2013; Mourey, 2020; West et al., 2017), and a climate for creativity in organisations (Kirsten & Du Preez, 2010). The evidence is stronger for group play. However, this might be because the studies involving solitary play typically involved very short sessions of free solitary play rather than longer sessions or sessions of guided solitary play (see Sections B and C of the supplementary materials).

Playing in groups has been proposed as an important component of SPC and SPOC (Dansky, 1999; Karakelle, 2009; Kirsten & Du Preez, 2010; Nisula & Kianto, 2018; Robson, 2017; West, 2014). The argument has been that by interacting with others during play, many abilities and conditions favourable to creativity are being improved, including the individuals' ability to negotiate conflict and evaluate ideas (Robson, 2017), the participants' willingness to engage in the creative process with others (Mainemelis & Ronson, 2006), and the team's climate for creativity (Kirsten & Du Preez, 2010). These benefits are particularly essential in today's organisations where creative work is a collective endeavour (Kirsten & Du Preez, 2010; Nisula & Kianto, 2018).

While several mechanisms behind the benefits mentioned above have been proposed, such as the development of trusting relationships (Mainemelis & Ronson, 2006) and an environment that encourages trust and support (Kirsten & Du Preez, 2010), these mechanisms remain untested. Furthermore, only one of the studies we identified compared the effects of different types of social content (i.e., associative vs cooperative (Wyver & Spence, 1999)), highlighting the need for more research around this play design characteristic. Therefore, exploring the role of social content in delivering the effects proposed in the literature, the mechanisms delivering these effects, the longevity of these effects, and the interactions of social content with other play design characteristics would be an important direction for future research.

Surveying how the composition of a play group influences the effects of SPOC would be another promising direction. For instance, future research could explore the benefits of SPOC in which play groups differ in expertise, cooperation, communication, trust, tolerance for exploration and mistakes (e.g., Vera & Crossan, 2005), familiarity between players (e.g., teams already working together (West et al., 2017)), roles of players in the workplace (e.g., team members and managers (West et al., 2017)), diversity, and cohesion.

The experimental research on solitary SPC and SPOC is limited, and the findings are mixed. However, considering that solidary play could be effective (Tsai, 2012; Zabelina & Robinson, 2010), more convenient to organise than group play, and more resource efficient in terms of space, materials, and facilitation, we believe that there is value in exploring the effects that can be delivered through solitary SPOC, the longevity of these effects, the mechanisms delivering these effects, and the effectiveness of solitary SPOC compared to group SPOC.

Cognitive content. Cognitively, play involves exploring ideas, objects, or the environment as well as imagination (Dansky, 1999; Vygotsky, 2004). It can be organised into physical exploration, physical play, constructive play, object/concept-dependent play, sociodramatic play, and thematic play (Wyver & Spence, 1999). Of the experimental studies we identified, 20 involved free play with objects with a non-specified cognitive content, one involved physical exploration, seven involved physical play, four involved constructive play, one involved object/concept-dependent play, seven involved sociodramatic play, and 29 involved thematic play. In line with what scholars in developmental psychology expected (Dansky, 1999; Wyver & Spence, 1999), we found that participating in thematic play (i.e., enacting situations remote from everyday life) can be effective in promoting divergent thinking and creativity in individuals and teams (Dansky, 1999; Dyson et al., 2016; Karakelle, 2009; Karwowski & Soszynski, 2008; Lewis & Lovatt, 2013; Rosen, 1974; West et al., 2017; Wyver & Spence, 1999) and a climate for creativity in the workplace (Kirsten & Du Preez, 2010). However, the evidence is stronger for high doses (160 minutes or more) of guided thematic play in groups. More research is necessary to clarify the effects of high doses of solitary thematic play, low doses of thematic play in groups, and low doses of solitary thematic play, as the number of studies

investigating the effects of these combinations of play design characteristics is limited and the findings are mixed.

More work is also needed in understanding the mechanisms behind the impact of thematic play on creativity as well as the interactions of thematic play with other play design characteristics. For instance, more research exploring the effects of long and short SPC and SPOC that involve thematic play is required to determine whether quick mechanisms (i.e., mechanisms that require little time to be activated) and/or slow mechanisms (i.e., mechanisms that require a lot of time to be activated) are at work when participating in thematic play. Similarly, more studies investigating the effects of group and solitary thematic play could demonstrate whether mechanisms relating to social interactions, such as exploration as a group in a safer environment (West, 2014), are in effect when engaging in thematic play in groups.

More research comparing the different types of cognitive content is also necessary to clarify how the mechanisms proposed in the literature relate to the different types of cognitive content. While studies comparing different types of cognitive content in experimental research do exist (i.e., Dansky, 1980a; Moore & Russ, 2008; Shmukler & Naveh, 1985; Wyver & Spence, 1999), these studies are limited in number. This absence of comparisons might be due to the expectation that thematic and sociodramatic play would be more effective than other types of cognitive content in stimulating creativity (see Dansky, 1999; Wyver & Spence, 1999). Management scholars engaging in this comparative research will need to carefully design the cognitive content of the SPOC interventions they will administer (Garaigordobil & Berrueco, 2011; Karakelle, 2009; West, 2014), especially because the purpose of these studies will be to decipher the relationship between mechanisms and cognitive content.

Research could also explore the impact of SPOC in which the cognitive content is remote from the participants' main work tasks (e.g., a sales force assuming the roles of nurses in a hospital emergency unit) as well as SPOC in which the cognitive content is related to the participants' job responsibilities (e.g., executives of an oil and gas company reacting to a scenario in which oil prices drop dramatically low (Mainemelis, Harvey & Peters, 2008: 40)).

Freedom. In play, participants can be guided by instructions in their engagement with materials, in their interactions with other players, and the cognitive

content of the activities they perform (i.e., guided play) (Dansky, 1999; Silverman, 2016). These instructions can be provided and modelled by facilitators. Alternatively, participants can engage with materials, social content, and cognitive content as they please (i.e., free play) (Dansky, 1999; Silverman, 2016). Since serious play involves activities *designed* to promote creativity, participants engaging in SPC and SPOC are not free to engage in play as they please. Rather, they are guided by instructions on how to engage with the designed activities. Therefore, promising directions regarding freedom as a play design characteristic of SPOC revolve around guidance and the role of facilitators and tutoring techniques in providing guidance.

What we can see in the literature is that SPC and SPOC with both high (e.g., West et al., 2017) and low (e.g., Dyson et al., 2016) facilitator involvement can deliver improvements in divergent thinking. However, it is possible that the improvements delivered in experiments with low and high facilitator involvement were different in terms of longevity and strength because of the difference in the levels of facilitator involvement. For example, it is possible that participants in hands-off facilitation approaches spent a lot of time developing knowledge around a single feature of an object while participants in hands-on facilitation approaches were guided to form knowledge about multiple features of the same object (Pellegrini & Greene, 1980), resulting in greater improvements in divergent thinking in the latter group. Differences in improvement such as the one described above suggest that exploring the impact of facilitator involvement levels and the interaction of freedom with other play design characteristics on outcome longevity and strength is a promising direction for future exploration.

In addition, it is possible that different levels of facilitator involvement might benefit individuals in different ways. For example, it is possible that high facilitator involvement is more beneficial for participants who have difficulty engaging in play (i.e., non-players) than for those who can naturally engage in play without facilitator support (i.e., players) (Dansky, 1980b; Hoffmann & Russ, 2016). This might be because more involved facilitators may be needed to help non-players engage with and benefit from play but may not be needed to do the same for players. This example highlights that the impact of facilitator involvement levels on participants with different individual characteristics (e.g., ability to engage in play (i.e., play ability)) is another avenue worth exploring in the future.

Related to participant play ability, another promising direction for future research concerns the role of facilitators as tutors of play as well as the role of tutoring techniques. An argument can be made that guidance involving tutoring techniques, such as individualisation and scaffolding (Fehr & Russ, 2016), might be needed for participants to gradually improve their play ability and, thus, become capable to engage in and benefit from the types of play that stimulate creativity. Let us take enacting situations remote from everyday life (i.e., thematic play) as an example. The literature suggests that SPC and SPOC that involve guided thematic play in groups can be effective in improving creativity-related outcomes in individuals, teams, and organisations (Dyson et al., 2016; Karakelle, 2009; Karwowski & Soszynski, 2008; Kirsten & Du Preez, 2010; Lewis & Lovatt, 2013; West et al., 2017). However, adults who do not engaged in thematic play in their daily lives might find the activity challenging and difficult to engage in (Karwowski & Soszynski, 2008). This means that for SPOC involving guided thematic play to be effective, scaffolding might be required to teach participants how to engage in the activity (e.g., Dyson et al., 2016; Karwowski & Soszynski, 2008). Future research could explore the role of facilitators as tutors of play as well as the role of tutoring techniques, such as scaffolding, in improving the participants' play ability and, through that, their capacity to engage in and benefit from SPOC.

Dosage. While SPOC is designed to deliver an important organisational objective, it is likely that many business leaders – including those who appreciate the benefits of play – will view time spent participating in SPOC as time taken away from main work tasks. For this reason, we expect that a lot of effort in this research area will be invested in identifying how to design SPOC that is not only effective but also time efficient. In this context, the time required for the mechanisms proposed in the literature to deliver the desired outcomes would be a crucial area of inquiry in future research. That both short (e.g., Lewis & Lovatt, 2013; Sowden et al., 2015) and long (e.g., Karakelle, 2009; West et al., 2017) SPC and SPOC can promote divergent thinking and creativity suggests that some of the mechanisms involved in play are quick while others might be slow. Knowledge about this feature of the mechanisms together with a concrete understanding of what outcomes are delivered by each mechanism will be valuable in determining the appropriate dose of effective SPOC.

This is because knowing how much time is required for a mechanism to deliver a specific effect can help determine the dose of SPOC that delivers that effect.

It is also important to explore the role of other play design characteristics in determining the dose of effective SPOC. Let us take play materials and freedom as an example. If the expectation is for two SPOC interventions to have similar effects, we would expect an intervention with a facilitator who allows participants to develop new knowledge about the objects they engage with at their own pace will likely need to be longer than an intervention with a facilitator who guides participants through the same process.

As we see in many of the SPC and SPOC interventions we identified, the dose of SPOC does not have to be expended in a single session. Rather, it can be divided into multiple, frequent sessions that take place over the course of a few weeks or months. An interesting direction would be to explore how the number, duration, and frequency of play sessions might influence the effectiveness of SPOC (e.g., Karwowski & Soszynski, 2008).

Affect. Affect has a central role in play that stimulates creativity (Mainemelis & Ronson, 2006; Russ, 2018; Russ & Wallace, 2017). First, as we mention in previous sections, play itself is absorbing and enjoyable (Russ & Wallace, 2017). Being enjoyable does not necessarily mean that play only involves positive affect. Rather, it means that even when play involves negative affect, the overall play experience is appraised as a positive and enjoyable one (Mainemelis & Ronson, 2006; Nisula & Kianto, 2018).

Second, as we allude to earlier, the literature suggests that there is a link between affect in play and creativity. Empirical research has found that both positive and negative affect in play have a significant positive relationship with divergent thinking (Mainemelis & Ronson, 2006; Russ, 2003; Russ & Wallace, 2013, 2017). In addition, scholars of play and creativity have proposed that play – especially pretend play – can stimulate creativity through mechanisms that involve affective processes and the interaction of cognitive and affective processes (Mainemelis & Ronson, 2006; Russ, 2003; Russ & Wallace, 2013, 2017). For example, it has been proposed that, in play, individuals create affect-laden associations that they can recall and use during the creativity process (Mainemelis & Ronson, 2006; Russ & Wallace, 2013). It has also been proposed that play stimulates creativity by allowing individuals to

experience their emotions (Mainemelis & Ronson, 2006; Russ & Wallace, 2013, 2017); by improving their affect, intrinsic motivation, and playfulness (Dansky, 1999; Howard-Jones et al., 2002; Mainemelis & Ronson, 2006; Sowden et al., 2015; West, 2014); by reducing their stress and self-censure (Chatoupis, 2013; Sylva et al., 1976; Zabelina & Robinson, 2010); by allowing individuals to psychologically adjust to their work (Mainemelis & Ronson, 2006); by increasing their willingness to engage in the creative process with colleagues (Mainemelis & Ronson, 2006; West, 2014); and by promoting a climate for creativity (Kirsten & Du Preez, 2010; Nisula & Kianto, 2018).

Considering the central role of affect in play, the possible affective mechanisms, and the possible cognitive-affective mechanisms of the play-creativity relationship, future research on the successful design and implementation of SPOC could further explore and understand these mechanisms. For example, studies could consider the mechanisms through which play promotes positive affect and, as a result, divergent thinking and mental transformations (see Mainemelis & Ronson, 2006). As another example, research could investigate the mechanisms through which play stimulates the creation of affect-laden associations and, thus, divergent thinking (see Mainemelis & Ronson, 2006; Russ & Wallace, 2013).

Another important direction for future research would be to explore how the design characteristics of play could help create an enjoyable play experience and facilitate the affective and cognitive-affective mechanisms of the play-creativity relationship. For example, studies could investigate how challenge and imagination as part of cognitive content (Mainemelis & Ronson, 2006) and interactions with others as part of social content (Nisula & Kianto, 2018) could create an enjoyable play experience. With regard to the affective and cognitive-affective mechanisms of the relationship, research could focus on elaborating on and examining how different configurations of play design characteristics could facilitate the mechanisms. For example, studies could explore how playing in groups, rather than playing alone, could better improve the participants' intrinsic motivation and willingness to engage in the creative process with their colleagues (see Mainemelis & Ronson, 2006; West, 2014). As another example, studies could explore how short or long sessions of play with affect-integrated cognitive content (e.g., happy vs angry pretend play (Russ & Kaugars, 2001)) might facilitate the formation of affect-laden associations.

1.4.2. Organisational Factors

While a thoughtful design will be essential to the successful implementation of SPOC in the business environment (Statler et al., 2011), a group of organisational factors is also expected to influence its successful design and implementation. In this section we discuss areas around leadership, human resource management, and medium of work that could be explored in future research.

Leadership. In addition to exploring SPOC design, management scholars could investigate the role of leadership in the successful design and implementation of SPOC. In general, leaders play an important role in promoting organisational creativity. With regard to SPOC, leaders can assist in its successful design and implementation in both direct and indirect ways. In an indirect way, they can help create conditions favourable to creativity so that improvements achieved during SPOC can be translated into improvements in organisational creativity. Senior and departmental leaders can do that by formulating and communicating mission-oriented visions (Anderson et al., 2014; Mumford, Scott, Gaddis & Strange, 2002; Rafferty & Griffin, 2004) and strategies (Dodgson, Gann & Salter, 2008; Pisano, 2015) that focus, guide, and support creative work; by prioritising creativity and installing practices and procedures that create cultures and climates conducive to creativity (Ahmed, 1998); and by imposing organisational structures that allow for cross-functional collaboration and communication that enables creativity (Damanpour & Aravind, 2012).

Line managers and team leaders can further ensure that a favourable climate for creativity exists by instilling a sense of challenge and autonomy in work, ensuring the availability of resources, demonstrating support and encouragement for creative work, and forming effective creative teams (Amabile, 1998). Finally, team leaders can help their teams by defining the problems to be solved, formulating and communicating the missions that will guide the creative projects, planning and structuring the projects, evaluating completed work, forecasting the consequences of their teams' actions, motivating team members, promoting the projects to management and stakeholders (Mumford & Barrett, 2011), and implementing strategies that will support their teams in engaging in the challenging cognitive (e.g., idea exchange (Brown & Paulus, 2002)) and social (e.g., motivation loss (Paulus, 2008)) processes involved in creativity.

Leadership can also influence the successful design and implementation of SPOC in a number of direct ways. For example, they can guide SPOC design by deciding on the creativity-related outcomes that need to be delivered through SPOC and by selecting the play design characteristics that best fit the participants and the organisation (Statler et al., 2011). They can also contribute to the successful implementation of SPOC by communicating that the organisation welcomes and encourages participation in SPOC (Statler et al., 2011); by articulating that time spent in SPOC is expected to stimulate organisational creativity; by providing the appropriate environmental conditions, space, time, and permission for participation in SPOC (Mainemelis & Ronson, 2006; West, 2014); by acting as examples with their participation in play and SPOC (Mainemelis, Kark & Epitropaki, 2015; West, 2014); and by striving to maintain a good climate for play (i.e., positive perceptions about play at work) (West, 2014). Considering that little is known about the relationship between leadership, play, and creativity (Mainemelis et al., 2015), future research in this area could focus on exploring the direct ways by which leaders can support the successful design and implementation of SPOC.

Human resource management. Issues hindering the successful implementation of SPOC might arise even when it was thoughtfully designed and the leaders of the organisation took all the appropriate actions. Problems with implementation might occur due to differences in assumptions about the role of play at work (Petelczyc et al., 2018); due to misunderstandings around what is acceptable and what is not during play (Petelczyc et al., 2018); due to a poor climate for play within the organisation (West, 2014); and due to differences in willingness to participate in SPOC. It is also possible that a successful SPOC intervention might deliver undesired outcomes that need to be addressed. These include employees finding their main work tasks unenjoyable and boring (Mainemelis & Dionysiou, 2015; Mainemelis & Ronson, 2006), having difficulty to apply convergent thinking (Zabelina & Robinson, 2010), feeling undue pressure to be creative in their work, and feeling guilty for not performing as creatively as they or the organisation would hope for after participating in SPOC. The human resources (HR) department could help address these issues and detrimental effects and support the successful implementation of SPOC through its human resource management (HRM) practices.

Like leadership, HR can help the successful design and implementation of SPOC in direct and indirect ways. In an indirect way, the department can help establish favourable conditions for creativity to occur after participation in SPOC. It can do that by helping to create a culture that supports creativity (McLean, 2005) and the transfer of improvements achieved during SPOC to the participants' work (see Blume, Ford, Baldwin & Huang, 2010). Considering that SPOC can be introduced as part of work or training and development, HR can also help its successful design and implementation in more direct ways. For example, the department can work with leadership to determine if SPOC is suitable and appropriate for the needs of the organisation, help design SPOC that delivers the desired outcomes, link performance appraisal to SPOC, assess the effectiveness of SPOC (see Ligon et al., 2012), and help create a good climate for play. Since less is known about the direct ways in which the HR department can support the design and implementation of SPOC, future research efforts in this area could focus on those.

Medium of work. Finally, SPC and SPOC we identified in the literature were all administered face-to-face. As the traditional organisational environment is transitioning to one where more employees work remotely and use the internet to collaborate (Petelczyc et al., 2018), participating in SPOC in person could become challenging. We, therefore, believe that there is value in exploring how SPOC could be used to improve the creativity of employees and teams working remotely. In this context, SPOC could be administered face-to-face during the occasional meetings of remote teams or administered online in synchronous and asynchronous formats. The medium of play (i.e., face-to-face, online) could also be considered a play design characteristic. However, because it heavily relies on the medium and location of work within an organisation, we discuss it under organisational factors.

1.4.3. Research Design

Designing robust research that can examine and measure the effectiveness of SPOC will be an important component of identifying and understanding the play design characteristics and the organisational factors that influence the successful design and implementation of SPOC. For this reason, we believe that there is value in discussing some of the methodological considerations that need to be made when conducting research in this area. Some of the methodological issues we discuss relate to the

development of robust research designs more broadly and are not unique to research on SPOC. However, we hope that, by including them here, researchers working in this area will be reminded of their importance and will consider them as they develop the methodologies of their research on SPOC.

Measures. As we allude to earlier in this essay, most of the empirical studies on the play-creativity relationship focus on divergent thinking abilities (Russ & Wallace, 2013). This is also the case for the experimental studies we reviewed. Researchers in the management literature interested in examining the effects of SPOC on divergent thinking will need to consider the measures they will use, the duration, administration, and scoring of those measures (Reiter-Palmon, Forthmann & Barbot, 2019), the stimulus concepts they will use in those measures (e.g., stimulus concepts for the Alternate Uses Test), strategies to avoid training effects on stimulus concepts (e.g., selecting stimulus concepts for pre- and post-tests that are analogous in terms of their frequency in language), and strategies to avoid training effects on subsequent tests when conducting multiple tests one after the other.

Most of the experimental research that investigated the effects of play on divergent thinking focused on ideational fluency and originality (see Section C of the supplementary materials). We would like to encourage scholars investigating the effects of SPOC on divergent thinking to consider additional important divergent thinking abilities, such as ideational flexibility – the ability to generate solutions that belong distinct categories (e.g., Felsman et al., 2020; Hainselin et al., 2018; Lewis & Lovatt, 2013; Moore & Russ, 2008) and ideational elaboration – the ability to elaborate on one's solutions (e.g., Campion & Levita, 2014; Felsman et al., 2020; Garaigordobil & Berrueco, 2011; Hainselin et al., 2018; Lewis & Lovatt, 2013).

We must also encourage work in the management literature to move beyond just divergent thinking as an outcome. We believe that studies exploring the effects of SPOC on multiple creative outcomes that are relevant to the organisational context will make greater contributions toward understanding how to design and implement effective SPOC. Some more relevant outcomes that can be considered are the number of individual and team creative projects introduced or successfully completed (e.g., Vera & Crossan, 2005), the climate for creativity within a team or an organisation (e.g., Kirsten & Du Preez, 2010; Nisula & Kianto, 2018), the financial success of

creative projects (e.g., Ligon et al., 2012), and the improvement of products and processes.

Measurement timing. Many of the studies we identified involved pre-intervention measurements that made it easier to distinguish which groups of participants (e.g., participants with low baseline divergent thinking (Garaigordobil, 2006)) and under which conditions (e.g., high levels of facilitator involvement (Hoffmann & Russ, 2016)) benefited the most from an intervention. These measurements also helped establish whether differences between condition groups were due to differences in improvement or due to an improvement in one group and a deterioration in another (e.g., Hoffmann & Russ, 2016). We believe that including pre-intervention measurements is a good practice that needs to be maintained in future research on the topic, as it can add clarity around the relationship between SPOC and organisational creativity.

Careful considerations around the timing of post-intervention measurements can also help create a better picture around the effectiveness of SPOC. As we mention earlier in the section, it is likely that some of the effects of play will be short-lived (e.g., increased positive affect (Dansky, 1999)) while others will be long-lasting (e.g., improved climate for creativity (Kirsten & Du Preez, 2010)). The timing of post-intervention measurements can reveal more information about the longevity of any changes that might occur as well as about the mechanisms that deliver those changes. For example, a measurement that takes place immediately after or a few days after an intervention can reveal the short-term effects of the intervention, whereas delayed and follow-up measurements can reveal its long-term effects. A combination of immediate, delayed, and follow-up measurements can help identify an intervention's short- and long-term effects, the mechanisms not supported by the findings, and the mechanisms with diminishing returns. The results obtained by such a combination can also suggest whether booster play sessions might be needed to maintain the effects (e.g., Moore & Russ, 2008; Russ, 2018).

Control groups. Some of the studies we reviewed included "no intervention" control groups (e.g., Dyson et al., 2016; Kirsten & Du Preez, 2010; West et al., 2017), which helped determine whether an intervention was indeed effective and why condition groups differed at the end of the intervention (see Lillard et al., 2013). We believe that comparing SPOC to "no intervention" groups in future research will be

necessary, especially because research on SPOC is in its early stages and the effectiveness of SPOC needs to be rigorously examined. Studies comparing SPOC interventions that only differ on one play design characteristic can also clarify the effectiveness of SPOC and point out promising play design characteristics.

Some of the experimental studies we identified compared the effectiveness of play to other training techniques, such as asking questions about specific objects to prompt participants to explore several attributes of those objects (e.g., Pellegrini & Greene, 1980) and training participants on the solutions of specific problems (e.g., Smith & Dutton, 1979). Management scholars interested in the effectiveness of SPOC compared to other training programmes could follow a similar approach.

Considering that SPOC could influence many stages of the creative process (e.g., problem framing, idea generation, and idea evaluation (Mainemelis & Ronson, 2006; Robson, 2017)), extra care needs to be taken when selecting alternative trainings and measures for comparison. This is because contrasts with different techniques and measures can lead to different conclusions. For example, a study comparing the effects of SPOC and idea generation training on divergent thinking could only reveal how effective the two techniques are in promoting idea generation. On the other hand, a study that takes into consideration that SPOC could influence other stages of the creative process and compares the effects of a SPOC intervention and an idea generation training on the ultimate creative outputs at work could reveal the extent to which any improvements achieved during these interventions are translated into creative performance. Insights such as these could help management scholars reach more meaningful conclusions about the effectiveness of SPOC compared to other techniques and assist organisations in selecting interventions that best meet their business objectives.

Moderators and covariates. In studies on SPOC design, the research community will also need to consider other factors that might influence the effectiveness of SPOC. The list of moderators and covariates discussed in the available literature consists of individual and team level factors, including individual general intelligence (Russ & Wallace, 2013), open-mindedness (i.e., a preference to have a wide range of perceptual, cognitive, and affective experiences (Soto & John, 2017a)) (Zabelina & Robinson, 2010), playfulness (Russ & Christian, 2011), play ability (Dansky, 1980b; Hoffmann & Russ, 2016), familiarity with pretend play (Mourey,

2020), ability to express affect in pretend play (Russ & Kaugars, 2001); and team expertise, cooperation, communication, trust, and tolerance for exploration and mistakes (Vera & Crossan, 2005). We would add that perceptions about play at work (West, 2014), differences in these perceptions due to occupation, seniority, and age (Petelczyc et al., 2018), and other play group characteristics we discuss earlier under "Social Content" (e.g., play group diversity) might also affect the effectiveness of SPOC and, therefore, merit further consideration.

Setting and sampling. Of the 43 experimental studies on SPC and SPOC we identified, only 15 recruited an adequate number of participants that would render them statistically powerful to detect even a large effect. This is likely because conducting experiments on this topic is difficult and labour intensive (Russ & Wallace, 2013). In general, having a small number of minimally powered studies makes it difficult to draw firm conclusions about the effectiveness of SPC and SPOC, especially if the interventions in these studies have substantially different play design characteristics. And having a small number of studies reporting contradictory results, even if these studies do not have enough statistical power, adds to the challenge. For this reason, management scholars engaging in experimental research in this area could consider recruiting a large enough number of participants that would make their studies statistically powerful. We acknowledge, however, that this will be particularly challenging for studies in which groups and organisations, rather than individuals, are the units of analysis.

As we see with both studies conducted in organisations (i.e., Kirsten & Du Preez, 2010; West et al., 2017), randomly allocating individuals, groups, or organisations to condition groups is not always possible. This means that management scholars conducting experimental research that is generalisable to the organisational context might have to resort to convenience samples. To minimise threats to internal validity arising with the lack of randomisation, researchers could take additional steps to make their quasi experiments closely approximate randomised experiments. These steps include conducting multiple pre- and post-intervention measurements using equivalent measures and matching condition groups (see Pitts, Prost & Winters, 2005).

Experimenter bias. Test administrators, test raters, and play facilitators were heavily involved in the experimental studies that administered SPC and SPOC interventions. Nevertheless, only a few studies reported taking measures to control for

rater blindness to hypotheses (only 8 of the 43 studies), rater blindness to participant condition groups (only 20), play facilitator blindness to hypotheses (only 3), and play facilitator fidelity to study protocol (only 12). Future research in the management literature could adopt a number of strategies to control for these sources of bias, including having pre- and post-intervention measurements administered and scored by researchers unaware of study hypotheses and participant condition groups, having play interventions administered by facilitators unaware of study hypotheses, and monitoring facilitator fidelity.

However, care needs to be taken when selecting the appropriate strategies, as the strategies themselves can not only be expensive but also disruptive. For example, Smith and Whitney (1987) addressed issues around rater blindness by having an experimenter facilitate a short intervention in one room and an experimenter blind to hypotheses and condition groups administer and score the post-test in another room. While this strategy minimised some potential biases, it is possible that the change of experimenter and room disrupted any short-term effects caused by the intervention (Silverman, 2016). Future research could consider alternative approaches that reduce rater-related biases without introducing disruptions. For example, studies could use an individual's creative outputs at work as the dependent variable (e.g., creative projects introduced (Vera & Crossan, 2005)) rather than the results of a divergent thinking test (DTT) that requires administration and scoring.

Smith and Syddall (1978) addressed issues around facilitator fidelity by observing and scoring their study's intervention facilitator using a check-list. Though this strategy helped control for facilitator contact, it is possible that it was distracting for both the participants and the facilitator (e.g., Schmidt, Goforth & Drew, 1975). Less intrusive strategies would involve videotaping interventions and scoring facilitator fidelity based on that video (e.g., Fehr & Russ, 2016; Hoffmann & Russ, 2016) and ensuring that participants require a minimal contribution from the facilitators by providing them with as much information as possible at the beginning of the intervention (e.g., Dyson et al., 2016).

Reporting. Though identifying the overall effectiveness of SPOC will not be the objective of any individual empirical study, every study can make a small contribution to greater meta-analytic efforts that can shed light on and guide the successful design and implementation of SPOC. For this reason, we urge management

scholars reporting empirical research on this topic to include the necessary statistics in their manuscripts (e.g., means, standard deviations, and group sizes). We also encourage authors and journals to publish the findings of robust studies, even if the findings are contradictory to any consensus in the field. Such studies can help reduce "file-drawer" bias in future meta-analytic efforts, can challenge long held assumptions, and can point to promising directions for future research.

1.5. Conclusion

More attention than ever before is given to the benefits of playing at work. In this context, SPOC is emerging as an effective way to promote organisational creativity. Considering the recent calls for more research on play at work (Hjorth et al., 2018; Petelczyc et al., 2018) and the encouraging findings of recent empirical work (Kirsten & Du Preez, 2010; Nisula & Kianto, 2018; West et al., 2017), we expect that more management scholars will be exploring the design and implementation of effective SPOC in the future. We hope that our review and research agenda can help advance research on play and organisational creativity by highlighting promising areas of study. We also hope that this essay can help advance research on organisational creativity more broadly by encouraging researchers to consider and explore SPOC as a viable technique of stimulating creativity in the workplace.

Table 1.1. The Characteristics of Play Interventions in the Experimental Studies

Category	Characteristic	Description	Example Study
Freedom	Free play	Un-designed, un-guided play	Dansky and Silverman (1973)
	Guided play (serious play)	Play designed and guided by instructions often provided by facilitators	West et al. (2017)
Materials	Test objects/concepts	Play with objects/concepts subsequently used in tests measuring the effectiveness of the intervention	Smith and Dutton (1979)
	Non-test objects/concepts	Play with objects/concepts not subsequently used in tests measuring the effectiveness of the intervention	Li (1978)
Social Content	Solitary play	Play individually/alone	Fehr and Russ (2016)
	Associative play	Play in groups with common goals but no clear social hierarchy	Wyver and Spence (1999)
	Cooperative play	Play in groups with common goals and clear social hierarchy	Dyson et al. (2016)
Cognitive Content	Physical exploration	Explore objects or the environment	Dansky (1980a)
	Physical play	Move around and interact with large toys or dance	Richard et al. (2020)
	Constructive play	Construct something with the provided materials	Tsai (2012)
	Object/concept-dependent play	Engage in pretend play with the provided objects/concepts, use proximal objects/concepts in their obvious use	Mourey (2020)
	Sociodramatic play	Enact situations from everyday life in pretend play (e.g., shopping at the grocery store)	Dansky (1980a)
	Thematic play	Enact situations remote from everyday life in pretend play (e.g., visiting the moon)	Dyson et al. (2016)
	Combination	A combination of the above types of cognitive content	Lewis and Lovatt (2013)
Dosage	Duration per play session	From 5 minutes to 8 hours	Russ and Kaugars (2001) Karwowski and Soszynski (2008)
	Number of play sessions	From 1 session to 40 sessions	Mourey (2020) Garaigordobil and Berrueco (2011)

Table 1.2. The Characteristics of Different Types of Play in Organisations

Characteristic	Play at Work that Stimulates Creativity	Serious Play for Organisational Creativity (SPOC)	Other Serious Play Interventions	Educational Serious Games	Gamification
Primary objective	Enjoyment	Stimulate organisational creativity by providing a safer environment for participants to develop the resources (e.g., knowledge) and practise the processes (e.g., imagination) necessary for creativity	Deliver important business objectives (e.g., new product design) by providing a safer environment for participants to explore and exercise their imagination	Deliver important business objectives (e.g., organisational creativity) by providing a predetermined learning experience and delivering specific learning points (e.g., how to be creative)	Deliver important business objectives (e.g., prevent software defects) by incentivising specific behaviours (e.g., software testing) that are expected to help achieve the business objectives
Volition	Voluntary	At the request of the organisation	At the request of the organisation	At the request of the organisation	At the request of the organisation
Is absorbing	Yes	Yes	Yes	Yes	Yes
Is enjoyable	Yes	Yes	Yes	Yes	Yes
The organisation provides the environmental conditions, space, time, and permission for participation	Not necessarily	Yes	Yes	Yes	Yes
Is distinct from ordinary life	Yes	Yes	Yes	Yes	No

Table 1.2. The Characteristics of Different Types of Play in Organisations (Continued)

Characteristic	Play at Work that Stimulates Creativity	Serious Play for Organisational Creativity (SPOC)	Other Serious Play Interventions	Educational Serious Games	Gamification
Has flexible means	Yes	Yes	Yes	No	No
Has flexible ends	Yes	Yes	Less flexible ends compared to SPOC	No	No
Involves exploration	Yes	Yes	Yes	Less exploration compared to SPOC and other serious play interventions	Less exploration compared to SPOC and other serious play interventions No relative safety for exploration
Involves imagination	Yes	Yes	Less imagination compared to SPOC involving thematic play	Less imagination compared to SPOC and other serious play interventions	Less imagination compared to SPOC and other serious play interventions No relative safety for imagination

Table 1.3. The Results of the Experimental Studies

Author(s)	*N* Per Group	Mostly Positive Effects	Mixture of Positive and No Effects	Mostly No Effects	As Good as Other Creativity Training
Minimally Powered					
Free Play					
Dansky and Silverman (1973)	3x30	+			
Sylva et al. (1976) Study 1	3x36	+			
Smith and Dutton (1979)	36,36,18,18	+			
Dansky (1980b)	3x32	+			
Barnett (1985)	6x15	+			
Howard-Jones et al. (2002)	2x26	+			
Vandenberg (1981)	2x(15,15,15)		+		
Pepler and Ross (1981) Study 2	3x24			+	
Simon and Smith (1985)	4x20			+	
Guided Play (Serious Play)					
Schmidt et al. (1975)	2x39	+			
Li (1978)	4x30	+			
Berretta and Privette (1990)	2x(29,33,30)	+			
Garaigordobil (2006)	54,32	+			
Hui and Lau (2006) Grades 1 and 4	30,33/31,34	+			
*Zabelina and Robinson (2010)	36,40	+			
Garaigordobil and Berrueco (2011)	53,33	+			
Chatoupis (2013)	28,30	+			
*West et al. (2017)	50(14),43(11)	+			
Richard et al. (2018)	64,76		+		
*Mourey (2020) Study 1	260 in 2		+		
*Felsman et al. (2020) Study 1	2x37		+		
*Richard et al. (2020)	26,30,36		+		
Russ and Kaugars (2001)	4x20			+	
*Felsman et al. (2020) Study 2	67,64			+	

Note: * = Adult participants.

Table 1.3. The Results of the Experimental Studies (Continued)

Author(s)	N Per Group	Mostly Positive Effects	Mixture of Positive and No Effects	Mostly No Effects	As Good as Other Creativity Training
Underpowered					
Free Play					
Dansky and Silverman (1975)	3x12	+			
Pepler and Ross (1981) Study 1	4x16	+			
Pellegrini and Greene (1980)	3x8			+	
Pellegrini (1981)	3x12			+	
*Campion and Levita (2014)	15,14,14,13			+	
Simon and Smith (1983)	8x8				+
Smith et al. (1985)	4x10				+
Guided Play (Serious Play)					
Rosen (1974)	58 in 4	+			
Dansky (1980a)	3x12	+			
Udwin (1983)	2x17	+			
Li (1985)	2x15	+			
Shmukler and Naveh (1985)	26,28,14,25	+			
Cleland (1994)	16,17,17	+			
Wyver and Spence (1999) Study 3	10,9,9,10	+			
*Karwowski and Soszynski (2008)	47 in 2	+			
*Karakelle (2009)	2x15	+			
Koutsoupidou and Hargreaves (2009)	12,13	+			
*Kirsten and Du Preez (2010)	15,13	+			
*Tsai (2012)	11,7	+			
*Lewis and Lovatt (2013) Study 1	21,20	+			
*Lewis and Lovatt (2013) Study 2	24, 12	+			
Sowden et al. (2015) Study 1	14, 13	+			
Sowden et al. (2015) Study 2	2x17	+			
*Dyson et al. (2016)	19,20	+			
Pirrone et al. (2018)	16,17	+			
*Mourey (2020) Study 2	17,20	+			
Feitelson and Ross (1973)	4x6		+		
Hainselin et al. (2018)	18,12		+		
Smith and Whitney (1987)	4x16			+	
Moore and Russ (2008)	16,13,16			+	
Fehr and Russ (2016)	41 in 2			+	
Hoffmann and Russ (2016)	2x20			+	
Smith and Syddall (1978)	2x7				+
Smith et al. (1981) Schools A and B	21,20/17,19				+
Christie (1983)	8,9				+

Note: * = Adult participants.

Table 1.4. Directions for Future Research

Topic	Research Directions
Design of Serious Play for Organisational Creativity (SPOC)	
Mechanisms	Clearly communicating and empirically testing the mechanisms proposed in the literature. Exploring the longevity of the outcomes delivered by these mechanisms. Understanding how play design characteristics and their interactions can facilitate these mechanisms.
Materials	Exploring the impact of proximal and non-proximal objects/concepts.
Social Content	Exploring the impact of different types of social content. Exploring the impact of play group composition and solitary play.
Cognitive Content	Exploring the impact of different types of cognitive content. Exploring the impact of cognitive content related to or remote from the participants' main work tasks.
Freedom	Exploring the impact of facilitator involvement levels. Exploring the role of facilitators as tutors of play and the role of tutoring techniques in improving play ability.
Dosage	Exploring how much time it takes for the mechanisms proposed in the literature to deliver the desired outcomes. Exploring the impact of number, duration, and frequency of play sessions.
Affect	Exploring the affective and cognitive-affective mechanisms proposed in the literature. Exploring how play design characteristics could help create an enjoyable play experience and facilitate the affective and cognitive-affective mechanisms proposed in the literature.
Organisational Factors	
Leadership	Exploring how leadership can influence the successful design and implementation of SPOC in direct ways through actions like deciding on the creativity-related outcomes that need to be delivered through SPOC; selecting the play design characteristics that best fit the participants and the organisation; welcoming and encouraging participation in SPOC; articulating that participation in SPOC is expected to stimulate organisational creativity; providing the appropriate environmental conditions, space, time, and permission for participation; acting as examples with their participation; and striving to maintain a good climate for play.
Human Resource Management	Exploring how the human resources department can influence the successful design and implementation of SPOC in direct ways through actions like determining if SPOC is suitable and appropriate; helping to design SPOC that delivers the desired outcomes; linking performance appraisal to SPOC; assessing the effectiveness of SPOC; and helping to create a good climate for play.
Medium of Work	Exploring the design and impact of face-to-face SPOC administered during the occasional meetings of remote teams, and synchronous and asynchronous SPOC administered online.

Table 1.4. Directions for Future Research (Continued)

Topic	Research Directions
Research Design	
Measures	Administering divergent thinking tests. Selecting measures relevant to the organisational context (e.g., team creative outputs, climate for creativity).
Measurement Timing	Timing pre-intervention, post-intervention, and follow-up measurements to identify short- and long-term effects, mechanisms not supported by the findings, mechanisms with diminishing returns, and the need for booster play sessions.
Control Groups	Including control groups to clarify the effectiveness of SPOC and highlight promising play design characteristics. Comparing SPOC to other training techniques.
Moderators and Covariates	Considering individual, team, and organisational level factors that might influence the effectiveness of SPOC.
Setting and Sampling	Recruiting an adequate number of individuals, teams, or organisations as participants. Designing robust quasi experiments.
Experimenter Bias	Following strategies to minimise experimenter biases introduced during testing, scoring, and intervention facilitation.
Reporting	Reporting the necessary statistics of empirical studies. Publishing robust studies regardless of the findings.

1.7. Supplementary Materials

1.7.1. Section A – Systematic Review of the Experimental Studies

Table 1.5. Database Searches and Results for the Systematic Review of the Experimental Studies

Search Phrase	University Search Platform Publications Found (Publications Selected)	Google Scholar Publications Found (Publications Selected)
play creativity	142 (3)	433 (7)
play divergent thinking	10 (2)	19 (2)
play problem solving	47 (5)	126 (8)
play creative behavior	3 (0)	2 (0)
play creative behaviour	3 (0)	1 (0)
improvisation creativity	61 (0)	138 (3)
improvisation divergent thinking	1 (1)	4 (3)
improvisation problem solving	0 (0)	3 (0)
improvisation creative behavior	0 (0)	0 (0)
improvisation creative behaviour	0 (0)	0 (0)
Total	267 (11)	726 (23)

Note: The set of publications selected from the university search platform and the set of publications selected from Google Scholar are overlapping.

1.7.2. Section B – Research Designs of the Experimental Studies

Table 1.6. The Research Designs of the Experimental Studies

Author(s)	Condition Groups (Cognitive Content)
Minimally Powered	
Free Play	
Dansky and Silverman (1973)	Free play with test objects, imitation with test objects, colouring task
Sylva et al. (1976) Study 1	Free play with test objects, solution observation with test objects, no intervention
Smith and Dutton (1979)	Free play with test objects, solution training with test objects, no intervention x 2
Dansky (1980b)	Free play with non-test objects, imitation with non-test objects, convergent problem-solving
Barnett (1985)	Solution observation of the first problem with test objects, solution observation of the first and second problems with test objects, solution observation of the first problem with test objects and practice, solution observation of the first and second problems with test objects and practice, free play with test objects, free play with non-test objects
Howard-Jones et al. (2002)	Free play with salt dough, handwriting task
Vandenberg (1981)	Free play with test objects, questioning on test objects
Pepler and Ross (1981) Study 2	Free convergent play with non-test objects, free divergent play with non-test objects, book reading
Simon and Smith (1985)	Free play with test objects, solution training with test objects, questioning on test objects, drawing
Guided Play (Serious Play)	
Schmidt et al. (1975)	Improvisational theatre training (sociodramatic and thematic play), guided curricular activities
Li (1978)	Guided play (sociodramatic) with test and non-test objects, free play with test and non-test objects, imitation with test and non-test objects, colouring task
Berretta and Privette (1990)	Guided 3 x flexible play (constructive, thematic, and physical), guided 3 x highly structured play (colouring task, play reading, physical game)
Garaigordobil (2006)	Guided play (constructive, concept-dependent, and thematic), guided curricular activities
Hui and Lau (2006) Grades 1 and 4	Improvisational theatre training (physical, sociodramatic, and thematic play), guided extra-curricular activities
*Zabelina and Robinson (2010)	Guided story writing with a childlike mindset (sociodramatic play), guided story writing without a childlike mindset
Garaigordobil and Berrueco (2011)	Guided play (constructive and thematic), guided curricular activities
Chatoupis (2013)	Improvisational motor training (physical play), conventional motor training
*West et al. (2017)	Improvisational theatre training (sociodramatic and thematic play), no intervention
Richard et al. (2018)	Improvisational motor training (physical play), conventional motor training
*Mourey (2020) Study 1	Improvisational theatre training (concept-dependent play), typing
*Felsman et al. (2020) Study 1	Improvisational theatre training (physical and thematic play), structured verbal and physical activities
*Richard et al. (2020)	Improvisational dance training (physical play), aerobic dance, reading

Russ and Kaugars (2001)	Guided happy play (sociodramatic) with non-test objects, guided angry play (sociodramatic) with non-test objects, free play with non-test objects, puzzle solving
*Felsman et al. (2020) Study 2	Improvisational theatre training (physical and thematic play), structured verbal and physical activities
Underpowered **Free Play**	
Dansky and Silverman (1975)	Free play with non-test objects, imitation with non-test objects, convergent problem-solving
Pepler and Ross (1981) Study 1	Free convergent play with non-test objects, free divergent play with non-test objects, convergent activity observation with non-test objects, divergent activity observation with non-test objects
Pellegrini and Greene (1980)	Free play with test objects, questioning on test objects, conversation with adults
Pellegrini (1981)	Free play with non-test objects, questioning on non-test objects, drawing
*Campion and Levita (2014)	Free dancing to music (physical play), listening to music, cycling to music, sitting quietly
Simon and Smith (1983)	Free play with test objects/Solution training with test objects X Experimenter bias/no bias X Normal/Low experimenter feedback
Smith et al. (1985)	Free play with test objects/Solution training with test objects X Normal/Low experimenter feedback
Guided Play (Serious Play)	
Rosen (1974)	Guided play (sociodramatic and thematic) with non-test objects, guide extra-curricular activities
Dansky (1980a)	Guided play (sociodramatic) with non-test objects, guided physical exploration with non-test objects, free play with non-test objects
Udwin (1983)	Guided play (sociodramatic and thematic) with non-test objects, free play with non-test objects with adult interaction
Li (1985)	Guided play (thematic) with non-test objects, guided skills mastery tasks with non-test objects
Shmukler and Naveh (1985)	Guided play (thematic) with non-test objects, guided play (structured thematic) with non-test objects, guided extra-curricular activities, no intervention
Cleland (1994)	Improvisational motor training (physical play), conventional motor training, no intervention
Wyver and Spence (1999) Study 3	Guided cooperative play (constructive and sociodramatic), guided associative play (thematic), guided cooperative play (thematic), no intervention
*Karwowski and Soszynski (2008)	Role-playing training (physical and thematic play) for an 8-hour session, role-playing training (physical and thematic play) for four 2-hour sessions
*Karakelle (2009)	Improvisational theatre training (sociodramatic and thematic play), no intervention
Koutsoupidou and Hargreaves (2009)	Improvisational music training, music lessons with adult
*Kirsten and Du Preez (2010)	Improvisational theatre training (sociodramatic and thematic play), no intervention
*Tsai (2012)	Guided play (constructive), no intervention
*Lewis and Lovatt (2013) Study 1	Improvisational theatre training (concept-dependent and thematic play), verbal discussion
*Lewis and Lovatt (2013) Study 2	Improvisational music training, music lesson with adult
Sowden et al. (2015) Study 1	Improvisational dance training (physical play), dance lesson with adult

Sowden et al. (2015) Study 2	Improvisational theatre training (concept-dependent and thematic play), verbal game
*Dyson et al. (2016)	Tabletop role-playing game (thematic play), no intervention
Pirrone et al. (2018)	Guided play (constructive) with building blocks on mathematical concepts, guided mathematics curriculum
*Mourey (2020) Study 2	Improvisational theatre training (physical, concept-dependent, and thematic play), consumer behaviour course
Feitelson and Ross (1973)	Guided play (thematic) with non-test objects, free play with non-test objects, music lessons with adult, no intervention
Hainselin et al. (2018)	Improvisational theatre training (sociodramatic and thematic play), sports
Smith and Whitney (1987)	Guided play (sociodramatic) with test and non-test objects, free play with test and non-test objects, imitation with test and non-test objects, colouring task
Moore and Russ (2008)	Guided play (thematic) with non-test objects, guided affect play (sociodramatic) with non-test objects, puzzles and colouring task
Fehr and Russ (2016)	Guided play (thematic) with non-test objects, guided skills mastery tasks with non-test objects
Hoffmann and Russ (2016)	Guided play (concept-dependent, sociodramatic, and thematic) with non-test objects, guided skills mastery tasks with non-test objects
Smith and Syddall (1978)	Guided play (sociodramatic and thematic) with non-test objects, guided skills mastery tasks with non-test objects
Smith et al. (1981) Schools A and B	Guided play (sociodramatic and thematic) with non-test objects, guided skills mastery tasks with non-test objects
Christie (1983)	Guided play (sociodramatic and thematic) with non-test objects, guided skills mastery tasks with non-test objects

Table 1.6. The Research Designs of the Experimental Studies (Continued)

Author(s)	Age (mean years)	Dosage	Total Dose (min.)
Minimally Powered Free Play			
Dansky and Silverman (1973)	5	10 min.	10
Sylva et al. (1976) Study 1	4.5	10 min.	10
Smith and Dutton (1979)	4.36	8 min.	8
Dansky (1980b)	4.7	10 min.	10
Barnett (1985)	4.64	15 min.	15
Howard-Jones et al. (2002)	7	25 min.	25
Vandenberg (1981)	7.5	10 min.	10
Pepler and Ross (1981) Study 2	4	3 x 10 min., over 5 days	30
Simon and Smith (1985)	4.4	8 min.	8
Guided Play (Serious Play)			
Schmidt et al. (1975)	6	Twice weekly, 30 min., for 8 weeks	480
Li (1978)	5.5	10 min.	10
Berretta and Privette (1990)	9.58	40 min.	40
Garaigordobil (2006)	11	Weekly, 2 hours, for 40 weeks, over ac. year	4800
Hui and Lau (2006) Grades 1 and 4	7, 10	Weekly, ~50 min., for 16 weeks	800
*Zabelina and Robinson (2010)	20.5	7 min.	7
Garaigordobil and Berrueco (2011)	6	Weekly, 75 min., for 40 weeks, over ac. year	3000
Chatoupis (2013)	7.98	4 times a week, 45 min., for 5 weeks	900
*West et al. (2017)	42	3 x 2.5 hours, over 5 weeks	450

Richard et al. (2018)	9.56	10 x 30 min., over 13 weeks	300
*Mourey (2020) Study 1	38.48	< 20 min.	< 20
*Felsman et al. (2020) Study 1	18.83	20 min.	20
*Richard et al. (2020)	25.36	Twice weekly, 30 min., for 5 weeks	300
Russ and Kaugars (2001)	7.5	5 min.	5
*Felsman et al. (2020) Study 2	18.92	20 min.	20
Underpowered Free Play			
Dansky and Silverman (1975)	4.8	10 min.	10
Pepler and Ross (1981) Study 1	4	3 x 10 min., over 5 days	30
Pellegrini and Greene (1980)	4.23	10 min.	10
Pellegrini (1981)	4.38	10 min.	10
*Campion and Levita (2014)	20.4	5 min.	5
Simon and Smith (1983)	4.28	8 min.	8
Smith et al. (1985)	4.08	8 min.	8
Guided Play (Serious Play)			
Rosen (1974)	6	Weekly, 40 min., for 10 weeks	400
Dansky (1980a)	5.04	Thrice weekly, 30 min., for 3 weeks	270
Udwin (1983)	4.67	10 x 30 min., over 5 weeks	300
Li (1985)	4	Weekly, 20 min., for 8 weeks	160
Shmukler and Naveh (1985)	4.7	8 x at least 20 min.	> 160
Cleland (1994)	8.29	Weekly, 45 min., for 20 weeks, over 6 mths	900
Wyver and Spence (1999) Study 3	4.71	Twice weekly, 30 min., for 4 weeks	240
*Karwowski and Soszynski (2008)	21.9	8 hours/ weekly, 2 hours, for 4 weeks	480
*Karakelle (2009)	24.5	Weekly, 3 hours, for 10 weeks	1800
Koutsoupidou and Hargreaves (2009)	6	Weekly, ~50 min., for 6 mths	1300
*Kirsten and Du Preez (2010)	> 18	> 40 min.	> 40
*Tsai (2012)	38	20 min.	20
*Lewis and Lovatt (2013) Study 1	22	20 min.	20
*Lewis and Lovatt (2013) Study 2	32	20 min	20
Sowden et al. (2015) Study 1	9	10 min.	10
Sowden et al. (2015) Study 2	11	10 min.	10
*Dyson et al. (2016)	20.64	4 x 3 hours, weekly, over 5 weeks	720
Pirrone et al. (2018)	6	Weekly, 2 hours, for 40 weeks, over ac. year	4800
*Mourey (2020) Study 2	20.68	Weekly, > 20 min, for 10 weeks	> 200
Feitelson and Ross (1973)	5.6	10 x 30 min., over 5 weeks	300
Hainselin et al. (2018)	11.57	Weekly, 1 hour, for 11 weeks	660
Smith and Whitney (1987)	4.25	10 min.	10
Moore and Russ (2008)	7.5	5 x 30 min., over 3-5 weeks	150
Fehr and Russ (2016)	4.71	3 x 20-30 min.	60-90
Hoffmann and Russ (2016)	7	Twice weekly, 30 min., for 3 weeks	180
Smith and Syddall (1978)	4	Thrice weekly, 40 min., for 5 weeks	600
Smith et al. (1981) Schools A and B	4.13	Daily, 40 min., for 8 weeks	1600
Christie (1983)	5	Weekly, 20 min., for 9 weeks	180

Table 1.6. The Research Designs of the Experimental Studies (Continued)

Author(s)	Assign.	Pre Test	Post Test	Social	Asses.
Minimally Powered Free Play					
Dansky and Silverman (1973)	R	-	I	I	I
Sylva et al. (1976) Study 1	R, M	-	I	I	I
Smith and Dutton (1979)	U	-	I	I	I

Dansky (1980b)	R	-	I	G	I
Barnett (1985)	R	-	I	I	I
Howard-Jones et al. (2002)	R, S	-	I	G	I
Vandenberg (1981)	R, M	-	I	I	I
Pepler and Ross (1981) Study 2	R, M	-	I	I	I
Simon and Smith (1985)	R	-	I	I	I
Guided Play (Serious Play)					
Schmidt et al. (1975)	R	-	I	G	I
Li (1978)	R	-	I	I	I
Berretta and Privette (1990)	R	-	I	G	I
Garaigordobil (2006)	R	+	I	G	I
Hui and Lau (2006) Grades 1 and 4	R	+	I	G	I
*Zabelina and Robinson (2010)	R	-	I	I	I
Garaigordobil and Berrueco (2011)	R	+	I	G	I
Chatoupis (2013)	R	+	I	G	I
*West et al. (2017)	C	+	I	G	I, G
Richard et al. (2018)	R (a)	+	I	G	I
*Mourey (2020) Study 1	R	-	I	I	I
*Felsman et al. (2020) Study 1	R	+	I	G	I
*Richard et al. (2020)	R	+	I	G	I
Russ and Kaugars (2001)	R	-	I	I	I
*Felsman et al. (2020) Study 2	R	+	I	G	I
Underpowered					
Free Play					
Dansky and Silverman (1975)	R	-	I	I	I
Pepler and Ross (1981) Study 1	R, M	-	I	I	I
Pellegrini and Greene (1980)	R	-	I	I	I
Pellegrini (1981)	R	-	I	I	I
*Campion and Levita (2014)	R	+	I	I	I
Simon and Smith (1983)	R	-	I	I	I
Smith et al. (1985)	R	-	I	I	I
Guided Play (Serious Play)					
Rosen (1974)	C	-	I	G	G
Dansky (1980a)	R	-	I	G	I
Udwin (1983)	R	+	4 W	G	I
Li (1985)	M	+	I	G	I
Shmukler and Naveh (1985)	R	+	4 W	G	I
Cleland (1994)	R, M	+	I	G	I
Wyver and Spence (1999) Study 3	R	+	I	G	I
*Karwowski and Soszynski (2008)	U	+	I	G	I
*Karakelle (2009)	C, R	+	I	G	I
Koutsoupidou and Hargreaves (2009)	R (b)	+	I	G	I
*Kirsten and Du Preez (2010)	C, M	+	8 W	G	I
*Tsai (2012)	R (a)	-	I	I	I
*Lewis and Lovatt (2013) Study 1	R	+	I	G	I
*Lewis and Lovatt (2013) Study 2	R	+	I	I	I
Sowden et al. (2015) Study 1	R	-	I	G	I
Sowden et al. (2015) Study 2	R	+	I	G	I
*Dyson et al. (2016)	C, R	+	I	G	I
Pirrone et al. (2018)	R	+	I	G	I
*Mourey (2020) Study 2	C, R (a)	-	16 W	G	I
Feitelson and Ross (1973)	R	+	I	I	I
Hainselin et al. (2018)	U	+	I	G	I
Smith and Whitney (1987)	R	-	I, 1 W	I	I
Moore and Russ (2008)	R	-	8-32 W	I	I
Fehr and Russ (2016)	R	+	I	I	I

Author(s)	Rater Hypotheses/Group	Facilitator Hypotheses	Facilitator Fidelity

Hoffmann and Russ (2016)	R, M	+	I	G	I
Smith and Syddall (1978)	M	+	I	G	I
Smith et al. (1981) Schools A and B	R (a)	+	I, 8 W	G	I
Christie (1983)	R	+	I, 12 W	G	I

Table 1.6. The Research Designs of the Experimental Studies (Continued)

Author(s)	Rater Hypotheses/Group	Facilitator Hypotheses	Facilitator Fidelity
Minimally Powered			
Free Play			
Dansky and Silverman (1973)	NA	NA	NA
Sylva et al. (1976) Study 1	NA	NA	NA
Smith and Dutton (1979)	NA	NA	NA
Dansky (1980b)	NA	NA	NA
Barnett (1985)	NA	NA	NA
Howard-Jones et al. (2002)	NA/+	NA	NA
Vandenberg (1981)	NA	NA	NA
Pepler and Ross (1981) Study 2	NA/+	NA	NA
Simon and Smith (1985)	NA/+	+	+
Guided Play (Serious Play)			
Schmidt et al. (1975)	NA/+	NA	NA
Li (1978)	NA	NA	NA
Berretta and Privette (1990)	NA/+	NA	NA
Garaigordobil (2006)	+/+	NA	+
Hui and Lau (2006) Grades 1 and 4	NA	NA	NA
*Zabelina and Robinson (2010)	NA/+	NA	NA
Garaigordobil and Berrueco (2011)	NA	NA	+
Chatoupis (2013)	NA	NA	+
*West et al. (2017)	NA	NA	NA
Richard et al. (2018)	NA	-	+
*Mourey (2020) Study 1	NA	NA	NA
*Felsman et al. (2020) Study 1	+/+	NA	NA
*Richard et al. (2020)	NA	NA	NA
Russ and Kaugars (2001)	NA/+	NA	NA
*Felsman et al. (2020) Study 2	+/+	NA	NA
Underpowered			
Free Play			
Dansky and Silverman (1975)	NA	NA	NA
Pepler and Ross (1981) Study 1	NA	NA	NA
Pellegrini and Greene (1980)	-/NA	NA	NA
Pellegrini (1981)	+/NA	NA	NA
*Campion and Levita (2014)	NA	NA	NA
Simon and Smith (1983)	NA/+	-	NA
Smith et al. (1985)	NA/+	-	NA
Guided Play (Serious Play)			
Rosen (1974)	+/+	NA	NA
Dansky (1980a)	NA/+	+	NA
Udwin (1983)	+/+	-	NA
Li (1985)	NA/+	NA	NA
Shmukler and Naveh (1985)	+/+	NA	+
Cleland (1994)	NA/+	NA	+
Wyver and Spence (1999) Study 3	NA	NA	NA
*Karwowski and Soszynski (2008)	NA	NA	NA
*Karakelle (2009)	NA	-	NA

Koutsoupidou and Hargreaves (2009)	NA	NA	+
*Kirsten and Du Preez (2010)	NA	NA	NA
*Tsai (2012)	NA	NA	NA
*Lewis and Lovatt (2013) Study 1	NA/+	NA	NA
*Lewis and Lovatt (2013) Study 2	NA/+	NA	NA
Sowden et al. (2015) Study 1	NA	NA	NA
Sowden et al. (2015) Study 2	NA	NA	NA
*Dyson et al. (2016)	NA	NA	NA
Pirrone et al. (2018)	NA	NA	NA
*Mourey (2020) Study 2	NA	+	NA
Feitelson and Ross (1973)	NA	NA	NA
Hainselin et al. (2018)	NA	NA	NA
Smith and Whitney (1987)	+/+	NA	NA
Moore and Russ (2008)	NA/+	NA	NA
Fehr and Russ (2016)	NA/+	-	+
Hoffmann and Russ (2016)	+/+	NA	+
Smith and Syddall (1978)	NA	+	+
Smith et al. (1981) Schools A and B	NA/+	NA	+
Christie (1983)	NA	NA	+

- Notes under Author(s): * = Adult participants.
- Notes under Assign. (assignment to condition groups): R = Random | M = Match | S = Switch | C = Convenience | U = Unclear or Unspecified | (a) = Randomisation was conducted at the class/school level and not at the individual level.
- Notes under Pre Test: - = Pre-test not conducted | + = Pre-test conducted.
- Notes under Post Test: I = For interventions with 1 session, immediately. For interventions with multiple sessions, less than 4 weeks after the intervention | # W = # weeks later.
- Notes under Social (social content): I = Individual (Solitary) Play | G = Group Play.
- Notes under Asses. (assessment level): I = Assessed individually | G = Assessed in groups.
- Notes under Rater Hypotheses/Group (rater blindness to hypotheses/condition groups): - = Not blind | + = Blind | NA = Information not available.
- Notes under Facilitator Hypotheses (facilitator blind to hypotheses): - = Not blind | + = Blind | NA = Information not available.
- Notes under Facilitator Fidelity (facilitator fidelity assessed/monitored): - = Not assessed/monitored | + = Assessed/monitored | NA = Information not available.

1.7.3. Section C – Mapping of the Experimental Studies

Table 1.7. The Mapping of Dependent Variables, Play Design Characteristics, and Results of the Experimental Studies

Variable	Free Play	
	Short	Long
Verbal Divergent Thinking (VDT)		
AUT: Stereotypic fluency	(I) (FPO) Dansky and Silverman (1973) **(I) (FPO) Dansky and Silverman (1975)** (I) (FPO) Pellegrini and Greene (1980) (I) (FPO) Pellegrini (1981) (I) (FPO) Li (1978) (I) (FPO) Smith and Whitney (1987)	
AUT: Fluency	**(G) (FPO) Dansky (1980b)** (I) (FPO) Russ and Kaugars (2001) (I) (FPO) Pepler and Ross (1981) Study 2 (I) (PP) *Campion and Levita (2014)	(G) (FPO) Dansky (1980a) (G) (FPO) Udwin (1983)
TTCT: Fluency IT: Fluency SMT: Fluency	**(I) (FPO) Pepler and Ross (1981) Study 1** (I) (FPO) Pepler and Ross (1981) Study 2	
VT: Fluency MSFM: Fluency RCAB: Fluency	**(I) (FPO) Pepler and Ross (1981) Study 1**	
AUT: Originality	**(I) (FPO) Dansky and Silverman (1973)** **(I) (FPO) Dansky and Silverman (1975)** (I) (FPO) Pellegrini and Greene (1980) (I) (FPO) Pellegrini (1981) (I) (FPO) Russ and Kaugars (2001) **(I) (FPO) Li (1978)** (I) (FPO) Smith and Whitney (1987) (I) (FPO) Pepler and Ross (1981) Study 2	(G) (FPO) Udwin (1983)
TTCT: Originality IT: Originality SMT: Originality	**(I) (FPO) Pepler and Ross (1981) Study 1** (I) (FPO) Pepler and Ross (1981) Study 2	
VT: Originality MSFM: Originality RCAB: Originality	(I) (FPO) Pepler and Ross (1981) Study 1	
AUT: Flexibility TTCT: Flexibility RCAB: Flexibility	(I) (FPO) Russ and Kaugars (2001)	(G) (FPO) Udwin (1983)
AUT: Elaboration		
Figural Divergent Thinking (FDT)		
TTCT: Fluency MOT: Fluency TCI: Fluency TCP: Fluency RCAB: Fluency CLT: Fluency	(I) (PP) *Campion and Levita (2014)	(I) (FPO) Feitelson and Ross (1973)
TTCT: Originality		
TCI: Originality TCP: Originality Painting: Originality IFT: Originality RCAB: Originality CLT: Originality	(I) (PP) *Campion and Levita (2014)	(I) (FPO) Feitelson and Ross (1973)
TCP: Flexibility RCAB: Flexibility		(I) (FPO) Feitelson and Ross (1973)
TTCT: Elaboration		

IFT: Elaboration		
CLT: Elaboration	(I) (PP) *Campion and Levita (2014)	
TTCT: Abstractness of title		
IFT: Abstractness of title		
TTCT: Resistance to premature closure		
Painting: Completion time		
Collage: Number of different colours used	**(G) (CP) Howard-Jones et al. (2002)**	
Collage: Number of paper tissues used	(G) (CP) Howard-Jones et al. (2002)	
TCI: Transformativeness		

Action and Movement Divergent Thinking (AMDT)

TCAM: Fluency	
ALT: Fluency	
MCT: Fluency	
DMA: Fluency	

TCAM: Originality	
ALT: Originality	
MCT: Originality	
ALT: Flexibility	
MCT: Flexibility	
TCAM: Imagination	

Musical Divergent Thinking (MDT)

MCTM-II: Extensiveness
MCTM-II: Flexibility
MCTM-II: Originality
MCTM-II: Syntax
MCTM-II: Overall

Overall Divergent Thinking (ODT)

TTCT: Overall
ATTA: Overall
TCPe: Overall
TTCT: Overall fluency
ATTA: Overall fluency
CD/AUT: Overall fluency
PMT/LMT/AUT/IT: Overall fluency
WKCT: Overall fluency
TTCT: Overall originality
ATTA: Overall originality
(CAT) Generated toy: Overall originality
TTCT: Overall flexibility
ATTA: Overall flexibility
CD/AUT: Overall flexibility
ATTA: Overall elaboration

Verbal Creativity (VC)

Storytelling: Creativity	
Storytelling: Fluency	(G) (FPO) Udwin (1983)
Storytelling: Originality	
Storytelling: Imaginativeness	(G) (FPO) Udwin (1983)
IT: Creativity	

Figural Creativity (FC)

(CAT) Collage: Creativity	**(G) (CP) Howard-Jones et al. (2002)**

Overall Creativity (OC)

TCT-DP
(DCOG) Generated ideas (groups)
(CAT) Generated toy

Climate for Innovation

TCI: Overall	
TCI: Participative safety	
TCI: Vision	
TCI: Support for innovation	
TCI: Task orientation	

Creative Problem-solving (CP-S)

Completion time	**(I) (FPO) Smith and Dutton (1979)**	
	(I) (FPO) Simon and Smith (1983)	
	(I) (FPO) Simon and Smith (1985)	
	(I) (FPO) Smith et al. (1985)	
	(I) (FPO) Barnett (1985)	
Number of spontaneous solvers	**(I) (FPO) Sylva et al. (1976) Study 1**	
	(I) (FPO) Vandenberg (1981)	
	(I) (FPO) Simon and Smith (1985)	
	(I) (FPO) Barnett (1985)	
Number of hints needed	**(I) (FPO) Sylva et al. (1976) Study 1**	
	(I) (FPO) Smith and Dutton (1979)	
	(I) (FPO) Simon and Smith (1985)	
	(I) (FPO) Smith et al. (1985)	
Level of hints needed	*(I) (FPO) Simon and Smith (1983)*	
	(I) (FPO) Simon and Smith (1985)	
	(I) (FPO) Smith et al. (1985)	
Goal-directed acts	**(I) (FPO) Sylva et al. (1976) Study 1**	
	(I) (FPO) Vandenberg (1981)	
Hint score	*(I) (FPO) Vandenberg (1981)*	
Number of partial solvers	**(I) (FPO) Barnett (1985)**	
Latency to start problem-solving	**(I) (FPO) Barnett (1985)**	
Percentage of time receiving assistance	**(I) (FPO) Barnett (1985)**	
MCB: Number of successes (groups)		
DBT: Number of successes		(I) (FPO) Feitelson and Ross (1973)

Creative Behaviour (CB)

SCBPT: Teachers	
SCBPT: Parents	

Imaginativeness

P-STE		(G) (FPO) Dansky (1980a)
SRE		(G) (FPO) Dansky (1980a)
CATB-CBF		(G) (FPO) Dansky (1980a)

Table 1.7. The Mapping of Dependent Variables, Play Design Characteristics, and Results of the Experimental Studies (Continued)

	Guided Play (Serious Play)	
Variable	Short	Long
Verbal Divergent Thinking (VDT)		
AUT: Stereotypic fluency	(I) (SP) Li (1978)	(G) (TP) Li (1985)
	(I) (SP) Smith and Whitney (1987)	(G) (TP) Hainselin et al. (2018)
AUT: Fluency	(I) (SP) Russ and Kaugars (2001)	**(G) (SP) Dansky (1980a)**
	(G) (TP) *Lewis and Lovatt (2013) Study 1	**(G) (TP) Udwin (1983)**
	(I) (MP) *Lewis and Lovatt (2013) Study 2	**(G) (TP) Shmukler and Naveh (1985)**
	(G) (TP) *Felsman et al. (2020) Study 1	(G) (TP) Hoffmann and Russ (2016)
	(G) (TP) *Felsman et al. (2020) Study 2	(G) (TP) Hainselin et al. (2018)
	(I) (OCP) *Mourey (2020) Study 1	**(G) (TP) *Mourey (2020) Study 2**
	(I) (SP/TP) Moore and Russ (2008)	
TTCT: Fluency		(G) (TP) Garaigordobil (2006)
		(G) (TP) Garaigordobil and Berrueco (2011)
IT: Fluency	(G) (PP) Sowden et al. (2015) Study 1	**(G) (SP) Wyver and Spence (1999) Study 3**

		(G) (TP) Wyver and Spence (1999) Study 3
SMT: Fluency		
VT: Fluency		
MSFM: Fluency	(I) (TP) Fehr and Russ (2016)	
RCAB: Fluency		(G) (PP) *Richard et al. (2020)
		(G) (PP) Richard et al. (2018)
AUT: Originality	**(I) (SP) Li (1978)**	**(G) (TP) Udwin (1983)**
	(I) (SP) Smith and Whitney (1987)	**(G) (TP) Li (1985)**
	(I) (SP) Russ and Kaugars (2001)	**(G) (TP) Shmukler and Naveh (1985)**
	(G) (TP) *Lewis and Lovatt (2013) Study 1	(G) (TP) Hoffmann and Russ (2016)
	(I) (MP) *Lewis and Lovatt (2013) Study 2	**(G) (TP) Hainselin et al. (2018)**
	(G) (TP) *Felsman et al. (2020) Study 1	
	(G) (TP) *Felsman et al. (2020) Study 2	
	(I) (SP/TP) Moore and Russ (2008)	
TTCT: Originality		**(G) (TP) Garaigordobil (2006)**
		(G) (TP) Garaigordobil and Berrueco (2011)
IT: Originality	**(G) (PP) Sowden et al. (2015) Study 1**	
SMT: Originality		
VT: Originality		
MSFM: Originality	(I) (TP) Fehr and Russ (2016)	
RCAB: Originality		(G) (PP) *Richard et al. (2020)
		(G) (PP) Richard et al. (2018)
AUT: Flexibility	(I) (SP) Russ and Kaugars (2001)	**(G) (TP) Udwin (1983)**
	(G) (TP) *Lewis and Lovatt (2013) Study 1	**(G) (TP) Shmukler and Naveh (1985)**
	(I) (MP) *Lewis and Lovatt (2013) Study 2	**(G) (TP) Hainselin et al. (2018)**
	(G) (TP) *Felsman et al. (2020) Study 1	
	(G) (TP) *Felsman et al. (2020) Study 2	
	(I) (SP/TP) Moore and Russ (2008)	
TTCT: Flexibility		(G) (TP) Garaigordobil (2006)
		(G) (TP) Garaigordobil and Berrueco (2011)
RCAB: Flexibility		(G) (PP) *Richard et al. (2020)
		(G) (PP) Richard et al. (2018)
AUT: Elaboration	(G) (TP) *Lewis and Lovatt (2013) Study 1	(G) (TP) Hainselin et al. (2018)
	(I) (MP) *Lewis and Lovatt (2013) Study 2	
	(G) (TP) *Felsman et al. (2020) Study 1	
	(G) (TP) *Felsman et al. (2020) Study 2	

Figural Divergent Thinking (FDT)

TTCT: Fluency		(G) (TP) Garaigordobil (2006)
		(G) (TP) Garaigordobil and Berrueco (2011)
MOT: Fluency		**(G) (SP) Wyver and Spence (1999) Study 3**
		(G) (TP) Wyver and Spence (1999) Study 3
TCI: Fluency		**(G) (TP) *Karwowski and Soszynski (2008)**
TCP: Fluency		(I) (TP) Feitelson and Ross (1973)
RCAB: Fluency		(G) (PP) *Richard et al. (2020)
CLT: Fluency		
TTCT: Originality		**(G) (TP) Garaigordobil (2006)**
		(G) (TP) Garaigordobil and Berrueco (2011)
TCI: Originality		**(G) (TP) *Karwowski and Soszynski (2008)**
TCP: Originality		**(I) (TP) Feitelson and Ross (1973)**
Painting: Originality		**(G) (TP) Garaigordobil (2006)**
IFT: Originality	**(G) (TP) Sowden et al. (2015) Study 2**	
RCAB: Originality		**(G) (PP) *Richard et al. (2020)**
CLT: Originality		
TCP: Flexibility		(I) (TP) Feitelson and Ross (1973)
RCAB: Flexibility		(G) (PP) *Richard et al. (2020)
TTCT: Elaboration		**(G) (TP) Garaigordobil (2006)**
		(G) (TP) Garaigordobil and Berrueco (2011)
IFT: Elaboration	**(G) (TP) Sowden et al. (2015) Study 2**	
CLT: Elaboration		
TTCT: Abstractness of title		(G) (TP) Garaigordobil (2006)
IFT: Abstractness of title	(G) (TP) Sowden et al. (2015) Study 2	
TTCT: Resistance to premature closure		**(G) (TP) Garaigordobil (2006)**
		(G) (TP) Garaigordobil and Berrueco (2011)
Painting: Completion time		**(G) (TP) Garaigordobil (2006)**
Collage: Number of different colours used		
Collage: Number of paper tissues used		

TCI: Transformativeness		(G) (TP) *Karwowski and Soszynski (2008)

Action and Movement Divergent Thinking (AMDT)

TCAM: Fluency		*(G) (TP) Christie (1983)*
ALT: Fluency		**(G) (PP) *Richard et al. (2020)**
MCT: Fluency		**(G) (PP) Richard et al. (2018)**
DMA: Fluency		**(G) (PP) Chatoupis (2013)**
		(G) (PP) Cleland (1994)
TCAM: Originality		(G) (TP) Christie (1983)
ALT: Originality		(G) (PP) *Richard et al. (2020)
MCT: Originality		(G) (PP) Richard et al. (2018)
ALT: Flexibility		**(G) (PP) *Richard et al. (2020)**
MCT: Flexibility		**(G) (PP) Richard et al. (2018)**
TCAM: Imagination		(G) (TP) Christie (1983)

Musical Divergent Thinking (MDT)

MCTM-II: Extensiveness		(G) (MP) Koutsoupidou and Hargreaves (2009)
MCTM-II: Flexibility		**(G) (MP) Koutsoupidou and Hargreaves (2009)**
MCTM-II: Originality		**(G) (MP) Koutsoupidou and Hargreaves (2009)**
MCTM-II: Syntax		**(G) (MP) Koutsoupidou and Hargreaves (2009)**
MCTM-II: Overall		**(G) (MP) Koutsoupidou and Hargreaves (2009)**

Overall Divergent Thinking (ODT)

TTCT: Overall	**(G) (CP/TP/PP) Berretta and Privette (1990)**	
ATTA: Overall		**(G) (TP) *Dyson et al. (2016)**
TCPe: Overall		**(G) (CP) Pirrone et al. (2018)**
TTCT: Overall fluency	(G) (CP/TP/PP) Berretta and Privette (1990)	
ATTA: Overall fluency	(I) (SP) *Zabelina and Robinson (2010)	(G) (TP) *Dyson et al. (2016)
CD/AUT: Overall fluency		**(G) (TP) *Karakelle (2009)**
PMT/LMT/AUT/IT: Overall fluency		**(G) (TP) Schmidt et al. (1975)**
WKCT: Overall fluency		**(G) (TP) Hui and Lau (2006) Grades 1 and 4**
TTCT: Overall originality	**(G) (CP/TP/PP) Berretta and Privette (1990)**	
ATTA: Overall originality	**(I) (SP) *Zabelina and Robinson (2010)**	(G) (TP) *Dyson et al. (2016)
(CAT) Generated toy: Overall originality	**(G) (PP) Sowden et al. (2015) Study 1**	
TTCT: Overall flexibility	(G) (CP/TP/PP) Berretta and Privette (1990)	
ATTA: Overall flexibility		(G) (TP) *Dyson et al. (2016)
CD/AUT: Overall flexibility		**(G) (TP) *Karakelle (2009)**
ATTA: Overall elaboration		(G) (TP) *Dyson et al. (2016)

Verbal Creativity (VC)

Storytelling: Creativity	(I) (TP) Fehr and Russ (2016)	(G) (TP) Hoffmann and Russ (2016)
		(G) (TP) Hui and Lau (2006) Grades 1 and 4
Storytelling: Fluency	(I) (CP) *Tsai (2012)	**(G) (TP) Udwin (1983)**
Storytelling: Originality	**(I) (CP) *Tsai (2012)**	
Storytelling: Imaginativeness		**(G) (TP) Udwin (1983)**
		(G) (TP) Shmukler and Naveh (1985)
IT: Creativity	**(G) (PP) Sowden et al. (2015) Study 1**	

Variable(s)	
Figural Creativity (FC)	
(CAT) Collage: Creativity	
Overall Creativity (OC)	
TCT-DP	(G) (TP) Hui and Lau (2006) Grades 1 and 4 **(G) (TP) *Karwowski and Soszynski (2008)** **(G) (TP) *West et al. (2017)**
(DCOG) Generated ideas (groups)	**(G) (TP) *West et al. (2017)**
(CAT) Generated toy **(G) (PP) Sowden et al. (2015) Study 1**	
Climate for Innovation	
TCI: Overall	**(G) (TP) *Kirsten and Du Preez (2010)**
TCI: Participative safety	**(G) (TP) *Kirsten and Du Preez (2010)**
TCI: Vision	**(G) (TP) *Kirsten and Du Preez (2010)**
TCI: Support for innovation	(G) (TP) *Kirsten and Du Preez (2010)
TCI: Task orientation	**(G) (TP) *Kirsten and Du Preez (2010)**
Creative Problem-solving (CP-S)	
Completion time	
Number of spontaneous solvers	
Number of hints needed	
Level of hints needed	
Goal-directed acts	
Hint score	
Number of partial solvers	
Latency to start problem-solving	
Percentage of time receiving assistance	
MCB: Number of successes (groups)	**(I,G) (TP) Rosen (1974)**
DBT: Number of successes	(I) (TP) Feitelson and Ross (1973) *(G) (TP) Smith and Syddall (1978)* *(G) (TP) Smith et al. (1981) Schools A and B*
Creative Behaviour (CB)	
SCBPT: Teachers	**(G) (TP) Garaigordobil and Berrueco (2011)**
SCBPT: Parents	(G) (TP) Garaigordobil and Berrueco (2011)
Imaginativeness	
P-STE	**(G) (SP) Dansky (1980a)**
SRE	**(G) (SP) Dansky (1980a)**
CATB-CBF	**(G) (SP) Dansky (1980a)**

- Notes under Variable(s): Acronyms represent the measures used. The full names of the measures can be found in Section D of the supplementary materials.
- Notes under Free / Guided Play (Serious Play): * = Adult participants | I = Individual (Solitary) Play | G = Group Play | FPO = Free Play with Objects | PP = Physical Play | CP = Constructive Play | OCP = Object/concept-dependent play| SP = Sociodramatic Play | TP = Thematic Play | MP = Music Play | Studies highlighted in bold found positive results | Studies in italics found that play interventions were at least as effective as other training or that play interventions were effective for some age groups but not for others.

1.7.4. Section D – Measures Used in the Experimental Studies

Table 1.8. The Abbreviations and Full Names of the Measures Used in the Experimental Studies

ATTA	Abbreviated Torrance Test for Adults
AUT	Alternate Uses Test
CAT	Consensual Assessment Technique
CATB-CBF	Cincinnati Autonomy Test Batter - Curiosity box fantasy
CD	Circle Drawing
CLT	Circles and Lines Test
DBT	Dog and Bone Test
DCOG	Distributed Creativity in Organizational Groups
IFT	Incomplete Figures Task
IT	Instances Test
LMT	Line Meaning Test
MCB	Madsen Cooperation Board
MCTM-II	Measure of Creative Thinking in Music II
MOT	Making Objects Test
MSFM	Multidimensional Stimulus Fluency Measure
P-STE	Picture-Story Transcending Elements
PMT	Patter Meaning Test
SCBPT	Scale of Creative Behaviours and Personality Traits
SMT	Structure Meaning Task
SRE	Story Recall Extension
TCAM	Thinking Creatively in Action and Movement
TCPe	Test of Creative Personality
TCP	Thinking Creatively with Pictures
TCT-DP	Test for Creative Thinking – Drawing Production
TTCT	Torrance Tests of Creative Thinking
VT	Village Task
WKCT	Wallach-Kogan Creativity Tests (Pattern Meaning Test, Line Meaning Test, Similarities Test, Alternate Uses Test, Instances Test)

Essay 2

How Play Can Stimulate Organisational Creativity: Exploring a Possible Mechanism

2.1. Introduction

It is Friday afternoon. You leave your desk to join your team in the meeting room for another of your weekly role-playing sessions. In these role-playing sessions, you and your team play a group of novice treasure hunters brought together by the prestigious Treasure Hunters Association to seek seven mysterious gemstones scattered in dangerous caves around the world. Your reward? Higher status in the association, which comes with numerous perks. All you need to do is work together to find and return the requested gemstones. Your magical items and abilities will certainly help you in this adventure. These role-playing sessions began three months ago at the request of your manager. Their goal is to improve your creativity at work.

In the business environment, creativity – the generation of novel and useful ideas (solutions) that solve an open-ended problem (Amabile, 1988; Sawyer, 2012) – is becoming all the more important for organisational competitiveness and viability (Anderson et al., 2014; Harari et al., 2016; Ligon et al., 2012; Madden, 2017). With this realisation in mind, management scholars are exploring a number of possible ways to stimulate creativity in the workplace. In this context, an increasing number of researchers and prominent organisations are discussing the positive effects of play on individual, team, and organisational creativity (Hunter et al., 2010; Kirsten & Du Preez, 2010; Mainemelis & Ronson, 2006; Nisula & Kianto, 2018; West, 2014; West et al., 2017). At the same time, management scholars are applying and extending theories originating in the developmental psychology literature (see Dansky, 1999;

Mellou, 1994, 1995; Russ & Wallace, 2013, 2017; Saracho, 2017) to explain how playing at work could stimulate creativity in the workplace. For example, extending the proposition that play can promote divergent thinking in children – a proposition put forth in the developmental psychology literature (Dansky, 1999) – Mainemelis and Ronson (2006) propose that play can promote creativity at work by fostering divergent thinking in employees.

Divergent thinking involves a set of cognitive abilities that are important to creativity (Russ, 2018), including ideational fluency – the ability to generate solutions, ideational originality – the ability to generate non-stereotypical (original) solutions, and ideational flexibility – the ability to generate solutions that belong to distinct categories (Runco, 2011). Under conditions favourable to creativity, improvements in individual divergent thinking abilities can lead to improvements in individual creativity (Scott, Leritz & Mumford, 2004). In the business environment – where individual and team creativity are the source of organisational creativity and innovation (Amabile, Conti, Coon, Lazenby & Herron, 1996; Puccio & Cabra, 2010) – such improvements in individual creativity could lead to improvements in organisational creativity and, ultimately, to improvements in organisational competitiveness and viability.

While many mechanisms explaining how play can promote creativity have been proposed in the developmental psychology literature and the management literature, most of these mechanisms have not been clearly communicated (Petelczyc et al., 2018; Russ & Wallace, 2013). In addition, robust research connecting the design characteristics of play (e.g., dosage, materials, content), the mechanisms by which play can promote creativity, and the creativity-related outcomes of play is currently lacking. This lack of robust research around play design characteristics, mechanisms, and outcomes forces business leaders and consultants interested in designing play activities that stimulate organisational creativity to rely on a limited number of successful play interventions reported in the literature. A major limitation of this approach is that these interventions are so different in their play design characteristics that relying on them to design and introduce play activities as part of work or as part of training and development can be challenging. It might also be unsound, considering that different play design characteristics will likely trigger different mechanisms and, thus, facilitate different effects.

To address this limitation and help develop robust research linking play design characteristics, mechanisms, and outcomes, we focus on play as an activity and discuss in greater detail one of the possible mechanisms behind the play-creativity relationship. We begin by reviewing the theories that explain how play can stimulate creativity. Then, we draw from the theory of associative hierarchies – a theory located in the creativity literature (Mednick, 1962) – and build on the idea that, during play, individuals form associations between remote concepts they engage with – an idea put forth in the developmental psychology literature (Dansky & Silverman, 1973) – to describe one of the possible mechanisms by which play can promote ideational fluency, originality, and flexibility. Subsequently, we develop propositions based on the mechanism we describe and provide directions for how to examine these propositions in future research. We also consider how five important play design characteristics (Dansky, 1999; Mellou, 1995; Wyver & Spence, 1999) might facilitate the mechanism we describe and provide recommendations for how to explore these considerations in future research. Finally, we discuss the implications and limitations of this work.

2.2. Literature Review

For the most part, work on play in childhood, adulthood, and the workplace sees play as an activity that is absorbing and enjoyable (Dansky, 1999; Petelczyc et al., 2018; Russ & Wallace, 2017; Van Vleet & Feeney, 2015) (for a discussion of play at work as a behavioural orientation see Mainemelis and Ronson (2006) and West, Hoff, and Carlsson (2016)). In the workplace, it is often voluntary (Petelczyc et al., 2018) but it can also be carried out at the request of the organisation (e.g., serious play (Kristiansen & Rasmussen, 2014; Statler et al., 2011)). Furthermore, it is usually carried out purely for enjoyment (Petelczyc et al., 2018) but it can also be carried out to primarily and directly achieve a business objective (e.g., serious play for strategy development (Kristiansen & Rasmussen, 2014)).

According to scholars of play and creativity in the developmental psychology and management literatures, play that can stimulate creativity has three additional characteristics. First, it involves exploring ideas, objects, or the environment and combining ideas, past experiences, concepts, actions, objects, and behaviours in new ways (i.e., imagination) (Dansky, 1999; Mainemelis & Ronson, 2006; Vygotsky,

2004; West, 2014). It can be organised into physical exploration (i.e., exploring objects or the environment), physical play (i.e., moving around and interacting with large toys or dancing), constructive play (i.e., constructing something), object/concept-dependent play (i.e., engaging in pretend play with a heavy reliance on objects/concepts), sociodramatic play (i.e., enacting situations from everyday life in pretend play, such as going to the park), and thematic play (i.e., enacting situations remote from everyday life in pretend play, such as flying a spaceship) (Wyver & Spence, 1999).

Second, it begins when those who want to engage in it agree on a baseline scenario (e.g., "I will build a sandcastle", "We will pretend to be two astronauts landing on Mars", "We will pretend to be a couple shopping at the grocery store") and continues as the participants improvise situations without aiming for fixed means (paths) and ends (goals) (Bruner, 1983; Feitelson & Ross, 1973; Mainemelis & Ronson, 2006; Russ & Wallace, 2017). Because of this flexibility in means and ends, play differs from activities characterised by rigid means and ends, such as sports and games (Feitelson & Ross, 1973).

And third, it is distinct from ordinary life and, thus, offers a safer environment for the participants to engage in exploration and imagination (Bruner, 1983; Mainemelis & Ronson, 2006). The environment is "safer" in the sense that the negative impact of many, but not all, actions, mistakes, and setbacks occurring in play is reduced (Bruner, 1983; Mainemelis & Ronson, 2006). For example, the consequences of a hospital failing an emergency response in play are not as harsh as the consequences of a hospital failing an actual emergency response.

The main argument of scholars of play and creativity has been that play with the characteristics we list above gives participants the opportunity to develop resources (e.g., knowledge, schemas, associations, abilities) and practise processes (e.g., imagination, idea evaluation) that they can later use to generate solutions after the play activity itself (e.g., in their work) (Dansky, 1999; Mainemelis & Ronson, 2006; Mellou, 1994, 1995; Nisula & Kianto, 2018; Russ & Wallace, 2013, 2017; Saracho, 2017; West, 2014). In terms of resources, it has been argued that, in play, participants obtain and organise knowledge about the objects they play with (Barnett, 1985; Piaget, 1999; Vandenberg, 1981); obtain knowledge by sharing ideas with others (Karakelle, 2009; Robson, 2017); obtain knowledge through imagination

(Bruner, 1972; Sutton-Smith, 1967; Vygotsky, 2004); develop abstract and symbolic thinking (Sutton-Smith, 1967; Vygotsky, 2004); form remote associations between objects, actions, and concepts they engage with (Dansky & Silverman, 1973; Sutton-Smith, 1967); create, access, and use affect-laden associations (Russ, 2003; Russ & Wallace, 2013); and develop mental flexibility, behavioural flexibility, and divergent thinking (Bruner, 1972; Mellou, 1995; Saracho, 2017; Sutton-Smith, 1967).

In terms of processes, it has been suggested that, in play, individuals exercise exploration, imagination, problem finding, conflict negotiation, idea sharing, and idea evaluation (Bruner, 1972; Dansky, 1999; Mellou, 1994, 1995; Robson, 2017; Russ & Wallace, 2017; Sutton-Smith, 1967; Vygotsky, 2004; West, 2014); and process, regulate, express, and experience emotions (Russ & Wallace, 2013, 2017). Finally, it has been proposed that play can stimulate creativity by improving the participants' emotions, feelings, mood, intrinsic motivation, and playfulness (i.e., predisposition to engage in play (Proyer & Ruch, 2011)) (Dansky, 1999; Howard-Jones et al., 2002; Mainemelis & Ronson, 2006; Nisula & Kianto, 2018; Sowden et al., 2015; West, 2014); by reducing stress and self-censure (Chatoupis, 2013; Sylva et al., 1976; Zabelina & Robinson, 2010); by allowing participants to psychologically adjust to their work (Mainemelis & Ronson, 2006); by increasing their willingness to engage in the creative process and share ideas with colleagues (Mainemelis & Ronson, 2006; West, 2014); and by fostering a climate for creativity (Kirsten & Du Preez, 2010; Nisula & Kianto, 2018).

The positive empirical findings around the effects of play in individuals, teams, and organisations (Dyson et al., 2016; Karakelle, 2009; Karwowski & Soszynski, 2008; Kirsten & Du Preez, 2010; Lewis & Lovatt, 2013; Nisula & Kianto, 2018; Silverman, 2016; West et al., 2017) suggest that play could be a viable option for business leaders interested in stimulating creativity in their organisations. However, while many possible mechanisms explaining how play can foster creativity have been proposed in the literature, most of these mechanisms have not been discussed in detail (Petelczyc et al., 2018; Russ & Wallace, 2013) and rigorous research linking play design characteristics, mechanisms, and outcomes is lacking. As a result, those interested in designing and implementing play to stimulate organisational creativity lack robust, evidence-based guidance. To address this limitation and pave the way for rigorous research in this area, we explore one of the possible mechanisms of the

72

relationship between play and three divergent thinking abilities important to creativity – ideational fluency, originality, and flexibility (Runco, 2011; Russ, 2018). We describe this possible mechanism next.

2.3. Theory Development

As part of their work in developmental psychology, Dansky and Silverman (1973) suggest that, during play, individuals form associations between otherwise unrelated/remote concepts they engage with. The argument is that the individuals can recall and use these new remote associations after the play activity itself to generate more solutions to open-ended problems. This improvement in their ability to generate more solutions is an improvement in their divergent thinking related to those specific concepts as well as in their divergent thinking more broadly. In their proposition, however, Dansky and Silverman (1973) do not clarify which divergent thinking abilities are promoted by the formation of new remote associations. They also do not elaborate on the mechanism by which these divergent thinking abilities are affected. To get an explanation as to how new remote associations formed during play could enhance divergent thinking we turn to the creativity literature and, specifically, to the theory of associative hierarchies (Mednick, 1962).

According to associative theories, people form pair-associations between two concepts when they engage with both concepts in the pair at the same time (Klein, 2019). Each pair-association has its own association strength, which typically increases as the simultaneous engagement with the two concepts increases. For example, one might possess a very strong association between the concepts "table" and "chair" because they regularly use a chair to sit at the table and a weak association between the concepts "table" and "tennis" because they occasionally play table tennis. Mednick (1962) explains that the association strength between two concepts, say "table" and "chair", affects (a) the probability of recalling and, thus, using the concept "chair" when given the concept "table" as a stimulus (and vice versa) and (b) the speed of recalling and, thus, using the concept "chair" when given the concept "table" as a stimulus (and vice versa). Specifically, the weaker the association strength between the two concepts, the lower the likelihood of recalling and, therefore, using one concept when given the other as a stimulus.

With regard to the speed of use, having multiple pair-associations (e.g., "table-shoe", "table-floor", "table-window") that share the same base concept (in this example, "table") and also have similar association strengths with the base concept makes the recall and, thus, the use of a concept slower. This is because, when given a concept as a stimulus (e.g., "table"), the concepts that share associations with that concept and have similar association strengths with it (in this example, "shoe", "floor", "window") enter into a cognitive competition of selecting one of those concepts. Because of this competition, more time is needed for the recall, selection, and, use of a concept in response to the stimulus (Olczak & Kaplan, 1969: 158).

When contrasted with each other within a population, associations are characterised by the perceived distance between the two concepts they involve (i.e., their remoteness). One association involves concepts that are very closely related (e.g., "table-chair"), another involves concepts that are less related (e.g., "table-cloth"), another involves concepts that are even less related (e.g., "table-leg"), and so on. Associations involving concepts that are considered very related are labelled *stereotypical*. The greater the perceived distance between two concepts in an association, the less stereotypical the association is. Associations involving concepts that are considered unrelated (e.g., "table-sky") are labelled *non-stereotypical* or *remote* (Mednick, 1962). To link this back to association strength, more stereotypical associations are expected to have a higher association strength than less stereotypical ones (Mednick, 1962).

The theory of associative hierarchies proposes that each individual possesses an associative hierarchy for each concept they know that consists of all their associations that contain that concept (Mednick, 1962). This hierarchy can be steep or flat. A steep associative hierarchy on a concept is characterised by a few strong very stereotypical associations and other weak less stereotypical associations. If we were to order the pair-associations of a steep associative hierarchy from high to low association strength, we would notice that the association strength gradient would be characterised by a rapid decline in association strength between the paired concepts. This sharp slope adds the label "steep" to the hierarchy.

A flat associative hierarchy on a concept is also characterised by a few very stereotypical associations. What differentiates it from a steep associative hierarchy is that the association strength connecting these associations in a flat associative

hierarchy is lower. Furthermore, the association strength gradient of a flat associative hierarchy is not characterised by any sharp decline at any point. Instead, association strength between concepts only gradually decreases, generating a flat association strength gradient. This earns the hierarchy the label "flat". We illustrate the association strength gradients of the two associative hierarchies for the concept "table" in Figure 2.1.

Mednick (1962) explains that in a task of continuous responding in which individuals are given a stimulus and are asked to produce concepts for a continuous duration, individuals are expected to produce concepts in an order and at a speed that reflects their associative hierarchy gradient for that stimulus. With regard to order, individuals are expected to produce concepts with a stronger association with the stimulus (which are also typically more related to the stimulus) before producing concepts with a weaker association with the stimulus (which are also typically less related to the stimulus). In terms of speed, individuals are expected to produce concepts at a slower speed when they have associations with low or similar association strength with the stimulus. This is supported by studies showing that, over the course of continuous responding, the number of less stereotypical responses increases (Benedek & Neubauer, 2013; Desiderato & Sigal, 1970; Milgram & Rabkin, 1980; Moran, Milgram, Sawyers & Fu, 1983; Olczak & Kaplan, 1969; Piers & Kirchner, 1971) and the speed of production decreases (Benedek & Neubauer, 2013; Mednick, Mednick & Jung, 1964; Olczak & Kaplan, 1969; Piers & Kirchner, 1971).

To demonstrate the difference between a steep and a flat associative hierarchy with an example, imagine we give two individuals the concept "table" as a stimulus. One individual possesses a steep and the other possesses a flat associative hierarchy for the concept. Their association strength gradients may look like those in Figure 2.1. In the early stages of concept production, the individual with the steep associative hierarchy is expected to produce the concepts "chair", "cloth", and "wood" at a higher speed than the individual with the flat associative hierarchy. This is because, for the individual with the flat associative hierarchy these concepts share a similar association strength with the concept "table" and, therefore, need more time to be recalled, selected, and used. As concept production continues, the individual with the flat associative hierarchy is expected to produce the concepts "wood", "leg", and "food" at a higher speed than the individual with the steep associative hierarchy. This is

because, for the individual with the steep associative hierarchy these concepts share a low and similar association strength with the concept "table" and, therefore, need more time to be recalled, selected, and used. By the end of the task, the individual with the steep associative hierarchy is expected to have produced the concepts "chair", "cloth", and "wood" and the individual with the flat associative hierarchy is expected to have produced the concepts "chair", "cloth", "wood", "leg", and "food". We illustrate concept production over time by the two individuals as described in the example above in Figure 2.2.

Similar to a task of continuous responding, individuals engaged in a problem-solving task are expected to recall and use associations from stronger (e.g., "table-chair") to weaker (e.g., "table-food") to generate solutions over time (Mednick, 1962). In the initial stages of the task, individuals are expected to use and exhaust their few strong stereotypical associations to generate stereotypical solutions. Then, they are expected to begin using their weaker, less stereotypical associations to generate less stereotypical solutions (Mednick, 1962; Moran et al., 1983; Olczak & Kaplan, 1969). As they recall and use less and less stereotypical associations, the individuals are expected use their non-stereotypical (remote) associations to generate non-stereotypical solutions.

That individuals recall and use their associations to generate solutions, suggests that their ability to create and use concept associations – also known as *associative fluency (AF)* – influences their ability to generate solutions (i.e., their ideational fluency). This proposition is supported by research reporting that individuals who demonstrate higher AF also demonstrate higher ideational fluency and originality (Benedek, Könen & Neubauer, 2012; Benedek & Neubauer, 2013; Desiderato & Sigal, 1970; Marron & Faust, 2018; Mednick et al., 1964; Piers & Kirchner, 1971).

That individuals recall and use their non-stereotypical associations to generate original solutions, also suggests that their ability to create and use concept associations (i.e., their AF) and, more specifically their ability to create and use non-stereotypical associations, influences their ability to generate original solutions (i.e., their ideational originality). To highlight this distinction, we differentiate the ability to create and use associations involving related concepts (i.e., stereotypical associations) from the ability to create and use associations involving remote concepts (i.e., non-

stereotypical/remote associations). We use the term *stereotypical associative fluency (SAF)* to refer to the first and the term *non-stereotypical associative fluency (NSAF)* to refer to the second. Put together, SAF and NSAF constitute an individual's AF.

Building on the distinction we make above, the theory of associative hierarchies (Mednick, 1962) suggests that SAF and NSAF on a concept facilitate the ability to generate solutions using that concept (i.e., ideational fluency related to that concept). It also suggests that NSAF on a concept facilitates the ability to generate non-stereotypical solutions using that concept (i.e., ideational originality related to that concept).

An argument can be made that as the number of solutions increases so does the number of distinct categories those solutions can be organised into (i.e., ideational flexibility). Since original solutions are less likely to belong to the same category, a stronger argument can be made that as the number of original solutions increases so does ideational flexibility. To link this to associative fluencies, an argument can be made that SAF and NSAF on a concept also facilitate ideational flexibility related to the concept. A stronger argument can be made that, in addition to ideational originality, NSAF on a concept also facilitates ideational flexibility related to the concept. However, this might not always be the case, as even original solutions can still belong to the same category (see Forthmann, Szardenings & Holling, 2020).

Let us take the problem of hiding a box in the kitchen as an example. Recalling and using the remote associations "table-bed sheets", "table-couch pillows", and "table-hook" can lead to the generation of the following original solutions: putting the box under the table and covering the table with a bed sheet, surrounding the table with couch pillows, and hanging coats on hooks located on the sides of table. These solutions do not necessarily belong to a different category, since they can all be categorised as "hiding the box under the table".

While we acknowledge that more research is needed to explore the relationship between AF, SAF, NSAF, and ideational flexibility (Marron & Faust, 2018), we believe that there is value in considering the relationship between play, associative fluencies, and ideational flexibility. For this reason, we include ideational flexibility in the possible mechanism we describe below.

Recall that what turned our attention to the theory of associate hierarchies was Dansky and Silverman's (1973) idea that, during play, individuals form new non-

stereotypical associations between remote concepts they engage with. Bringing this idea together with the theory of associative hierarchies, we propose that, during play, an individual forms new non-stereotypical associations between remote concepts they engage with, in such a way that they can recall and, therefore, use those associations after the play activity itself. Being able to recall and use a comparatively greater number of non-stereotypical associations involving those concepts, the individual can generate a comparatively greater number of non-stereotypical solutions using them. This improvement in their ability to generate a greater number of non-stereotypical solutions is an improvement in their ideational fluency related those concepts (and ideational fluency more broadly) because they can use those concepts to generate more solutions. It is also an improvement in their ideational originality related to those concepts (and ideational originality more broadly) because they can use those concepts to generate a greater number of non-stereotypical solutions. Finally, it is an improvement in their ideational flexibility related to those concepts (and ideational flexibility more broadly) because they can use those concepts to generate a greater number of non-stereotypical solutions that can be organised into a greater number of distinct categories. Put succinctly, we propose that participating in play promotes NSAF on concepts involved in play, which in turn promotes ideational fluency, originality, and flexibility related to those concepts (and ideational fluency, originality, and flexibility more broadly).

To demonstrate how this mechanism could take place in the business environment, we will refer to the role-playing sessions we describe at the opening of this essay. Imagine a team of four accomplished engineers working in the research and development (R&D) department of an organisation in the exploration robotics industry. Their objective as a team in the organisation is to design small-sized robots that can navigate challenging terrains. The team begins having weekly role-playing sessions, in which they pretend to be a group of novice treasure hunters seeking seven gemstones scattered in dangerous caves around the world. In their arsenal, each has their magical ability. This ability is the unique engineering ability each engineer brings to the R&D team (e.g., expertise in design and communications, experience in applied mathematics, proficiency in computer programming and artificial intelligence, and adeptness in solving complex problems).

In their inventory, the players have a bottomless bag of technologies and materials they can use during their adventures. The bag includes technologies and materials the players are familiar with and have access to. It also includes technologies and materials the players are not familiar with due to lack of access caused by financial constraints or intellectual property restrictions. In addition to the technologies and materials they are familiar with, the players need to use the technologies and materials they are not familiar with in order to retrieve the gemstones. The caves the players need to navigate are among the most dangerous caves on earth, and information about their terrains is provided to the players in the form of maps and soil analysis results. A facilitator is present during these role-playing sessions to ensure that unfamiliar technologies and materials are considered during play, that the engineers play as a group, and that the engineers use their unique abilities to retrieve the gemstones.

In each session, the players must navigate the challenging terrains of inhospitable caves to recover the requested gemstones. To achieve that, they will need to combine the abilities, technologies, and materials available to them in old and new ways to overcome the obstacles they face. As a result of creating these combinations in the safer environment of the role-playing sessions, the four engineers would generate new associations between the abilities, technologies, and materials they use in these combinations. Some of the combinations would involve technologies and materials that even the adept engineers were not familiar with at the beginning of the role-playing sessions. Therefore, some of the associations the engineers would form by creating these combinations would be between remote concepts. When solving problems as an R&D team after the role-playing sessions, the engineers can recall and use these new non-stereotypical associations to generate a greater number of solutions overall, a greater number of original solutions, and solutions that can be organised in a greater number of distinct categories.

To the best of our knowledge, no previous study has elaborated on how the creation of new non-stereotypical associations between remote concepts involved in play (Dansky & Silverman, 1973) could lead to improvements in NSAF on those concepts and, ultimately, to improvements in ideational fluency, originality, and flexibility related to those concepts (and ideational fluency, originality, and flexibility more broadly). This mechanism is particularly important and worthy of exploration because it relates to an important cognitive process involved in creativity – the recall

and use of concept associations to generate solutions to open-ended problems (Runco, 2011).

2.4. Propositions and Directions for Future Research

The theory of associative hierarchies and the mechanism we describe in the previous section could be examined in future empirical work. To assist in that research effort, we develop a number of propositions and discuss how they could be explored in the future. We begin with propositions and directions for future research relating to associative fluencies and ideational fluency, originality, and flexibility. Then, focusing on the mechanism we describe in the previous section, we develop propositions and provide research directions relating to the mediating role of NSAF in the relationship between play and ideational fluency, originality, and flexibility. Finally, we consider how five play design characteristics that can influence the effects of play on creativity-related outcomes (Dansky, 1999; Mellou, 1995; Wyver & Spence, 1999) might facilitate the mechanism we describe and make recommendation for future research.

2.4.1. Associative Fluencies and Divergent Thinking

In the previous section, we build on the theory of associative hierarchies (Mednick, 1962) to argue that SAF on a concept facilitates ideational fluency and flexibility related to the concept and that NSAF on a concept facilitates ideational fluency, originality, and flexibility related to the concept. To this day, research on the relationship between AF and divergent thinking abilities (e.g., Benedek et al., 2012; Benedek & Neubauer, 2013; Desiderato & Sigal, 1970; Marron & Faust, 2018; Mednick et al., 1964; Piers & Kirchner, 1971) focuses on ideational fluency and originality and does not help differentiate the individual effects of SAF and NSAF on divergent thinking abilities. We believe that such a differentiation in future research could help disentangle the relationship between play, associative fluencies, and divergent thinking abilities and allow researchers and businesses to make more informed decisions when designing play for organisational creativity. For example, determining that play promotes NSAF but not SAF could guide the design of play that involves a range of remote concepts for participants to engage with. Based on the expectation that an individual's SAF facilitates their ideational fluency and flexibility

and that their NSAF facilitates their ideational fluency, originality, and flexibility, we propose that:

Proposition 1: Stereotypical associative fluency (SAF) on specific concepts facilitates [P1a] ideational fluency and [P1b] ideational flexibility related to those concepts.

Proposition 2: Non-stereotypical associative fluency (NSAF) on specific concepts facilitates [P2a] ideational fluency, [P2b] ideational originality, and [P2c] ideational flexibility related to those concepts.

We present the conceptual framework for propositions 1 and 2 in Figure 2.3. The two propositions could be tested in studies that measure AF with tasks like the Continuous Free Word-Association Task (CFWAT) as well as divergent thinking with tests like the Alternate Uses Test (AUT) (e.g., Benedek et al., 2012). In these studies, scholars will need to differentiate SAF from NSAF and ideational fluency, originality, and flexibility using methods like frequency-based scoring (see Reiter-Palmon et al., 2019).

Based on the theory of associative hierarchies, individuals engaged in a problem-solving task use and exhaust their few strong stereotypical associations to generate stereotypical solutions before they begin using their weaker less stereotypical associations to generate less stereotypical solutions (Mednick, 1962). Because of that, we would anticipate SAF and NSAF to impact ideational fluency and flexibility differently depending on the stage of the problem-solving task. From the beginning of the task until the point related associations are exhausted, we would expect SAF to have a greater influence on ideational fluency and flexibility than NSAF. This is because during this period, individuals are expected to use a greater number of related associations to generate solutions. From the moment related associations are exhausted until the end of the problem-solving task, we would expect NSAF to have a greater influence on ideational fluency and flexibility than SAF. This is because during this period, individuals are expected to use a greater number of unrelated associations to generate solutions. Based on this, we propose that:

Proposition 3: Until the point related associations are exhausted in a problem-solving task, SAF has a greater influence on [P3a] ideational fluency and [P3b] ideational flexibility than NSAF.

Proposition 4: From the point related associations are exhausted in a problem-solving task, NSAF has a greater influence on [P4a] ideational fluency and [P4b] ideational flexibility than SAF.

An important research direction in this area would be to examine the strength of the relationship between SAF, NSAF, ideational fluency, and ideational flexibility at different time intervals of AF and divergent thinking measures.

2.4.2. Play, Associative Fluencies, and Divergent Thinking

In the previous section, we propose that play promotes NSAF on the concepts involved in it, which in turn promotes ideational fluency, originality, and flexibility related to those concepts (and ideational fluency, originality, and flexibility more broadly). In other words, we propose that play has an indirect effect on ideational fluency, originality, and flexibility through its direct effect on NSAF. To examine this mechanism, future research could explore the following three propositions on the mediating role of NSAF in the relationship between play and subsequent ideational fluency, originality, and flexibility:

Proposition 5: Play has an indirect effect on ideational fluency through its direct effect on NSAF, such that [P5a] play increases NSAF on concepts involved in it and [P5b] increasing NSAF on those concepts increases ideational fluency related to those concepts.

Proposition 6: Play has an indirect effect on ideational originality through its direct effect on NSAF, such that [P6a] play increases NSAF on concepts involved in it and [P6b] increasing NSAF on those concepts increases ideational originality related to those concepts.

Proposition 7: Play has an indirect effect on ideational flexibility through its direct effect on NSAF, such that [P7a] play increases NSAF on concepts

involved in it and [P7b] increasing NSAF on those concepts increases ideational flexibility related to those concepts.

We present the conceptual framework for propositions 5, 6, and 7 in Figure 2.3. The three propositions could be tested in studies in which some individuals participate in play interventions while others do not receive any interventions. To investigate the mediating role of NSAF, these studies will need to measure NSAF, ideational fluency, ideational originality, and ideational flexibility after the play interventions. In addition, since the mechanism we describe focuses on the concepts involved in play, measures of these abilities will need to include concepts involved in the interventions. However, this does not necessarily mean that the measures will need to exclusively include concepts involved in the interventions. On the contrary, we believe that measuring the effects of play interventions on concepts involved and concepts not involved in the interventions (e.g., Li, 1978) can help determine whether the mechanism we describe is indeed one of the mechanisms of the relationship. For example, in studies where participants enact a moon landing, measures can be completed on concepts involved in the play sessions, such as a "spaceship" and a "space suit", as well as on concepts not involved in the play sessions, such as a "bus" and a "swimming suit". Studies showing improvements on concepts involved in the interventions would lend some support to the mechanism we describe. On the other hand, studies showing no improvements on concepts involved in the interventions would suggest that the mechanism we describe did not take place (at least not for the concepts measured).

Based on the theory of associative hierarchies, we would anticipate that NSAF will begin having an impact on ideational fluency, originality, flexibility once related associations are exhausted. Considering that the mechanism we propose in this work is that play promotes the three divergent thinking abilities by promoting NSAF, we would anticipate that the effects of play through the mechanism we describe can only be observed after related associations are exhausted. This means that tests measuring the effects of play through the mechanism we describe will need to be at least long enough for related associations to be exhausted. An important direction for future research in this area would involve probing how long measures of AF and divergent thinking need to be to effectively capture the anticipated effects of play on concepts involved in play.

2.4.3. Play Design Characteristics, Associative Fluencies, and Divergent Thinking

What activates the mechanism we describe is the formation of new non-stereotypical associations between remote concepts involved in play. This means that, for the mechanism to take place, players will need to engage with and form associations between remote concepts. For that to happen, play will need to (a) involve remote concepts for participants to engage with and (b) last long enough for non-stereotypical associations to be formed. As we allude to earlier in this essay, those who study the play-creativity relationship discuss five play design characteristics that can influence the impact of play on creativity-related outcomes. These are materials, cognitive content, social content, freedom, and dosage (Dansky, 1999; Mellou, 1995; Wyver & Spence, 1999). In the remainder of this section, we consider a number of ways by which these five play design characteristics could facilitate the formation of new non-stereotypical associations by introducing remote concepts into play, enabling the formation of both cognitive and affect-laden associations between remote concepts, and allowing enough time for the participants to engage with remote concepts. We summarise these ways in Table 2.1.

Materials. During play, participants can engage with a number of proximal objects that are designed to be used in a specific way (e.g., dolls) and non-proximal objects that are not designed to be used in a specific way (e.g., building blocks) (Mellou, 1995). These objects could facilitate the formation of remote associations by introducing remote concepts into play. Non-proximal objects could introduce remote concepts into play when used in symbolic transformation. For example, using a stick to represent a horse during play (Vygotsky, 2004) could introduce the remote concepts "stick" and "horse" and enable the formation of a remote association between them. Non-proximal objects could also introduce remote concepts into play when used to construct something. For example, using building blocks to create a toy car could introduce the remote concepts "building block" and "car" and enable the formation of an association between them. Finally, non-proximal objects could introduce remote concepts into play when participants actively explore several of their attributes (e.g., Pellegrini & Greene, 1980). For example, exploring the ability of a cylindrical building block to stand tall and hold a vase and its ability to roll like a wheel could introduce

the remote concepts "cylindrical building block", "vase", and "wheel" and enable the formation of associations between them. Based on the above, we propose that:

Proposition 8: Play with non-proximal objects can facilitate the mechanism by introducing remote concepts into play when [P8a] the objects are used in symbolic transformation, [P8b] the objects are used to construct something, and [P8c] the participants actively explore several of the objects' attributes.

Proximal objects could also facilitate the mechanism we describe in this essay by introducing remote concepts into play. First, like non-proximal objects, proximal objects could be used in symbolic transformation (e.g., using a toy phone as a remote control (Mellou, 1995)). Therefore, they could introduce remote concepts through symbolic transformation and enable the formation of associations between those concepts. Second, similar to non-proximal objects, proximal objects can introduce remote concepts when players explore a wide range of their attributes (e.g., Pellegrini & Greene, 1980). For example, using a musical drum as a seat and as a container could introduce the remote concepts "musical drum", "seat", and "container" and enable the formation of associations between them. Finally, including diverse and unrelated proximal objects in play could introduce remote concepts related to those objects that could be used to create remote associations. In our example of the novice treasure hunters, this is accomplished through the inclusion of technologies and materials the engineers are familiar with as well as technologies and materials the engineers are not familiar with. Based on the above, we propose that:

Proposition 9: Play with proximal objects can facilitate the mechanism by introducing remote concepts into play when [P9a] the objects are used in symbolic transformation, [P9b] the participants actively explore several of the objects' attributes, and [P9c] a diverse and unrelated set of objects are used together.

Future research exploring the mechanism we describe in this work could examine the effects of playing with materials in the different ways we describe above on subsequent NSAF and ideational fluency, originality, and flexibility. For example, studies could investigate the effects of exploring the attributes of objects during play (e.g., exploration robotics engineers exploring several attributes of engineering

materials), using objects together during play (e.g., exploration robotics engineers using engineering materials together), and so forth. Important directions in this area would involve investigating the effects of play with materials that are relevant and materials that are irrelevant to the participants' jobs (e.g., exploration robotics engineers playing with engineering materials and medical materials) as well as materials the participants are familiar and not unfamiliar with (e.g., exploration robotics engineers playing with materials they have used before and materials they have not).

Another interesting research direction would be to investigate the remoteness of any new associations depending on the use of the materials. It is possible that different uses could lead to the formation of associations with varying degrees of remoteness. For example, exploring very diverse attributes of proximal and non-proximal objects and using very diverse proximal objects together could lead to the formation of associations with greater remoteness.

When exploring the effects of play as it relates to the mechanism we discuss in this essay, effort will be needed to identify the concepts involved in play and measuring NSAF and ideational fluency, originality, and flexibility related to those concepts. When play involves proximal objects (e.g., toy cars), identifying concepts involved in play (e.g., "cars") might be an easier task. However, when play involves non-proximal objects, more effort will be needed to identify the concepts involved. For example, in play that involves symbolic transformation (e.g., using a stick as a horse), researchers will need to identify the concepts related to the referents (in this example, "horse") and explore the effects of play on concepts related to the symbols (in this example, "stick") and on concepts related to the referents.

Cognitive content. The cognitive content of a play session can be organised into physical exploration, physical play, constructive play, object/concept-dependent play, sociodramatic play, and thematic play (Wyver & Spence, 1999). These types of cognitive content could facilitate the mechanism we describe in this work by introducing remote concepts into play in different ways. The introduction of remote concepts in physical exploration, physical play, constructive play, and object/concept-dependent play heavily relies on how the participants will engage with the remaining play design characteristics. It especially relies on materials, because materials have a central role in these four types of cognitive content.

However, we believe that enacting situations from everyday life (i.e., sociodramatic play) and enacting situations remote from everyday life (i.e., thematic play) could facilitate the formation of remote associations in additional ways that go beyond the participants' engagement with the remaining play design characteristics. Following up on the idea that, in play, individuals form non-stereotypical associations (Dansky & Silverman, 1973), Dansky (1980a, b, 1999) concludes that sociodramatic play and thematic play encourage flexibility and imaginativeness and provide a more "adaptable medium" for the formation of those associations (Dansky, 1980a: 56). Nevertheless, the author does not identify how non-stereotypical associations are formed in sociodramatic and thematic play. It is possible that sociodramatic play encourages the creation of non-stereotypical associations by introducing materials into different contexts that, albeit related to everyday life, involve concepts that are remote from the materials being used. For example, using a bed sheet to create a hammock in the garden in one play session, to create a den in another session, and to have a picnic on in yet another session could enable the creation of non-stereotypical associations between the concept "bed sheet" and the concepts "hammock", "den", and "picnic". Based on this, we propose that:

Proposition 10: Sociodramatic play can facilitate the mechanism by introducing remote concepts into play when materials are introduced into different, albeit related to everyday life, contexts.

Similarly, thematic play could facilitate the creation of non-stereotypical associations by introducing materials into contexts that are remote from everyday life and involve concepts that are remote from the materials being used. For example, using a bed sheet to create a flag to plant on the moon upon landing in one play session, to create a spaceship in another session, and to use as a flying carpet in another could facilitate the creation of non-stereotypical associations between the concept "bed sheet" and the concepts "flag", "spaceship", and "flying carpet". Based on this, we propose that:

Proposition 11: Thematic play can facilitate the mechanism by introducing remote concepts into play when materials are introduced into contexts remote from everyday life.

While some experimental studies compare the effects of play interventions that differ in their cognitive content (e.g., Dansky, 1980a; Moore & Russ, 2008; Shmukler & Naveh, 1985; Wyver & Spence, 1999), these studies are located in the developmental psychology literature, are limited in number, and do not consider the mechanisms facilitated by the different types of cognitive content. This means that research exploring the effects of the different types of cognitive content is necessary not only in relation to the mechanism we describe in this work but also in relation to other mechanisms put forth in the literature.

To explore how cognitive content could facilitate the mechanism we discuss, researchers could investigate the effects of the different types of cognitive content on NSAF and ideational fluency, originality, and flexibility (e.g., constructive play: exploration robotics engineers constructing a small robot; sociodramatic play: exploration robotics engineers testing a robot's ability to traverse a makeshift platform in the laboratory). When it comes to thematic play, researchers could also explore the effects of thematic play that involves situations relevant to the profession of the participants (e.g., exploration robotics engineers navigating inhospitable caves to collect valuable minerals) and thematic play that involves situations remote from the profession of the participants (e.g., exploration robotics engineers developing a robot for the automotive industry). Research in this area could also examine the interaction between materials (e.g., proximal vs non-proximal, familiar vs unfamiliar, relevant vs irrelevant) and cognitive content as it relates to the formation of remote associations (e.g., sociodramatic play with familiar vs unfamiliar materials).

Research with children and adults (Dansky, 1999; Dyson et al., 2016; Karakelle, 2009; Karwowski & Soszynski, 2008; Lewis & Lovatt, 2013; Wyver & Spence, 1999) suggests that thematic play is particularly effective in stimulating divergent thinking. With regard to the mechanism we describe, it is possible that thematic play affects the formation of non-stereotypical associations and, thus, divergent thinking in different ways compared to other types of cognitive content. It is possible that thematic play provides the conditions for a greater number of remote concepts to be introduced into play because the materials are introduced into contexts remote from everyday life. Since the situations enacted in thematic play are remote from everyday life, it is also possible that the remote associations formed during thematic play (e.g., "bed sheet-flying carpet") are characterised by greater remoteness

compared to the remote associations formed during play with other types of cognitive content (e.g., sociodramatic play: "bed sheet-picnic"). Future research could explore this further by looking at the relationship between the cognitive content of play, the number and remoteness of the associations being formed during play, and divergent thinking after play.

Finally, the literature suggests that play can stimulate creativity through mechanisms that involve interactions of cognitive and affective processes (e.g., experiencing emotions (Mainemelis & Ronson, 2006; Russ, 2003; Russ & Wallace, 2013, 2017)). This is particularly the case for pretend play, which typically involves emotions and experiencing those emotions (Russ & Wallace, 2013). With regard to the mechanism we explore in this essay, scholars propose that the integration of affect into the cognitive content of play could facilitate the formation of affect-laden associations between the concepts involved in play (Russ, 2003; Russ & Wallace, 2013). This means that play with affect-integrated cognitive content could facilitate the formation of an affect-laden association between two remote concepts (Mainemelis & Ronson, 2006), in addition to facilitating the formation of a cognitive association between the two concepts. Just like a cognitive association, an affect-laden association can make two concepts appear more related even when they are cognitively remote (Mainemelis & Ronson, 2006) and can increase the likelihood of recalling and using one concept when given the other as a stimulus (Russ, 2003; Russ & Wallace, 2013).

Based on the above, play with affect-integrated cognitive content could facilitate the formation of both a cognitive and an affect-laden association between two remote concepts involved in play, making the two concepts more likely to be recalled and used when generating solutions. In this way, play with affect-integrated cognitive content could facilitate the mechanism we discuss here by enabling the formation of both cognitive and affect-laden associations between the same remote concepts introduced into play. With this in mind, we propose that:

Proposition 12: Play with affect-integrated cognitive content can facilitate the mechanism by enabling the formation of both cognitive and affect-laden associations between the same remote concepts involved in play.

Future research exploring the mechanism we describe here could examine the effects of integrating affect into the cognitive content of play on subsequent NSAF and ideational fluency, originality, and flexibility. Studies could also compare the effects of integrating different emotions (e.g., happiness, sadness, anger, surprise (Russ & Kaugars, 2001)) in order to determine which emotions are most facilitative of the mechanism. For example, research could compare the effects of thematic play that involves threatening situations (e.g., exploration robotics engineers navigating inhospitable caves) to the effects of thematic play that does not involve any threatening situations (e.g., exploration robotics engineers navigating hospitable caves).

Social content. Play can be a solitary or a group activity (Wyver & Spence, 1999). Playing in groups offers individuals the opportunity to obtain knowledge, develop abilities, and exercise processes that are considered essential for creativity and cannot be achieved through solitary play alone (Dansky, 1999; Karakelle, 2009; Kirsten & Du Preez, 2010; Nisula & Kianto, 2018; Robson, 2017; West, 2014). For example, participants can obtain new knowledge through the sharing of ideas with others (Karakelle, 2009; Robson, 2017) and exercise conflict negotiation (Robson, 2017). While the introduction of remote concepts during solitary play heavily relies on how the participants will engage with the remaining play design characteristics (e.g., materials), we believe that the sharing of ideas that occurs during group play (Karakelle, 2009; Robson, 2017) is particularly relevant to the mechanism we describe in this essay. This is because, this sharing of ideas can expose participants to concepts they are not familiar with and consider unrelated. This exposure can make the engagement with remote concepts and the formation of remote associations between them more likely. Based on this, we propose that:

Proposition 13: Group play can facilitate the mechanism by introducing remote concepts into play when participants share ideas with each other.

In our review of the literature, we were able to identify a single experimental study that compares the effects of play interventions that differ in their social content (i.e., associative vs cooperative (Wyver & Spence, 1999)). However, this study does not consider the mechanisms facilitated by the different types of social content. More studies are necessary to examine how the mechanism we discuss in this essay and other mechanisms proposed in the literature relate to social content. To explore how

social content could impact the formation of non-stereotypical associations, scholars can study the effects of cooperative play (e.g., groups of exploration robotics engineers pretending to have complementary abilities), associative play (e.g., groups of exploration robotics engineers pretending to have the same abilities), and solitary play (e.g., exploration robotics engineers playing alone).

Research in this area could also delve into how the characteristics of play groups could influence the number and remoteness of ideas being shared and, thus, the formation of remote associations. Characteristics that merit further consideration include quality of communication, trust, cooperation, tolerance for exploration and mistakes (e.g., Vera & Crossan, 2005), proximity (e.g., playing face-to-face vs playing online), diversity, and cohesion. This is because these characteristics can influence both the number and the remoteness of new non-stereotypical associations. For example, higher quality of communication, cooperation, proximity, and cohesion could facilitate the sharing of a greater number of ideas and, through that, facilitate the formation of a greater number of remote associations. As another example, greater diversity in expertise, higher trust, and higher tolerance for exploration and mistakes could facilitate the sharing of very diverse ideas and, through that, facilitate the formation of associations with greater remoteness.

Freedom. Play can be led by instructions often provided by facilitators who model and guide engagement with the activities involved (i.e., guided play) or can be led by participants who engage with the activities as they please (i.e., free play) (Dansky, 1999; Silverman, 2016). In free play, participants do not receive outside guidance. Therefore, the introduction of remote concepts in free play heavily relies on how the participants will engage with the remaining play design characteristics (e.g., material, cognitive content).

On the other hand, in guided play, instructions can encourage the participants to adhere to the other four play design characteristics in ways that enable the introduction of remote concepts into play, the formation of both cognitive and affect-laden associations between the same remote concepts, and the prolonged engagement with the same remote concepts. For example, instructions could encourage the exploration of multiple material attributes (e.g., Pellegrini & Greene, 1980), the preservation of social roles and hierarchies (e.g., players and game masters (Dyson et al., 2016)), the engagement in thematic play (e.g., West et al., 2017), the engagement

in affect-integrated pretend play (e.g., Russ & Kaugars, 2001), and the participation for long periods (e.g., Karwowski & Soszynski, 2008). In our example of treasure hunters, the formation of remote associations is enabled by a facilitator who ensures that unfamiliar technologies and materials are considered during play and that the engineers continue to engage in thematic play as a group. Based on this, we propose that:

Proposition 14: Guided play can facilitate the mechanism when instructions encourage adherence to other play design characteristics in ways that enable [P14a] the introduction of remote concepts into play, [P14b] the formation of both cognitive and affect-laden associations between the same remote concepts, and [P14c] the prolonged engagement with the same remote concepts.

To explore the effects of freedom on the mechanism we describe, future research could investigate the impact of free play, play in which guidance is given on all other play design characteristics, and play in which guidance is given on some play design characteristics but not on others. For example, scholars could study the effects of play in which guidance is given on engagement with materials (e.g., a facilitator ensures that familiar and unfamiliar materials are considered during play), play in which guidance is given on adherence to cognitive content (e.g., a facilitator ensures that players engage in thematic play), and so forth.

Dosage. Play that can effectively promote divergent thinking can differ in total dose and dosage (e.g., Dyson et al., 2016; Karakelle, 2009; Karwowski & Soszynski, 2008; Lewis & Lovatt, 2013; Sowden et al., 2015). And there is reason to believe that both total dose and dosage play an important role in whether the mechanism we discuss in this work will be activated or not. What activates the mechanism we describe is the creation of non-stereotypical associations in such a way that these associations can be recalled and, thus, used in the future. This means that for these remote associations to be useful in future problem-solving tasks, they need to be strong enough to be recalled during problem-solving.

A longer engagement with the same remote concepts can strengthen the association between them (Klein, 2019). Therefore, we would expect that as the dose of play involving remote concepts increases so would the strength of any associations

involving those concepts. In addition, we would expect that as the dose of play increases so would the engagement with a greater number of remote concepts, as longer sessions can allow for a greater number of remote concepts to be introduced into play. Taken together, we would expect that as the dose of play involving remote concepts increases so would NSAF and, consequently, ideational fluency, originality, and flexibility related to those concepts. Furthermore, associations can be weakened overtime if the concepts involved in them are not engaged with together (Klein, 2019). Because of that, we would expect that booster play sessions (Moore & Russ, 2008; Russ, 2018) in which participants engage with the same remote concepts would help maintain any new remote associations and, thus, sustain the mechanism we describe. Based on the above, we propose that:

Proposition 15: Longer play sessions can facilitate the mechanism by [P15a] allowing for a prolonged engagement with the same remote concepts and [P15b] allowing for an engagement with a greater number of remote concepts.

Proposition 16: Multiple play sessions with the same remote concepts can facilitate the mechanism by allowing for a prolonged engagement with the same remote concepts.

Important directions for future research in this area would involve examining the total dose necessary for the mechanism we discuss to be activated, the appropriate dosage in terms of duration, number, and frequency of play sessions (e.g., one session that lasts eight hours vs four sessions that each last two hours (Karwowski & Soszynski, 2008)), and the need for booster play sessions.

Interactions between play design characteristics. As we demonstrate in our discussion on each of the five play design characteristics, the interactions between them can help introduce different remote concepts into play, facilitate the formation of both cognitive and affect-laden associations between the same remote concepts, and extend the duration of engagement with the same remote concepts. For example, exploring an object alone could introduce a limited number of remote concepts whereas exploring the same object under the guidance of a facilitator could introduce a greater number of remote concepts, as the facilitator can encourage the consideration of different attributes of the object. Similarly, exploring a set of objects alone and exploring the same objects with others could introduce different remote concepts, as

participants in group play can exchange ideas about those objects. Likewise, using everyday items in sociodramatic play and using the same items in thematic play could expose participants to different sets of remote concepts, as sociodramatic play involves situations and concepts related to everyday life whereas thematic play involves situations and concepts remote from everyday life. In a similar way, engaging in thematic play for 2 hours could facilitate the formation of more and stronger remote associations than engaging in thematic play for 30 minutes, as longer play can increase the likelihood of introducing a greater number of remote concepts into play as well as the duration of engagement with those concepts.

Because of their direct impact on the mechanism we describe, we believe that future research exploring the mechanism will need to consider and explore how different configurations of play design characteristics influence the mechanism. For example, researchers could investigate the effects of solitary sociodramatic play with familiar materials for 3 hours, guided thematic play with familiar and unfamiliar materials in groups for 3 hours, and so on. Based on the above, we propose that:

Proposition 17: Play can facilitate the mechanism when play design characteristics interact in ways that enable [P17a] the introduction of remote concepts into play, [P17b] the formation of both cognitive and affect-laden associations between the same remote concepts, and [P17c] the prolonged engagement with the same remote concepts.

Finally, we would expect that new remote associations would directly promote ideational fluency, originality, flexibility at work when the concepts involved in these new associations are concepts the participants are using when solving problems in their work. This means that for play to directly improve these divergent thinking abilities at work through the mechanism we describe, it would need to involve concepts that are relevant to the problems the participants are solving as part of their job. In our example of treasure hunters, play is beneficial because the remote associations formed during the play sessions involve the abilities, technologies, and materials the engineers are using to solve problems as an R&D team. Future research exploring the mechanism we describe in the organisational context could explore how concepts relevant to the participants' work can be introduced into play through materials, cognitive content, social content, and freedom. Studies could also compare

the impact of play involving and the impact of play not involving relevant concepts in order to determine whether the mechanism we describe can indeed take place in the workplace and can indeed promote the three divergent thinking abilities at work. These comparisons could also help clarify whether including relevant concepts into play makes a significant contribution in promoting ideational fluency, originality, and flexibility at work.

2.5. Discussion

Research inside (Hunter et al., 2010; Kirsten & Du Preez, 2010; Mainemelis & Ronson, 2006; Nisula & Kianto, 2018; West, 2014; West et al., 2017) and outside (Dyson et al., 2016; Karakelle, 2009; Karwowski & Soszynski, 2008; Lewis & Lovatt, 2013; Russ & Wallace, 2013; Silverman, 2016) the organisational context suggests that participating in play can stimulate organisational creativity. However, research exploring the mechanisms of the play-creativity relationship (Petelczyc et al., 2018; Russ & Wallace, 2013) and connecting play design characteristics, mechanisms, and outcomes is currently lacking. To address this limitation, we make an initial attempt to describe in greater detail a possible mechanism of the relationship. By doing so, this study paves the way for more research that takes a deeper look at the mechanisms of this potential relationship.

In addition to describing the possible mechanism, we also consider how five important play design characteristics – materials, cognitive content, social content, freedom, and dosage (Dansky, 1999; Mellou, 1995; Wyver & Spence, 1999) – might facilitate the mechanism we describe. Specifically, focusing on the fact that the mechanism is activated by the creation of non-stereotypical associations between remote concepts involved in play, we explore how the five pay design characteristics could facilitate the mechanism by enabling the introduction of remote concepts into play, the formation of both cognitive and affect-laden associations between the same remote concepts, and the prolonged engagement with the same remote concepts. By doing so, this study creates a direct link between play design characteristics, the mechanism we describe, and ideational fluency, originality, and flexibility. As such, it contributes to the limited literature on the play-creativity relationship in the organisational context, paves the way for more research linking play design

characteristics, mechanisms, and outcomes, and serves as a roadmap for future research on the topic.

In describing the possible mechanism and considering how the five play design characteristics might enable the mechanism, we also make recommendations for how the mechanism could be examined in future research. These recommendations could encourage researchers to both study the mechanism we discuss here and develop recommendations for future research when exploring other mechanisms of the play-creativity relationship.

We expect that as more management scholars begin to explore the links between play design characteristics, mechanisms, and outcomes, those links will become clearer and the research community's capacity to provide guidance on designing play for organisational creativity will become stronger. Such evidence-based guidance can be valuable to business leader and consultants interested in using play to stimulate creativity in the business environment. A better understanding of the relationship between play design characteristics, mechanisms, and outcomes could also highlight the need for business leaders to be actively engaged in the design and implementation of play in their organisations. For example, it could emphasise the need for business leaders to consider their organisational objectives and design or select play that delivers outcomes that are aligned with those objectives. It could also underscore the need for business leaders to consider the characteristics of their organisations and design or select play that fits well with those characteristics. For instance, for organisations in which most of the employees work remotely, implementing play that involves concepts rather than physical objects might be more cost efficient and implementing play that is conducted online rather than face-to-face might be more convenient.

In addition to contributing to the literature on play and creativity in the workplace, this essay makes two contributions to the literature on organisational creativity. First, the essay adds to the broader discussion around the possible ways of promoting creativity at work by considering play as one such possible way and exploring its potential relationship with divergent thinking abilities. And second, the essay could encourage more theoretical and empirical research that explores play as a technique of stimulating organisational creativity.

Our study has a number of limitations that can be addressed in future research. First, we conceptualise play as an activity and focus on how the design characteristics of the play activity itself could facilitate the mechanism we describe. We do not consider how individual and organisational differences might facilitate or hinder one's engagement with remote concepts during play and, thus, the activation of the mechanism. For example, it is conceivable that employees who are more open to exploring different ideas will engage with a greater number of remote concepts as they explore several ideas during play. Similarly, it is likely that participants who can engage in all the types of cognitive content of play will engage with a greater number of remote concepts during play (for play ability see Dansky, 1980b; Dyson et al., 2016; Fehr & Russ, 2016; Hoffmann & Russ, 2016; Karwowski & Soszynski, 2008). Likewise, it is possible that individuals who are predisposed to engage in play (for playfulness see Proyer & Ruch, 2011) or who enjoy playing will spend more time in play and, therefore, engage with a greater number of remote concepts and/or engage with remote concepts for longer periods. As a final example, some employees might be more reserved in engaging in all the types of cognitive content of play (e.g., thematic play) due to their seniority in the organisation and, therefore, engage with fewer remote concepts during play. Future research extending our work could explore how individual and organisational differences might affect the participants' engagement with remote concepts and the formation of remote associations during play.

Second, we do not consider how the formation of new non-stereotypical associations might affect ideational fluency, originality, and flexibility depending on the participants' associative hierarchies on those concepts. We do that because we expect that individuals with steep and flat associative hierarchies on those concepts will eventually recall and use the new non-stereotypical associations during problem-solving given enough time and given that the associations are strong enough to be recalled. However, we acknowledge that the three divergent thinking abilities might be affected in different ways under different conditions for individuals with steep and flat associative hierarchies. For example, it is likely that individuals with steep associative hierarchies on the concepts might require less time to recall and use the new remote associations compared to individuals with flat associative hierarchies on the concepts. This is because, for individuals with steep associative hierarchies, the

new remote associations might have a higher association strength compared to their existing remote associations and, therefore, might require less time to be recalled and used. On the other hand, for individuals with flat associative hierarchies, the new remote associations might have a similar association strength to their existing remote associations and, therefore, might require more time to be recalled and used. Future research could explore how the formation of new remote associations might differentially affect divergent thinking depending on the participants' associative hierarchies on those concepts.

Third, we focus on play as an activity that is independent from work and in which individuals can form new remote associations that can be recalled and used after the play activity itself. However, we believe that there is value in conceptualising play as a behavioural orientation toward work (e.g., Csikszentmihalyi, 1996; Mainemelis & Ronson, 2006; West et al., 2016) and exploring how the design characteristics of work (e.g., materials used, complexity of the tasks), the individual characteristics of employees (e.g., play ability), and the characteristics of the organisation (e.g., climate for play) might facilitate the mechanism we describe. Future research could extend our work by following this research direction.

Fourth, we focus on how the creation of remote associations that might occur in play (Dansky & Silverman, 1973) can ultimately affect ideational fluency, originality, and flexibility at the individual level. We do not explore how changes in an individual's associative fluencies and divergent thinking abilities might affect creativity at the team and organisational levels. Future research could consider studies on team and organisational creativity (e.g., Paulus, Dzindolet & Kohn, 2012) and extend the propositions we make in this study to the team and organisational levels.

Finally, when exploring the possible play-creativity mechanism, we adopt a variance theory perspective and focus on the effects of play on divergent thinking abilities. Nevertheless, we believe that there is value in adopting a process theory perspective and exploring the mechanism through that lens. Considering the role of booster play sessions in facilitating the mechanism, future research adopting a process theory perspective could explore the process through which participating in frequent play sessions could lead to the generation of ideas using concepts involved in those sessions. To link this to the limitation we discuss above, future studies could also explore the process through which participating in play can lead to improvements in

individual divergent thinking, individual creativity, team creativity, and, ultimately, organisational creativity.

2.6. Conclusion

As more business leaders and management scholars begin to discuss the benefits of play in organisations (Hjorth et al., 2018; Petelczyc et al., 2018), we anticipate that some will learn about the potential of play to promote organisational creativity and turn their attention to the play-creativity relationship. In this work, we recognise the importance of scrutinising the potential mechanisms of the relationship and understanding the connection between play design characteristics, mechanisms, and outcomes. We make an initial attempt to describe one of the possible mechanisms of the relationship and to consider how the mechanism relates to play design characteristics and creativity-related outcomes. We hope that our work paves the way for a thorough examination of the mechanisms of the play-creativity relationship, serves as a guide for how to explore the links between play design characteristics, mechanisms, and outcomes, and encourages more researchers to engage in this investigation in the future.

2.7. Tables and Figures

Table 2.1. How Play Design Characteristics Can Facilitate the Mechanism

| Play Design Characteristic	How it Can Facilitate the Mechanism
Materials	
Non-proximal Objects	By introducing remote concepts into play when the objects are used in symbolic transformation, the objects are used to construct something, and the participants actively explore several of the objects' attributes.
Proximal Objects	By introducing remote concepts into play when the objects are used in symbolic transformation, the participants actively explore several of the objects' attributes, and a diverse and unrelated set of objects are used together.
Cognitive Content	
Physical Exploration Physical Play Constructive Play Object/concept-dependent Play	Heavily rely on engagement with other play design characteristics, especially materials.
Sociodramatic Play	By introducing remote concepts into play when materials are introduced into different, albeit related to everyday life, contexts.
Thematic Play	By introducing remote concepts into play when materials are introduced into contexts remote from everyday life.
Affect-integrated Cognitive Content	By enabling the formation of both cognitive and affect-laden associations between the same remote concepts involved in play.
Social Content	
Solitary Play	Heavily relies on engagement with other play design characteristics.
Group Play	By introducing remote concepts into play when participants share ideas with each other.
Freedom	
Free Play	Heavily relies on engagement with other play design characteristics.
Guided Play	When instructions encourage adherence to other play design characteristics in ways that enable the introduction of remote concepts into play, the formation of both cognitive and affect-laden associations between the same remote concepts, and the prolonged engagement with the same remote concepts.

Table 2.1. How Play Design Characteristics Can Facilitate the Mechanism (Continued)

Play Design Characteristic	How it Can Facilitate the Mechanism
Dosage	
Total Dose	When play sessions are longer, by allowing for a prolonged engagement with the same remote concepts and allowing for an engagement with a greater number of remote concepts.
Booster Play Sessions	When play involves multiple play sessions with the same remote concepts, by allowing for a prolonged engagement with the same remote concepts.
Interactions	
	When play design characteristics interact in ways that enable the introduction of remote concepts into play, the formation of both cognitive and affect-laden associations between the same remote concepts, and the prolonged engagement with the same remote concepts (e.g., exploring an object under the guidance of a facilitator who encourages the exploration of multiple attributes of the object).

Figure 2.1. The Associative Hierarchies for the Concept "Table"
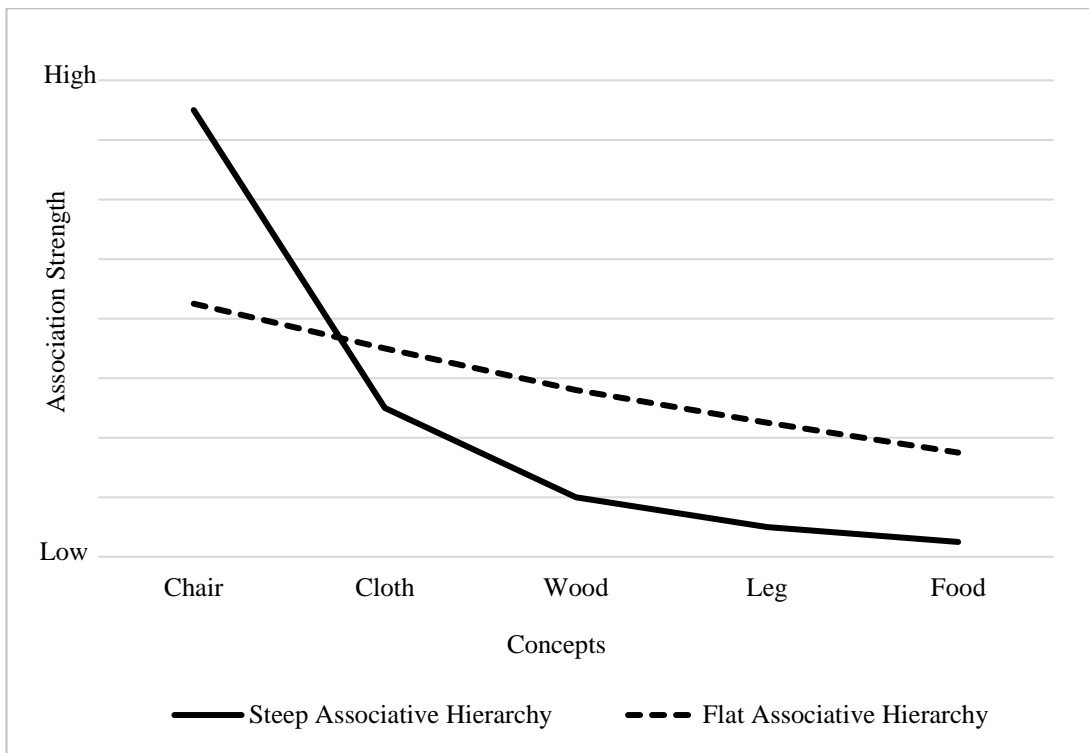
Source: Based on Mednick's theory of associative hierarchies (1962: 223).

**Figure 2.2. Response Production Over Time for the Concept "Table"
Depending on the Associative Hierarchy**

Steep Associative Hierarchy

Chair   Cloth   Wood

Flat Associative Hierarchy

Chair   Cloth   Wood   Leg   Food

Time
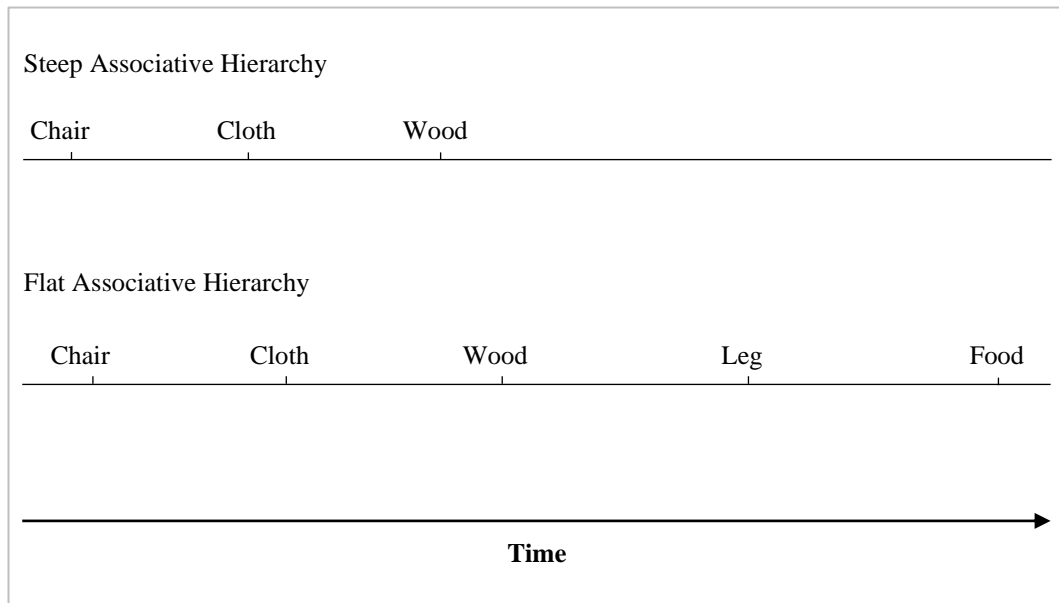
Source: Based on Mednick's (1962) theory of associative hierarchies.

Figure 2.3. Conceptual Framework for Propositions 1, 2, 5, 6, and 7
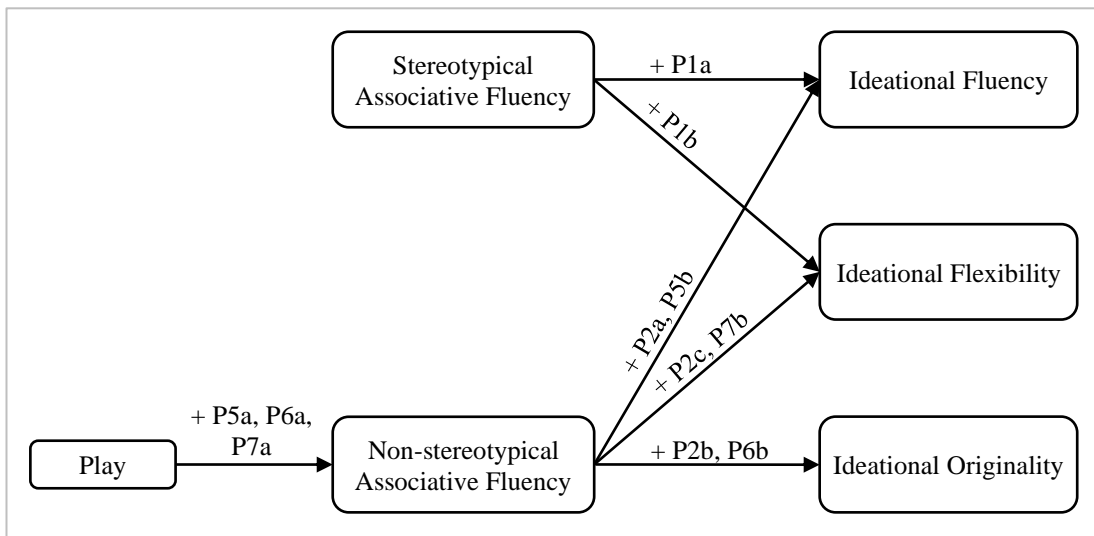
Essay 3

Play and Organisational Creativity: Testing a Possible Mechanism

3.1. Introduction

A few months ago, you joined the design team of a small, innovative organisation that designs and produces decorative jars. Since you joined, you and your team have spent the first hour of every workday playing with jars of different sizes, shapes, and materials and other decorative items, such as plants, flowers, leaves, stones, fabrics, and dry foods. During these play sessions, you can play with and explore any design ideas you have. For the past month, you have been exploring the idea of terrarium jars. The goal of these daily play sessions is for you and your team to become more creative at your work as designers. The company you work for is not alone in dedicating time for play during working hours. In fact, for many innovative organisations around the world, playing is an integral part of working (Mainemelis & Ronson, 2006; Petelczyc et al., 2018). DuPont and Google are among a number of prominent organisations that go as far as asking their employees to spend some of their time at work to play with and explore new ideas (Mainemelis & Ronson, 2006). But how can playing at work make you more creative at your job?

Scholars in the developmental psychology literature have been speculating about the role of play as an activity in fostering creativity since the 1960s (Mellou, 1995; Saracho, 2017). Their focus has been on the effects of play on subsequent creativity in children. They have proposed several mechanisms explaining how playing can lead to improvements in creativity by allowing individuals to develop knowledge, schemas, abilities, and associations and exercise processes that they can

later use to generate solutions after the play activity itself (Dansky, 1999; Mellou, 1994, 1995; Russ & Wallace, 2013, 2017; Saracho, 2017). These include developing knowledge and schemas about the objects they play with (Barnett, 1985; Piaget, 1999; Vandenberg, 1981); obtaining knowledge by combining ideas, past experiences, concepts, actions, objects, and behaviours in new ways (i.e., knowledge through imagination) (Bruner, 1972; Sutton-Smith, 1967; Vygotsky, 2004); forming remote associations between objects, actions, and concepts they engage with (Dansky & Silverman, 1973; Sutton-Smith, 1967); creating, accessing, and using affect-laden associations (Russ, 2003; Russ & Wallace, 2013); developing divergent thinking (Bruner, 1972; Mellou, 1995; Saracho, 2017; Sutton-Smith, 1967); and exercising processes such as imagination, exploration, problem finding, conflict negotiation, idea evaluation, and idea sharing (Dansky, 1999; Robson, 2017; Russ & Wallace, 2017; Vygotsky, 2004).

These theoretical developments were followed by empirical research demonstrating a link between play and creativity (Russ & Lee, 2017) and experimental research showing that play could promote divergent thinking and creativity in children (Russ & Wallace, 2013; Silverman, 2016; c.f. Lillard et al., 2013). Scholars in adult psychology and adult education who extended the experimental work conducted with children to the adult context found that play could also foster divergent thinking and creativity in adults (Dyson et al., 2016; Karakelle, 2009; Karwowski & Soszynski, 2008; Lewis & Lovatt, 2013).

Though creativity is a broader term that refers to the process of generating novel and useful ideas (solutions) to an open-ended problem (Amabile, 1988; Sawyer, 2012), the empirical work in the developmental psychology literature is predominantly focused on divergent thinking (Russ & Wallace, 2013). Divergent thinking involves cognitive abilities important to creativity (Russ, 2018), including ideational fluency – the ability to generate solutions, ideational originality – the ability to generate non-stereotypical (original) solutions, and ideational flexibility – the ability to generate solutions that belong to distinct categories (Runco, 2011).

Recognising the important role of creativity in organisational competitiveness and viability (Anderson et al., 2014; Harari et al., 2016; Ligon et al., 2012; Madden, 2017), management scholars have also proposed play as an effective way to promote creativity in the workplace (Kirsten & Du Preez, 2010; Mainemelis & Ronson, 2006;

Nisula & Kianto, 2018; West, 2014). Drawing from the theoretical work found in the developmental psychology literature, they have suggested several ways by which play as an activity could promote creativity at work. These include inducing positive affect and playfulness (i.e., a predisposition to engage in play (Proyer & Ruch, 2011)) (Mainemelis & Ronson, 2006; Nisula & Kianto, 2018; West, 2014); allowing individuals to psychologically adjust to their work (Mainemelis & Ronson, 2006); increasing the intrinsic motivation and willingness of employees to engage in the creative process and share and explore ideas with colleagues (Mainemelis & Ronson, 2006; West, 2014); and fostering an organisational climate for creativity (Kirsten & Du Preez, 2010; Nisula & Kianto, 2018). Recent empirical work in the organisational context supports these propositions, showing that play can also promote divergent thinking, creativity, and a climate for creativity at work (Kirsten & Du Preez, 2010; Nisula & Kianto, 2018; Petelczyc et al., 2018; West et al., 2017). Together, these findings suggest that play can be a viable option for business leaders interested in introducing play as part of work or as part of training and development in order to stimulate creativity in their organisations.

A major limitation in the literature on play and creativity – whether it is in developmental psychology or management – is that, while many mechanisms have been proposed, most have not been clearly communicated (Petelczyc et al., 2018; Russ & Wallace, 2013) and, to the best of our knowledge, none have been experimentally tested. Considering that the relationship between play and creativity might be reciprocal (Russ & Lee, 2017; Wyver & Spence, 1999), this lack of experimental research on the mechanisms of the relationship makes it more difficult to understand precisely how play might stimulate creativity and, therefore, more challenging to design play that can stimulate creativity at work. In the current study, we address this limitation in the literature and help generate more robust research on play-creativity mechanisms by examining one of the possible mechanisms of the relationship. Specifically, we draw from the theory of associative hierarchies (Mednick, 1962) and build on the idea that, during play, individuals form associations between remote concepts they engage with (Dansky & Silverman, 1973) to propose and experimentally test a possible mechanism by which play can promote ideational fluency and originality.

The rationale behind studies focusing on divergent thinking abilities, including the current study, is that improvements in individual divergent thinking can lead to improvements in individual creativity (Scott et al., 2004). In the organisational context, ideas by individuals and teams are considered the "starting point" of organisational creativity and innovation (Amabile et al., 1996: 1155; Puccio & Cabra, 2010). For this reason, improvements in individual creativity in the workplace could lead to improvements in organisational creativity and, as a result, to improvements in organisational competitiveness and viability.

In the next section, we provide a definition of play, review the experimental research on play and creativity, and build on the idea of remote association formation during play to develop testable hypotheses.

3.2. Literature Review

3.2.1. Play and Organisational Creativity

Research discussing the possible effects of play on creativity, including organisational creativity, often focuses on play as an activity that is absorbing and enjoyable (Dansky, 1999; Kirsten & Du Preez, 2010; Nisula & Kianto, 2018; Petelczyc et al., 2018; Russ & Wallace, 2017; West et al., 2017). It involves participants exploring ideas, objects, or the environment as well as exercising their imagination alone (i.e., solitary play) or in groups (i.e., group play) (Dansky, 1999; Mainemelis & Ronson, 2006; Vygotsky, 2004; West, 2014; Wyver & Spence, 1999). It begins when those who want to engage in it reach an agreement on a baseline context (e.g., "I will create a tower using these building blocks", "I will pretend to be the doctor, you will pretend to be the nurse, and you will pretend to be the patient") and continues as the participants improvise events without aiming for a specific path and goal (i.e., flexible means and ends) (Bruner, 1983; Feitelson & Ross, 1973; Mainemelis & Ronson, 2006; Russ & Wallace, 2017). It is considered to be distinct from ordinary life and, hence, to be an activity in which the real-life adverse effects of much of what occurs in it are reduced (Bruner, 1983; Mainemelis & Ronson, 2006). For example, the harmful effects of using a faulty toy car are expected to be negligible compared to the detrimental effects of using a faulty car.

We should note that, in the business environment, play is usually described as a voluntarily activity that is carried out for enjoyment (Petelczyc et al., 2018; Van

Vleet & Feeney, 2015). Nevertheless, it can also be carried out at the request of the organisation to achieve important business objectives (e.g., serious play for strategy development (Kristiansen & Rasmussen, 2014; Statler et al., 2011)). This means that play that stimulates creativity could also be carried out at the request of the organisation in order to promote organisational creativity.

Experimental studies that sought to examine the effects of play on creativity administered a wide range of play interventions that maintained many of the characteristics of play described above. These interventions either left the participants to play as they pleased (i.e., free play) or included play activities purposefully designed to promote creativity and guidance on how to engage with those activities (i.e., guided play) (Dansky, 1999; Silverman, 2016). Cognitively, the activities included in these interventions involved exploring objects or the environment (i.e., physical exploration); moving around and playing with large toys or dancing (i.e., physical play); crafting something (i.e., constructive play); engaging in pretend play with a heavy reliance on objects and concepts (i.e., object/concept-dependent play); enacting situations from everyday life, such going to the beach (i.e., sociodramatic play); enacting situations remote from everyday life, such as responding to a large forest fire (i.e., thematic play); or any combinations of the above (for definitions of cognitive content see Wyver & Spence, 1999). These activities involved exploration and imagination as well as flexible means and ends. Socially, they were carried out individually (i.e., solitary play) or in groups (i.e., group play).

The results of these experimental studies suggest that as little as 20 minutes of free play with provided objects (Dansky, 1980b; Dansky & Silverman, 1973, 1975; Li, 1978) or guided constructive, concept-dependent, sociodramatic, or thematic play (Felsman et al., 2020; Lewis & Lovatt, 2013; Li, 1978; Mourey, 2020; Sowden et al., 2015; Tsai, 2012) can promote divergent thinking and creativity in children and adults. The evidence is more compelling for the effectiveness of higher doses of guided thematic play in groups (Dyson et al., 2016; Garaigordobil & Berrueco, 2011; Hui & Lau, 2006; Karakelle, 2009; Karwowski & Soszynski, 2008; Kirsten & Du Preez, 2010; Russ & Wallace, 2013; Silverman, 2016; West et al., 2017).

As we allude to in the introduction, scholars in the developmental psychology and management literatures have proposed many mechanisms by which play can deliver the effects observed in the experimental studies mentioned above (Dansky,

1999; Kirsten & Du Preez, 2010; Mainemelis & Ronson, 2006; Mellou, 1995; Russ & Wallace, 2013, 2017; Saracho, 2017; West, 2014). However, most of these mechanisms have not been elaborated (Petelczyc et al., 2018; Russ & Wallace, 2013) and none have been experimentally tested. In the current study, we address this limitation by examining one of the possible mechanisms behind the play-creativity relationship. We bring together the idea that, during play, individuals form associations between remote concepts they engage with (Dansky & Silverman, 1973) and the theory of associative hierarchies (Mednick, 1962) to propose and experimentally test a possible mechanism by which play can promote ideational fluency and originality. We elaborate on this possible mechanism and develop hypotheses next.

3.2.2. Play, Associative Fluencies, and Ideational Fluency and Originality

In speculating about how play might stimulate creativity, Dansky and Silverman (1973) propose that, in play, individuals form associations between remote concepts they engage with. The implication is that, after the play activity itself, the individuals can recall and use these new remote associations to generate more solutions, which is an improvement of their divergent thinking abilities. However, Dansky and Silverman (1973) do not identify which divergent thinking abilities are affected by the formation of new remote associations, nor do they describe the mechanism of the effect. We believe that a possible explanation can be found in the creativity literature via the theory of associative hierarchies (Mednick, 1962).

Associative theories propose that people form pair-associations between two concepts when they engage with both concepts in the pair simultaneously (Klein, 2019). Each of these pair-associations has its own association strength, which usually increases as the frequency in which the individuals engage with the pair of concepts increases. For instance, someone might have a very strong association between the concepts "window" and "curtain" because they frequently open and close their window curtains and a weak association between the concepts "window" and "rain" because they occasionally enjoy watching the rain through the window. The strength of the association between two concepts affects the probability of recalling and, therefore, using one of the concepts in the pair when given the other concept as a stimulus. Specifically, the weaker the association strength between two concepts, the

lower the likelihood of recalling and, thus, using one of the concepts when given the other as a stimulus (Mednick, 1962).

Each of these pair-associations is labelled *stereotypical* if the pair of concepts is very related. The less related the two concepts, the less stereotypical the association between them. An association between concepts that are considered unrelated is labelled *non-stereotypical* or *remote* (Mednick, 1962). Furthermore, more stereotypical associations are expected to have a higher association strength than less stereotypical ones (Mednick, 1962).

The theory of associative hierarchies proposes that individuals have an associative hierarchy for each concept they know, which consists of their associations that contain the concept (Mednick, 1962). If we were to order the associations found in the individuals' associative hierarchy from high to low association strength, we would get an association strength gradient. In a task of continuous responding in which individuals are given a stimulus and are asked to produce concepts for a continuous duration, the individuals are expected to recall and produce concepts in an order that reflects their association strength gradient for the stimulus. Specifically, the individuals are expected to produce concepts from stronger to weaker association strength with the stimulus (Benedek & Neubauer, 2013; Desiderato & Sigal, 1970; Mednick, 1962; Milgram & Rabkin, 1980; Moran et al., 1983; Olczak & Kaplan, 1969; Piers & Kirchner, 1971).

Similarly, during problem solving, the individuals are expected to recall and use associations from stronger to weaker to generate solutions (Mednick, 1962). The individuals are expected to use their more stereotypical associations to generate more stereotypical solutions and their less stereotypical associations to generate less stereotypical solutions (Mednick, 1962). In this process, the individuals are expected to use their non-stereotypical associations to generate non-stereotypical solutions (Mednick, 1962). Since more stereotypical associations are expected to have a higher association strength than less stereotypical ones, the individuals are expected to generate solutions from more stereotypical to less stereotypical (Mednick, 1962; Moran et al., 1983; Olczak & Kaplan, 1969).

That individuals recall and use their associations to generate solutions suggests that their ability to create and use stereotypical associations and their ability to create and use non-stereotypical (remote) associations facilitate their ability to generate

solutions (i.e., their ideational fluency). That individuals recall and use their non-stereotypical associations to generate non-stereotypical solutions suggests that their ability to create and use remote associations also facilitates their ability to generate non-stereotypical solutions (i.e., their ideational originality). To highlight this distinction, we build on the term *associative fluency (AF)*, which refers to someone's ability to create and use concept associations (e.g., Benedek & Neubauer, 2013). We use the term *stereotypical associative fluency (SAF)* to refer to someone's ability to create and use stereotypical associations and the term *non-stereotypical associative fluency (NSAF)* to refer to someone's ability to create and use non-stereotypical associations. Together, SAF and NSAF constitute an individual's AF.

Based on the distinction we make above, the theory of associative hierarchies (Mednick, 1962) suggests that an individual's SAF and NSAF on a concept facilitate their ability to generate solutions using that concept (i.e., their ideational fluency related to that concept). It also suggests that an individual's NSAF on a concept facilitates their ability to generate original solutions using that concept (i.e., their ideational originality related to that concept). Based on this, we hypothesise that:

Hypothesis 1: Stereotypical associative fluency (SAF) on specific concepts will be positively related to ideational fluency related to those concepts.

Hypothesis 2: Non-stereotypical associative fluency (NSAF) on specific concepts will be positively related to [H2a] ideational fluency and [H2b] ideational originality related to those concepts.

We should note that more research is still needed to explain how an individual's AF, SAF, and NSAF on a concept might influence their ability to provide solutions that belong to a range of distinct categories using that concept (i.e., ideational flexibility related to that concept) (Marron & Faust, 2018). For this reason, in our description of the possible mechanism that follows we focus on ideational fluency and originality but not flexibility.

Dansky and Silverman (1973) suggest that, during play, individuals form new non-stereotypical associations between the remote concepts they engage with. Combining this idea with the theory of associative hierarchies, we propose that, during play, individuals form new non-stereotypical associations between remote concepts they engage with, in such a way that they can recall and use those associations after

the play activity. Having the ability to recall and use a comparatively greater number of non-stereotypical associations involving those concepts, the individuals can generate a comparatively greater number of non-stereotypical solutions using those concepts. This improvement in their ability to generate a greater number of non-stereotypical solutions is an improvement in their ideational fluency related to those concepts because they can produce more solutions using them. It is also an improvement in their ideational originality related to those concepts because they can produce a greater number of non-stereotypical solutions using them. Put directly, we propose that play promotes NSAF on the concepts involved in it, which in turn promotes ideational fluency and originality related to those concepts. Based on this proposition, we hypothesise that:

> Hypothesis 3: A play intervention will have an indirect effect on ideational fluency through its direct effect on NSAF, such that [H3a] the play intervention will be positively related to NSAF on concepts involved in the play intervention and [H3b] NSAF on those concepts will be positively related to ideational fluency related to those concepts.

> Hypothesis 4: A play intervention will have an indirect effect on ideational originality through its direct effect on NSAF, such that [H4a] the play intervention will be positively related to NSAF on concepts involved in the play intervention and [H4b] NSAF on those concepts will be positively related to ideational originality related to those concepts.

The first part of the two hypotheses above (H3a and H4a) represents Dansky and Silverman's (1973) proposition that, in play, individuals form new non-stereotypical associations between the remote concepts they engage with. The second part of the two hypotheses (H3b and H4b) represents the explanation provided via the theory of associative hierarchies (Mednick, 1962) about how the formation of new non-stereotypical associations might promote ideational fluency and originality.

We present the conceptual framework for hypotheses 1 to 4 in Figure 3.1. To demonstrate the mechanism we propose above with an example, we will refer to the play sessions we describe at the opening of this essay. Imagine a team of three designers working for an organisation that designs and produces decorative jars. For the past month, the team has spent the first hour of every workday playing with the

idea of designing alternative terrarium jars. They made the decision that their terrarium jars would look like the typical terrarium jars found in the market but would not include the typical materials – gravel, small stones, pebbles, active charcoal, potting soil, and real and artificial decorative plants. Rather, they would involve real dry foods, herbs, nuts, and spices used in cooking. They have been exploring the ideas of using spices as soil, using herbs as plants, and using spices, nuts, dry pasta, and dry legumes to decorate and add colour to their terrarium jars.

As they take this new approach in designing terrarium jars, the designers engage with materials and concepts in different ways. In this process, they are likely to create new non-stereotypical associations between remote concepts they engage with at the same time. For example, using lentils as pebbles in their alternative terrarium jars, the designers could create associations between the concept "lentils" and other concepts not typically associated with lentils, such as "decoration", "terrarium", and "pebbles". The creation of these new associations increases the designers overall AF as well as NSAF, since the new associations are non-stereotypical. Engaged in their main work tasks outside these play sessions, the designers can recall and use their new non-stereotypical associations to generate a greater number of jar designs overall and a greater number of original jar designs. This is an improvement in their ideational fluency and ideational originality related to those concepts. To continue with the "lentils" example, a designer thinking about using pebbles in their next design, could recall the lentils they used as pebbles during play and use lentils instead of pebbles to design a greater number of original decorative jars.

3.3. Method

3.3.1. Design, Participants, and Setting

To test the hypotheses we develop in the previous section, we followed a single-session pre-test-post-test experimental design with three condition groups: one experimental group that participated in concept-dependent play (i.e., play group), one experimental group that participated in concept-dependent sentence writing (i.e., sentence writing group), and a control group that received no intervention. A total of 118 students from a university in the U.K. who were adults and had a good or excellent fluency in the English language agreed to participate for £11.60.

While our context of interest in the current study is the business environment, we believe that a study with a student sample can provide insights and help us draw conclusions that can be extended to the organisational context. This is because the mechanism we investigate involves a fundamental process of creativity – the recall and use of concept associations to generate solutions (Runco, 2011) – that is not tied to any specific context.

The experiment, which was fully designed as a Qualtrics survey, involved reading instructions on a standard monitor and typing responses using a standard keyboard and a standard mouse on a laboratory computer. Participants completed it individually using separate computers during one of the available seven sessions. Recruited participants attended the experimental sessions they registered for and were randomly allocated into one of the three condition groups by Qualtrics. This meant that participants randomly allocated into the control group (no intervention) were likely to complete the experiment earlier. Indeed, some of the participants completed the experiment and left the laboratory earlier than others. To avoid disrupting the experiment with the departure of participants, we informed all the participants that some of them would complete the experiment earlier than others depending on the condition group they were randomly allocated into. Furthermore, we asked all the participants to complete the compensation form provided to them and raise their hand upon the completion of the experiment. Then, the experiment facilitator collected their compensation forms and provided them with their compensation. At that point, the participants quietly left the laboratory. However, despite these efforts to minimise the disruption, the early departure of some participants might have influenced the performance of the remaining participants on the post-intervention measures. We discuss this further in the limitations.

3.3.2. Tasks and Procedure

The experiment was divided into two parts, with a 10-minute break in between the two parts. In Part 1, all the participants were asked to consent to participate (see Section A of the supplementary materials for the consent form); were screened for age and fluency in the English language; provided their demographic characteristics; and completed a measure for each control variable (i.e., general intelligence, open-mindedness, and playfulness), a measure for ideational fluency and originality (i.e.,

the Alternate Uses Test (AUT)), and a measure for SAF and NSAF (i.e., the Continuous Free Word-Association Task (CFWAT)). Immediately after, all the participants were asked to take a 10-minute break before beginning Part 2. On beginning Part 2, all the participants were randomly allocated to one of the three condition groups by Qualtrics. Then, depending on their condition groups, they were asked to complete their respective interventions, a measure for ideational fluency and originality (i.e., the AUT), and a measure for SAF and NSAF (i.e., the CFWAT). Participants in the control group did not receive an intervention and, therefore, started Part 2 by completing the measure for ideational fluency and originality. Adding together the time necessary to complete all the measures, the interventions, and the break, we estimated that completing the experiment in full would require up to 116 minutes, independent of the condition group. The three participants recruited for a pilot study – one participant for each condition group – completed the experiment in under 101 minutes. Based on our estimations and the pilot study, we allocated 116 minutes for each experimental session.

3.3.3. Interventions

Concept-dependent play (play group). For the play group, we designed a play activity that involved exploration, imagination, engagement with remote concepts, flexibility of means and ends, and enjoyment. Following a similar route to that of Zabelina and Robinson (2010), we asked participants to imagine that they were 8 years old (elements of enjoyment and imagination) and to write 24 sentences describing their play during their next playdate with friends (elements of exploration, imagination, engagement with remote concepts, and flexibility of means and ends). Those sentences were to be used to write up an article for the school newspaper. We presented participants with 24 pairs of concepts (we call this set of concept pairs $C_{intervention}$) and asked them to write a sentence for each pair that included both concepts in their singular or plural form. We divided the 24 concept pairs into four groups of six, with each group centring around one of the following concepts: "table", "jar", "rock", and "pin" (we call this set of concepts C_{post}). We presented each group of concepts one at a time in its own concept page. We randomised the order in which the concept pages were presented to the participants during the intervention. We show the concept page for the concept "table" we presented to the play group in Figure 3.2.

116

In this activity, we classified sentences as describing a play activity if they (a) described play and (b) described how the actual objects would be used or how the objects would represent something else (symbolic transformation) in play. We classified sentences as not describing a play activity if they described activities other than play or simply described where the objects would be placed. For example, for the concepts "table" and "hat" two sentences that would be classified as describing a play activity would be the following sentences extracted from the participants' responses: "We will stand on the tables and wear hats" and "We will pass the hat, when the music stops, the child has to stand on the table and sing". Two sentences that would be classified as not describing a play activity would be the following sentences extracted from the participants' responses: "The hat is stuck under the table" and "I placed my hat on the table".

Concept-dependent sentence writing (sentence writing group). We were interested to clarify whether a simpler task of writing sentences with the same concept pairs was sufficient to deliver the possible positive effects of the play activity we designed. To achieve this goal, we also designed a sentence writing activity that was very similar to the play activity but lacked two defining characteristics of play activities: imagination and enjoyment. To minimise imagination and enjoyment from the sentence writing activity, we did not ask participants in this group to imagine that they were 8 years old and to write sentences describing their play. Rather, we simply informed them that we would present them with 24 pairs of concepts and ask them to write a sentence for each pair that included both concepts in their singular or plural form. Then, we presented the participants in this group with the same 24 concept pairs we presented to the play group and asked them to write a sentence for each pair. We presented the same 24 concept pairs divided into the same concept pages and with the same order on their respective concept pages.

The only difference between the concept pages we presented to the play group and the sentence writing group was that the pages we presented to the play group included the following description at the top: "You are 8 years old and you are writing sentences describing what you and your friends will be doing during your next playdate". To ensure that the play and sentence writing groups did not have any other differences, we also randomised the order in which the concept pages were presented to the participants of the sentence writing group.

In this activity, we expected participants to write sentences that would include the two concepts provided to them. For example, for the concepts "table" and "hat" we expected to read sentences like the following two sentences extracted from the participants' responses: "I usually place my hat on the table every time I go home" and "I left my hat on the table and forgot to bring it out with me today".

No intervention (control group). For the control group, we eliminated all activities so that we could capture the effects of the two interventions on the study's dependent variables compared to no intervention.

Duration of the interventions. Evidence from experimental work with children suggests that as little as 10 minutes of free or guided play with objects can significantly improve ideational originality on those objects (Dansky & Silverman, 1973; Li, 1978). Considering the limited number of studies examining the effects of single short interventions of concept-dependent play on adult ideational fluency and originality (i.e., Mourey, 2020) and the limited budget of the current research, we decided to restrict the interventions to 24 concept pairs. We estimated that, by dedicating an average of 50 seconds to write one sentence for each concept pair, participants in the play and sentence writing groups would require an average of 20 minutes to complete their respective interventions.

We provide more information about the selection of concepts for the interventions later in this section and present the instructions provided to the play and sentence writing groups in Section C of the supplementary materials.

3.3.4. Dependent Variables

Stereotypical and non-stereotypical associative fluencies. We measured SAF and NSAF both before and after the interventions using the Continuous Free Word-Association Task (CFWAT). The measure is compatible with Mednick's (1962) conceptualisation of continuous responding in the theory of associative hierarchies, and has been used in previous studies investigating individuals' ability to create and use stereotypical (i.e., SAF) and non-stereotypical (i.e., NSAF) associations (e.g., Benedek & Neubauer, 2013; Desiderato & Sigal, 1970; Mednick et al., 1964; Piers & Kirchner, 1971). For the measure, we asked participants to produce all the words that came to their minds for the concepts "stone", "drum", "cup", and "spear" (we call this

set of concepts C_{pre}) during the pre-intervention CFWAT and the concepts in C_{post} during the post-intervention CFWAT.

Even though most of the responses to the CFWAT were single words, participants provided some short phrases. For this reason, we coded single-word and short-phrase responses as valid responses. We were not able to find guidance on scoring short-phrase responses to the CFWAT. For this reason, we followed an approach similar to that of Fitzpatrick, Playfoot, Wray and Wright (2015), who scored short-phrase responses to a continued free word-association task (i.e., a task that asked participants to provide the first word that came to their minds). With the exception of names, labels, and titles, we separated short phrases into their individual words and coded the individual words. We did not score function words (e.g., "and", "or", "with", "I", "a", "the", "to") (see Fitzpatrick et al., 2015). We scored names, labels, and titles as one response.

To demonstrate the above with an example, consider the following response to the concept "paperclip": "books, stapler, puncher, silver colour, Harry Potter, clip a book, create figures to decorate my bedroom". In this example, each single-word response was coded as one response, the phrase "silver colour" was coded as two responses ("silver" and "colour"), the phrase "Harry Potter" was coded as one response, the phrase "clip a book" was coded as two responses ("clip" and "book"), and the phrase "create figures to decorate my bedroom" was considered invalid for the CFWAT and was not coded.

Previous studies on the theory of associative hierarchies operationalised a participant's ability to create and use remote associations (i.e., their NSAF) as the count of responses given only by the participant (e.g., Piers & Kirchner, 1971) or as the count of uniqueness points assigned by independent raters to the participant's responses (e.g., Benedek & Neubauer, 2013). Due to the limited budget of the current study, we used frequency-based scoring for both the CFWAT and the measure of ideational fluency and originality (i.e., the AUT). For the CFWAT, we followed an approach similar to the approach of frequency-based scoring for the AUT. More specifically, we categorised responses given by 5% or less of the participants as non-stereotypical and all other responses as stereotypical (e.g., Hainselin et al., 2018; Milgram & Rabkin, 1980). We followed this approach because it involves a less restrictive threshold for categorising responses as non-stereotypical than the approach

of Piers and Kirchner (1971), who categorised responses as non-stereotypical if they were provided by only one participant.

For each concept, we scored for *SAF* as the count of individually unique stereotypical responses listed by the participant and *NSAF* as the count of individually unique non-stereotypical responses listed by the participant. For each concept, we marked responses with a sample frequency between 0% and 5% (inclusive) (0% < frequency ≤ 5%) as non-stereotypical and all other responses as stereotypical. Incomplete, non-understandable, and repeated responses were not scored. We grouped together responses that represented the same concept but were written in a different form or spelling. For example, we scored both the responses "tv" and "television" as "television". We also scored together responses that could be perceived as the same verb in a different tense. For example, we scored both the responses "break" and "breaking" as "break/breaking".

Finally, we calculated a summative score of SAF and NSAF for the pre-intervention CFWAT by summing the participants' scores on the four concepts in C_{pre} and for the post-intervention CFWAT by summing the participants' scores on the four concepts in C_{post}. We used the summative scores for the analysis. The scores of the four concepts for pre-intervention (Cronbach's α = .793; mean inter-item correlations = .499) and post-intervention (α = .836, mean inter-item correlations = .585) SAF, and pre-intervention (α = .902, mean inter-item correlations = .702) and post-intervention (α = .920, mean inter-item correlations = .748) NSAF showed good internal consistency (Pallant, 2016).

Ideational fluency and originality. We measured ideational fluency and originality both before and after the interventions using the Alternate Uses Test (AUT). The AUT is considered a valid measure for ideational fluency and originality in children and adults (Benedek et al., 2012; Coney & Serna, 1995; Hass, 2015; Lewis & Lovatt, 2013; Moore & Russ, 2008; Ochse & Van Lill, 1990; Olczak & Kaplan, 1969; Russ & Kaugars, 2001). We asked participants to provide as many uses as they could consider for the concepts in C_{pre} during the pre-intervention AUT and the concepts in C_{post} during the post-intervention AUT. Example responses to the AUT for the concept "paperclip" would be: "use as bookmark, reset a mobile phone, make a figure, craft a necklace". Assessing ideational fluency and originality with an

electronically administered AUT has been found to be feasible and reliable (Hass, 2015).

For each concept, we coded for *ideational fluency* as the count of individually unique uses listed by the participant and *ideational originality* as the count of uniqueness points assigned to the participant for each individually unique use listed. When scoring for ideational originality, we assigned 2 uniqueness points for each use with a sample frequency between 0% and 1% (inclusive) ($0\% < \text{frequency} \leq 1\%$) and 1 uniqueness point for each use with a sample frequency between 1% (not inclusive) and 5% (inclusive) ($1\% < \text{frequency} \leq 5\%$) (e.g., Hainselin et al., 2018; Milgram & Rabkin, 1980). Incomplete, non-understandable, repeated, and inadequate (e.g., "sell it", "clean it") uses were not scored.

Finally, we calculated a summative score of ideational fluency and originality for the pre-intervention AUT by summing the participants' scores on the four concepts in C_{pre} and for the post-intervention AUT by summing the participants' scores on the four concepts in C_{post}. We used the summative scores for the analysis. The scores of the four concepts for pre-intervention ($\alpha = .864$, mean inter-item correlations = .618) and post-intervention ($\alpha = .827$, mean inter-item correlations = .551) ideational fluency, and pre-intervention ($\alpha = .723$, mean inter-item correlations = .399) and post-intervention ($\alpha = .709$, mean inter-item correlations = .380) ideational originality showed good internal consistency (Pallant, 2016).

We asked all the participants to produce responses for 3 minutes per stimulus concept for both the CFWAT and AUT, which is as long as the longest time-restricted continuous responding task reviewed for this study (i.e., Desiderato & Sigal, 1970). This resulted in a pre- and post-intervention CFWAT and AUT that each required 12 minutes to complete. A clock of a 3-minute interval, which appears to have no effect on the time participants spend completing an AUT (Hass, 2015), was presented to all the participants for each stimulus concept when completing both measures. To prompt participants to write for as long as possible (Hass, 2015), participants were asked to continue writing until the end of the 3-minute intervals ("Please try and continue to write until the end of the 3-minute interval."). Furthermore, participants were not able to move to the next stimulus concept before the end of the 3-minute interval dedicated to each stimulus concept. Imposing a 3-minute time limit per stimulus concept appears to better capture ideational fluency and originality compared to allowing participants

121

to advance to the next task when they believe they have completed the task (Hass, 2015). This is likely because individuals tend to spend as much time on a task as they can quickly think of responses and then move to the next task (Hass, 2015).

The order in which the concepts were presented to the participants during the pre- and post-intervention CFWAT and AUT was randomised. To compute the sample frequency of responses for each concept that was used to calculate NSAF and ideational originality, we created a lexicon containing all the unique responses provided by all the participants. Then, we calculated the sample frequency of each response as the percentage of participants who provided that response for the concept. All data was anonymised and the first author, who scored the responses of all the participants, was unaware of the participants condition groups.

We provide more details on the selection of the AUT as the measure for ideational fluency and originality and on the instructions we provided to the participants for the CFWAT and AUT in Sections B and C of the supplementary materials. We also present more information about the scoring of the two measures in Section D of the supplementary materials.

3.3.5. Control Variables

We measured three control variables known to affect divergent thinking: general intelligence (Russ & Wallace, 2013), preference to have a wide range of mental experiences (i.e., open-mindedness (Soto & John, 2017a)) (Benedek et al., 2012; Zabelina & Robinson, 2010), and playfulness (Russ & Christian, 2011).

General intelligence. To measure general intelligence, we administered the 11 Matrix Reasoning (11MR) online measure of The International Cognitive Ability Resource (ICAR; https://icar-project.com), which consists of 11 items similar to those used in Raven's Progressive Matrices (Condon & Revelle, 2014). Each item contains a 3 x 3 array of geometric shapes as the stimulus with one of the nine shapes missing. Each item also contains six geometric shapes as possible responses to the stimulus, with one of the six geometric shapes correctly completing the stimulus by taking the place of the missing shape. The measure asks participants to select the response that correctly completes the stimulus. Completing the measure requires 10 to 15 minutes. When completing the measure, all the participants were restricted by a 15-minute upper limit but were able to move to the next task earlier should they wished to.

Open-mindedness. To measure open-mindedness, we administered the short version of the Next Big Five Inventory (BFI-2-S; Soto & John, 2017a, b). The measure asks participants to rate their agreement with 30 self-report statements using a 5-point likert scale ranging from 1 (disagree strongly) to 5 (agree strongly). BFI-2-S measures each of the five personality traits (i.e., extraversion, agreeableness, conscientiousness, negative emotionality, and open-mindedness) with six self-report statements. Completing the measure requires three to five minutes. The validation conducted by the authors of the measure indicates that the BFI-2-S retains most of the reliability and validity of BFI-2 at the trait level and is useful in assessing personality traits in research contexts where overall assessment time prohibits the administration of the full BFI-2 (Soto & John, 2017a, b).

The six items measuring open-mindedness showed poor internal consistency (α = .526, mean inter-item correlations = .158). A closer inspection revealed that items 5 and 20 (reversed) representing the "aesthetic sensitivity" facet of the trait had negative correlations with other items of the trait, the smallest corrected item-total correlations, and the highest Cronbach's alphas if deleted (α if item 5 deleted = .543, α if item 20 deleted = .539). A principal axis factor analysis (FA) with direct oblimin rotation also showed that item 5 had a KMO sampling adequacy index below .5 (item 5 KMO = .452, item 15 KMO = .477). Items 5 and 20 were the only items that had a negative loading on the first of the three factors recommended by the analysis (item 5 loading = -.097, item 20 loading = -.075). Based on these findings, we recalculated the open-mindedness score excluding items 5 and 20. The recalculated score showed acceptable internal consistency (α = .573, mean inter-item correlations = .253) (Pallant, 2016) and was used in the analysis.

Playfulness. To measure playfulness, we administered the Short Measure for Adult Playfulness (SMAP; Proyer, 2012; Proyer & Ruch, 2011). The measure asks participants to rate their agreement with five self-report statements using a 4-point likert scale ranging from 1 (strongly disagree) to 4 (strongly agree). Validation yielded encouraging first evidence for the validity of SMAP as a time-effective measure for adult playfulness (Proyer, 2012; Proyer & Ruch, 2011). The five items of the measure showed good internal consistency (α = .796, mean inter-item correlations = .451) (Pallant, 2016).

3.3.6. Selecting Concepts for the Measures and the Interventions

Research on continuous responding in the context of associative hierarchies has revealed that a stimulus' frequency of occurrence in the English language (low vs high), form (noun vs adjective), abstractness (concrete vs abstract), and associative hierarchy (flat vs steep; stimuli with steep associative hierarchies are defined as stimuli that elicit one dominant association and other associations of low association strength; stimuli with flat associative hierarchies are defined as stimuli that do not elicit any dominant associations) can influence concept production (Desiderato & Sigal, 1970; Mednick et al., 1964; Piers & Kirchner, 1971). With the selection of the AUT as the measure for ideational fluency and originality (i.e., "provide all the possible uses"), all concepts for the CFWAT, the AUT, and the interventions needed to be concrete as opposed to abstract and nouns as opposed to adjectives.

With the selection of a single-session pre-test-post-test experimental design, participants needed to complete the CFWAT and AUT before and after the interventions. To minimise any possible training effects of the pre-intervention measures on the post-intervention measures, the concepts in the pre- and post-intervention CFWAT and AUT needed to be different. To ensure that the two sets of concepts used in the pre- and post-intervention CFWAT and AUT were as analogous as possible, both sets needed to include four concrete nouns: two concepts with a high and two concepts with a lower frequency in the English language and two concepts with a steep and two concepts with a flat associative hierarchy.

To select concrete nouns with high and lower frequency in the English language, we compiled two lists using the Thorndike-Lorge Frequency List of English words (Thorndike & Lorge, 1944) – one list for the concepts with high frequency and one list for the concepts with lower frequency. To the best of our knowledge, the Thorndike-Lorge Frequency List is the most comprehensive of the available corpus lists and does not significantly differ from the more recent American Heritage Word Frequency Book developed in 1971 (Dinnan, 1975). The Thorndike-Lorge Frequency List has also been used in earlier studies on the theory of associative hierarchies (e.g., Desiderato & Sigal, 1970; Mednick et al., 1964). For the list of concepts with high frequency, we reviewed the list of the 500 most frequently used and the next 500 mostly frequently used words (Thorndike & Lorge, 1944: 267-270). All concepts in this list appeared 100 or more times per million words in the texts analysed. For

concepts with lower frequency, we reviewed the list of words occurring at least once per million words in the texts analysed (Thorndike & Lorge, 1944: 1-208). From this list, we selected all the concepts that appeared from 40 to 49 times per million words. From the two lists, we removed concepts that were not solid objects that could be easily manipulated in the physical world (see Sutton-Smith, 1967) (e.g., locations, professions, names, titles, general categories such as "animal", familial relationships, colours, shapes, units of measurement, buildings, territories, liquids, food, objects difficult to move such as "stove", and material such as "glass"). Combined, the two lists comprised the selected concepts for the experiment.

In categorising concepts into steep and flat associative hierarchies, we used the recent work of De Deyne, Navarro, Perfors, Brysbaert and Storms (2019). In their study, De Deyne et al. (2019) asked 88722 participants to provide the first three responses that came to their minds for 14 to 18 stimulus concepts from a list of 12292 concepts. Their final dataset consists of responses from 83863 participants for 12217 concepts. We selected De Deyne et al.'s (2019) processed data containing the first responses by 100 participants and ordered the responses for each of the selected concepts in terms of frequency. We classified concepts having their most frequent response leading with at least 15% difference in frequency compared to the second most frequent response as concepts with a steep associative hierarchy and the remaining as concepts with a flat associative hierarchy. We present the refined list of the selected concepts in Table 3.1.

After categorising the selected concepts, we used the *sample* function in R to randomly select four concepts for the pre-intervention (C_{pre}) and four concepts for the post-intervention (C_{post}) CFWAT and AUT. The concepts were selected in such a way that both concept sets consisted of one concrete noun with high frequency in the English language and a steep associative hierarchy, one concrete noun with lower frequency in the English language and a steep associative hierarchy, one concrete noun with high frequency in the English language and a flat associative hierarchy, and one concrete noun with lower frequency in the English language and a flat associative hierarchy.

Since we were interested in the effects of play with specific concepts on NSAF and ideational fluency and originality related to those concepts, the interventions of the current work needed to involve the participants' engagement with the concepts in

C_{post}. To create the set of concept pairs for the interventions ($C_{intervention}$), we used the *sample* function in R to randomly select six concepts for each concept in C_{post}: three concepts from the list of concepts with high frequency in the English language and three concepts from the list of concepts with lower frequency in the English language, independent of their associative hierarchy. With this process, we created 24 concept pairs that could be divided into four groups of six, with each group centring around one of the concepts in C_{post}. We present the concept sets C_{pre}, $C_{intervention}$, and C_{post} in Table 3.2.

3.3.7. Data

We began preparing the data for analysis by identifying participants who did not provide at least one valid response for each concept presented to them when completing the pre- and post-intervention CFWAT and AUT. We classified these participants as participants who did not complete the experiment in full. Of the 118 recruited participants, 18 did not complete the experiment in full and were excluded from the analysis.

Next, we looked at the responses of the participants in the play and sentence writing groups to their respective interventions. We wanted to ensure that we only included in the analysis the participants who had adequately engaged with the activities of their interventions. To make sure that we included as many participants as possible in the analysis, we included all the participants who appropriately engaged with at least half of the concept-pairs provided to them for at least three of the core concepts of the interventions ($C_{intervention}$ core concepts: "table", "jar", "rock", and "pin"). Seven of the participants in the play group did not write at least three sentences describing play for at least three of the core concepts of the intervention and, therefore, they were excluded from the analysis. All participants in the sentence writing group wrote at least three sentences for all the core concepts of the intervention and, therefore, none was excluded from the analysis.

For outlier detection and management, we looked for potential error outliers using boxplots as the visual tool and standard deviation analysis as the quantitative technique for single-construct analysis (Aguinis, Gottfredson & Joo, 2013: 276). For standard deviation analysis we looked for scores greater than ± 2.24 standard deviation units away from the mean (Aguinis et al., 2013: 282-283). We looked for potential

error outliers in the pre-intervention scores of SAF, NSAF, ideational fluency, and ideational originality for the four concepts and their respective summative scores. We also looked for outliers in the post-intervention scores of the same variables for the four concepts and their respective summative scores. The reason we reviewed the individual scores for the four concepts was to ensure that none of these scores, which contribute to their respective summative scores, were error outliers. This inspection revealed that 32 participants had at least one score that was flagged as a potential error outlier by the boxplots or the standard deviation analysis (for more information see Section G of the supplementary materials).

After verifying that none of the scores of the 32 participants were error outliers, we looked for interesting outliers (Aguinis et al., 2013) in the summative scores that we would use in hypothesis testing. We identified that four participants were consistently outperforming their groups in both the pre- and post-intervention measurements: one participant in the play group, one participant in the sentence writing group, and two participants in the control group. Including the four participants in the dataset resulted in the kurtosis of the dependent variables of the study being above ± 2 for all condition groups, demonstrating a violation of the assumption of normality (George & Mallery, 2020). To address this violation, we excluded the four participants from the study (Field, 2018), which resulted in the skewness and kurtosis of the dependent variables being below ± 2 for all condition groups, demonstrating acceptable normality (George & Mallery, 2020). The final dataset consisted of data from 89 participants: 25 in the play group, 32 in the sentence writing group, and 32 in the control group.

Of the 89 participants, 82 (92.1%) were 18 to 24 years old; 65 (73%) had an excellent fluency in the English language, 49 (55.1%) were female; 58 (65.2%) were Asian, Asian British, or Asian American and 27 (30.3%) were White; 50 (56.2%) had a high school graduate diploma or equivalent; and 73 (82%) were full-time students in undergraduate degrees. The three condition groups did not significantly differ in their demographic characteristics and the day and time they completed the experiment based on the Fisher's exact tests and the likelihood ratios (Field, 2018). We present the descriptive statistics and the comparisons of the condition groups on the demographic characteristics in Section H of the supplementary materials.

3.4. Results

For the analysis, we used IBM SPSS Statistics 26. We present the raw descriptive statistics of the dependent and control variables in Table 3.3 and their Pearson correlations in Table 3.4. To test Hypotheses 3 and 4, we used multiple hierarchical regression using Hayes' PROCESS macro Model 4 with condition group as the multi-categorical independent variable, post-intervention NSAF as the mediator, and post-intervention ideational fluency and originality as the dependent variables. We controlled for general intelligence, open-mindedness, and playfulness. Following Hayes' (2018) recommendations for repeated measures designs, we also controlled for pre-intervention NSAF and ideational fluency when testing Hypothesis 3 and pre-intervention NSAF and ideational originality when testing Hypothesis 4. To estimate confidence intervals for indirect effects, we used bootstrapping (10,000 samples, seed = 20200813).

Supporting Hypothesis 1, both pre- and post-intervention SAF had a significant positive relationship with ideational fluency (pre-intervention $r = .583$, $p < .01$; post-intervention $r = .671$, $p < .01$). In support of Hypotheses 2a and 2b, pre- and post-intervention NSAF had a significant positive relationship with ideational fluency (pre-intervention $r = .493$, $p < .01$; post-intervention $r = .658$, $p < .01$) and ideational originality (pre-intervention $r = .526$, $p < .01$; post-intervention $r = .641$, $p < .01$). Pre- and post-intervention SAF also had a significant positive relationship with ideational originality (pre-intervention $r = .447$, $p < .01$; post-intervention $r = .486$, $p < .01$).

Before testing Hypotheses 3 and 4, we confirmed that the skewness and kurtosis of post-intervention NSAF, ideational fluency, and ideational originality were below ± 2 for all condition groups (see Table 3.3), demonstrating acceptable normality (George & Mallery, 2020). We also confirmed that the assumptions of homoskedasticity and homogeneity of regression slopes were met for these three dependent variables. We present the results of these tests in Section I of the supplementary materials. When testing Hypotheses 3 and 4, we found that concept-dependent play and concept-dependent sentence writing had indirect effects on ideational fluency and originality through their direct effects on NSAF. However, the effects were in the opposite direction to the one we expected. We present the results for Hypotheses 3 and 4 in Tables 3.5 and 3.6, respectively.

Participants in the play group who engaged in concept-dependent play (a_2 = -14.937, p < .001) and the sentence writing group who engaged in concept-dependent sentence writing (a_1 = -8.615, p = .005) exhibited significantly lower NSAF compared to the control group who did not engage in an intervention, rejecting H3a. Participants who exhibited higher NSAF exhibited higher ideational fluency (b = .226, p = .001), supporting H3b. Bootstrap confidence intervals for the indirect effects of concept-dependent play (a_2b = -3.382; SE = 1.284; CI 95% = [-6.280, -1.253]) and concept-dependent sentence writing (a_1b = -1.951; SE = .979; CI 95% = [-4.246, -.449]) based on 10,000 bootstrap samples were entirely below zero. There was no evidence that participating in concept-dependent play (c'_2 = -.619, p = .765) or concept-dependent sentence writing (c'_1 = -.387, p = .830) influenced ideational fluency independent of their effects on NSAF.

Similarly, participants in the play (a_2 = -14.774, p < .001) and sentence writing (a_1 = -7.831, p = .009) groups exhibited significantly lower NSAF compared to the control group, rejecting H4a. Participants who exhibited higher NSAF exhibited higher ideational originality (b = .175, p = .018), supporting H4b. Bootstrap confidence intervals for the indirect effects of concept-dependent play (a_2b = -2.582; SE = 1.387; CI 95% = [-5.657, -.267]) and concept-dependent sentence writing (a_1b = -1.369; SE = .881; CI 95% = [-3.473, -.066]) based on 10,000 bootstrap samples were entirely below zero. There was no evidence that participating in concept-dependent play (c'_2 = -2.379, p = .306) or concept-dependent sentence writing (c'_1 = -.271, p = .892) influenced ideational originality independent of their effects on NSAF.

To get a better understanding of these results, we followed up this analysis with paired samples t-tests on NSAF and ideational fluency and originality. We found that the pre- and post-intervention NSAF of the play (b = -2.680, p = .221) and sentence writing (b = 4, p = .097) groups did not significantly differ, while the control group demonstrated significantly higher post-intervention NSAF (b = 7.688, p = .001). We also found that the pre- and post-intervention ideational originality of the sentence writing (b = -.969, p = .578) and control (b = 1.750, p = .189) groups did not significantly differ, while the play group demonstrated significantly lower post-intervention ideational originality (b = -3.560, p = .026). Differences in ideational fluency were not significant for either group (play group: b = -1.520, p = .303; sentence writing group: b = -.781, p = .536; control group: b = 1.813, p = .182).

3.5. Discussion

Most of the mechanisms explaining how play can stimulate creativity inside and outside the organisational context have not been described in detail (Petelczyc et al., 2018; Russ & Wallace, 2013) and none have been experimentally tested. In this essay, we address this limitation by describing and experimentally testing one of the possible mechanisms by which play can promote ideational fluency and originality – two cognitive abilities important to creativity (Runco, 2011; Russ, 2018). We describe how play can lead to improvements in NSAF, which in turn can lead to improvements in ideational fluency and originality. We develop hypotheses based on this mechanism and test those hypotheses using data from a single-session pre-test-post-test experimental design.

The results for Hypotheses 1 and 2 are in line with earlier research on the theory of associative hierarchies (e.g., Benedek et al., 2012; Benedek & Neubauer, 2013; Marron & Faust, 2018) and support the proposition that SAF facilitates ideational fluency and the proposition that NSAF facilitates ideational fluency and originality – two propositions deriving from the theory of associative hierarchies (Mednick, 1962). This suggests that the mechanism we describe and test in this study merits further exploration in future research.

The theory of associative hierarchies suggests that individuals use their stereotypical associations to generate stereotypical solutions and their non-stereotypical associations to generate non-stereotypical solutions (Mednick, 1962). For this reason, we would expect SAF to have no relationship with ideational originality. Nevertheless, we found that SAF and ideational originality had a significant positive relationship. It is possible that SAF and ideational originality do indeed have a significant positive relationship that is not explained through the theory of associative hierarchies. However, it is also possible that the positive correlations we identified were the result of our study's research design. We discuss this further in the limitations.

The results for Hypotheses 3 and 4 were mixed in that concept-dependent play (play group) and concept-dependent sentence writing (sentence writing group) had a negative rather than a positive indirect effect on ideational fluency and originality through their direct influence on NSAF. These negative results might have been due

to a negative effect caused by the two interventions on NSAF, ideational fluency, and ideational originality.

However, it is also possible that the two interventions did not have any effect. Follow-up paired samples t-tests showed that participants who did not receive an intervention (control group) demonstrated significantly higher post- than pre-intervention NSAF. They also showed that participants in the play group demonstrated significantly lower post- than pre-intervention ideational originality. The descriptive statistics for the three condition groups also show that (a) both the play and sentence writing groups demonstrated higher pre-test NSAF, ideational fluency, and ideational originality than the control group, (b) NSAF decreased for the play group and increased for the sentence writing and control groups at the post-test, and (c) ideational fluency and originality decreased for the play and sentence writing groups and increased for the control group at the post-test (see Table 3.3). These observations suggest that the negative results for Hypotheses 3 and 4 might have been due to a regression to the mean at the post-test for all three condition groups rather than a negative effect caused by the two interventions. In other words, it is possible that completing one of the two interventions of the study (play and sentence writing groups) and not completing an intervention (control group) did not affect NSAF, ideational fluency, and ideational originality in any way. Rather, the groups regressed to their respective means on the three variables at the post-test, creating the impression that the two interventions had a negative indirect effect on ideational fluency and originality through their direct influence on NSAF.

While the play intervention was not effective in promoting ideational fluency and originality through its direct effect on NSAF, this study contributes to the literature in six ways. First, by being the first study to describe in detail and experimentally test one of the possible mechanisms behind the play-creativity relationship, the study paves the way for more empirical research on the mechanisms of the relationship. Second, it adds to our limited understanding of how play design characteristics relate to the possible mechanisms and creativity-related outcomes discussed in the literature. As more management scholars engage in this in-depth examination of the relationship, the ways in which play design characteristics, mechanisms, and outcomes relate to each other can become clearer. And a clear understanding of their relationship can serve as a good guide for the design and selection of play that stimulates creativity in

the workplace. Third, the study provides support to the proposition that SAF facilitates ideational fluency and the proposition that NSAF facilitates ideational fluency and originality. This suggests that the mechanism we describe is worthy of further examination.

Fourth, the study adds to the limited number of studies experimentally testing the relationship between play and divergent thinking in adults. To this day, only 15 experimental studies have examined and reported the effects of play on adult divergent thinking and creativity (Campion & Levita, 2014; Dyson et al., 2016; Felsman et al., 2020; Karakelle, 2009; Karwowski & Soszynski, 2008; Kirsten & Du Preez, 2010; Lewis & Lovatt, 2013; Mourey, 2020; Richard et al., 2020; Tsai, 2012; West et al., 2017; Zabelina & Robinson, 2010). All but two of the studies found positive effects, suggesting that play can be a viable option for those interested in promoting organisational creativity. However, these studies are so limited in their number and so diverse in their play design characteristics (e.g., solitary constructive play for 20 minutes in Tsai, 2012 vs group thematic play for 7.5 hours in West et al., 2017) that developing a firm understanding of the play-creativity relationship based on them is challenging. By adding to this small set of studies, this work takes the research community a step closer toward a better understanding of the relationship.

Fifth, and related to the fourth contribution, the essay adds to the broader literature on organisational creativity. It does so by adding to the small set of studies that empirically tests the viability of play as a way of promoting creativity-related abilities at work and, potentially, encouraging more researchers to do the same in the future.

Finally, the study introduces the idea of computer-based play that involves mental rather than physical engagement with concepts. This medium of delivering play for creativity has not been explored in previous experimental studies on the topic. We believe that computer-based play is worth exploring in the future, because it can be resource efficient in terms of space, materials, and facilitation. Because of that, it can allow for business resources that would otherwise be required for play to be allocated to other projects. It can also be an option for organisations in which employees cannot participate in face-to-face play interventions.

It is possible that the play intervention in the current study was not effective because play, in general, is not effective in promoting ideational fluency and

originality (Lillard et al., 2013). It is also possible that play can be effective (Dyson et al., 2016; Karakelle, 2009; Karwowski & Soszynski, 2008; Kirsten & Du Preez, 2010; Lewis & Lovatt, 2013; Russ & Wallace, 2013; Silverman, 2016; West et al., 2017; Zabelina & Robinson, 2010) but the play intervention we administered in the current study was not. This could be due to the research design limitations of our study as well as the play design characteristics of the play intervention we administered. In what follows, we discuss the research design and play design limitations of the study that might have led to the play intervention not being effective. We also provide recommendations for how to address these research design limitations and for how to improve the play intervention in future research.

3.5.1. Research Design Limitations and Recommendations for Future Research

In designing the current study, we took a series of actions to minimise possible threats to internal and external validity (Campbell & Stanley, 1966; De Winter & Dodou, 2017; Pitts et al., 2005). We list those actions in Section E of the supplementary materials. What is more, while conducting the experiment in the laboratory and scoring the CFWAT and AUT, we noted some design limitations that could be addressed in future research. The first limitation relates to the length of the experiment and to the level of difficulty of the interventions. Since the control group did not receive an intervention, the experiment was longer for both the play and sentence writing groups. It is possible that the participants in the play and sentence writing groups experienced respondent fatigue (De Winter & Dodou, 2017), which led to the interventions having a negative effect, the interventions having no effect, or the participants performing poorly in the post-intervention measurements. Future research could consider asking participants to complete the pre-intervention measures, the interventions, and the post-intervention measures on different days to minimise fatigue.

In addition, the intervention of the play group was characterised as hard by some participants who piloted the task in the early stages of the study. It is possible that participants in the play group also found the activity challenging because it is generally challenging for them to engage in play (Dansky, 1980b; Dyson et al., 2016; Hoffmann & Russ, 2016; Karwowski & Soszynski, 2008). Future research could

consider individualisation and scaffolding to help participants engage in the play activity (e.g., Dyson et al., 2016; Fehr & Russ, 2016; Karwowski & Soszynski, 2008).

Even though we were interested in introducing all the characteristics of play in the intervention of the play group, we did not ask participants whether they found the intervention to be absorbing and enjoyable. This means that participants might not have experienced the activity as play. This is a limitation of many studies in the field, including the current one. Future research could consider introducing a measure asking participants to rate their experience.

Another limitation relates to the sequence in which the CFWAT and the AUT were completed. This sequence can entail a form of training bias in that completing the CFWAT before completing the AUT can influence divergent thinking. This can be derived from the findings of Freedman (1965), who engaged in creativity training using word-association tasks. Specifically, Freedman (1965) observed improvements in creativity as measured by the Remote Associates Test (RAT) after a CFWAT. Such improvements were not observed after continued free word-association tasks (Caron, Unger & Parloff, 1963; Maltzman, Belloni & Fishbein, 1964). Freedman (1965) argues that this is possibly because, during a CFWAT, individuals recall and use a number of associations in a short period of time, which is what is required to solve the problems in the RAT. To minimise training effects on ideational fluency and originality in the current study, we administered the AUT before the CFWAT both before and after the interventions. However, though more research is needed on this front, it is possible that completing the AUT first might have affected the participants' performance on the CFWAT. This highlights the need for more research on the training effects caused by the order in which the measures are administered. Until more research is conducted on these potential training effects, future research could consider asking participants to complete the measures on different days to minimise immediate training effects.

It is also possible that the participants' performance on the intervention tasks, the CFWAT, and the AUT was limited by the participants' ability to express their thoughts in the written form of the English language. Future research could consider administering the interventions and measures orally (e.g., Desiderato & Sigal, 1970).

We expected that participants in the control group would complete the experiment and leave the laboratory earlier than the play and sentence writing groups.

We informed participants that some of them would complete the experiment earlier than others depending on the condition group they were randomly allocated into. We also implemented a procedure to ensure that participants left the laboratory as quietly as possible. Nevertheless, it is likely that the departure of participants from the laboratory before the end of a session had a negative impact on the performance of the remaining participants on the post-intervention measures. Future research could consider asking participants to complete the pre-intervention measures, the interventions, and the post-intervention measures on different days so that all the participants complete the same measures at the same time and leave the laboratory at the same time.

To minimise any possible training effects of the pre- on the post-intervention measures, we used different concepts in the pre-intervention (C_{pre}) and the post-intervention (C_{post}) CFWAT and AUT. We selected the four concepts in C_{pre} and the four concepts in C_{post} so that the two sets were analogous in terms of abstractness (four concrete), form (four nouns), frequency in the English language (two lower and two high), and associative hierarchy (two steep and two flat). However, it is still possible that C_{pre} and C_{post} were not analogous enough. Future research could consider selecting more analogous concepts or using the same concepts at the pre-test and post-test and administering the two tests on different days. Using the same concepts at the pre-test and post-test could also help clarify the effects of a play intervention on SAF, NSAF, ideational fluency, and ideational originality depending on the participants' associative hierarchies on those concepts. Also related to the concepts involved in the experiment, it is likely that the concept pairs in $C_{intervention}$ were not remote enough for NSAF to have improved after the interventions. Future research could consider selecting concept pairs characterised by greater remoteness (i.e., pairs in which the two concepts are less related).

We should also note that research establishing word-association norms involves continued word-association tasks that ask participants to provide the first one to three words that come to their minds (e.g., De Deyne et al., 2019; Fitzpatrick et al., 2015). As a result, any classifications of concepts as having steep or flat associative hierarchies are not based on CFWATs that are compatible with Mednick's (1962) conceptualisation of continuous responding. This is also the case for any estimations of the association strength between two concepts. Future work on word-association

norms could address this limitation in the literature. Future research on this topic could also seek to standardise the scoring of short-phrase responses as well as the grouping of responses (e.g., same verb in different tense) to the CFWAT.

The correlation between ideational fluency and originality was greater than .8, suggesting that the two could not be interpreted independently (see Benedek et al., 2012). This highlights the need to consider the selection and scoring of divergent thinking tests (DTTs) (Reiter-Palmon et al., 2019) as well as the administration of additional DTTs (Fehr & Russ, 2016) in future research. The administration of several DTTs needs to be implemented with caution because, as we mention earlier in this section, the training effects caused by the order in which the tests are administered needs to be investigated further.

The significant positive correlations between SAF and both ideational fluency and originality is another indication that ideational fluency and originality could not be interpreted independently. Future research scoring measures of divergent thinking could consider a different scoring approach that reduces the confounding effects of ideational fluency on originality (see Forthmann et al., 2020). For example, future research could score for *stereotypical ideational fluency (SIF)* as the number of stereotypical solutions, for *non-stereotypical ideational fluency (NSIF)* as the number of non-stereotypical (original) solutions (e.g., Dansky & Silverman, 1973, 1975), and for *ideational fluency (IF)* as the sum of the two scores. Following this scoring method, we would expect to find significant positive relationships between AF and IF, AF and SIF, AF and NSIF, SAF and IF, SAF and SIF, NSAF and IF, and NSAF and NSIF. We would also expect to find no significant relationships between SAF and NSIF and between NSAF and SIF.

Another research design limitation of our study relates to the length of the post-intervention CFWAT and AUT we administered. Since what we propose is that play promotes ideational fluency and originality by promoting NSAF, the effects of play through the mechanism we describe can only be observed after stereotypical associations are exhausted. This means that tests measuring the effects of play through the mechanism we describe will need to be at least long enough for stereotypical associations to be exhausted. It is possible that the 3-minute intervals of the CFWAT and AUT we administered were not long enough to capture the effects of the play intervention. Future research could seek to identify the least amount of time required

for measures of AF and divergent thinking to capture the effects of play through the mechanism we describe.

Finally, to avoid issues relating to administration and scoring, future research could consider creative outputs that do not require administration and scoring, such as the number of creative projects introduced (e.g., Vera & Crossan, 2005) by employees who participate in a play intervention. Future research in the organisational context could also consider recruiting a larger and more representative sample. We discuss additional lessons learned in Section F of the supplementary materials.

3.5.2. Recommendations for Play Intervention Refinements for Future Research

In addition to addressing the limitations we discuss above, future research on the mechanism we describe could refine the play intervention of the current study. For guidance on refining the intervention, researchers could look at the available reviews of the literature. For example, Dansky (1999) found that interventions with 8 to 12 small-group sessions of guided sociodramatic and thematic play that each last 20 to 30 minutes can be effective in promoting divergent thinking in children. Based on these findings, researchers could administer multiple frequent sessions of solitary concept-dependent play in order to investigate the effects of dosage on NSAF and ideational fluency and originality. Studies could also administer the sessions in small groups in order to investigate the effects of group rather than solitary concept-dependent play. Finally, future research could administer thematic play that involves the concepts of interest in order to investigate the effects of concept-dependent thematic play on the three abilities.

3.6. Tables and Figures

Table 3.1. Concepts Considered for the Measures and the Interventions

Flat Associative Hierarchy				Steep Associative Hierarchy			
High Frequency in the English Language							
bag	ball	board	box	*book	*branch	*chain	coat
chair	clothes	cup	dress	hat	*stone	table	
flower	picture	ring	rock				
shoe	stick	watch	weight				
Lower Frequency in the English Language							
bench	brick	candle	doll	*blossom	drum	feather	*glove
file	hay	hook	jewel	jar	painting	*rug	*saddle
mirror	pearl	pencil	pin	*throne			
pot	rod	shield	shirt				
spear	straw	whip					

Note: * = Concepts having their most frequent response leading with at least 20% difference in frequency compared to the second most frequent response.

Table 3.2. Concepts Selected for the Measures and the Interventions

Activity	Concept Set
Pre-intervention CFWAT and AUT (C_{pre})	stone, drum, cup, spear
Interventions ($C_{intervention}$)	table: hat, coat, book, candle, hook, file
	jar: ring, bag, book, glove, straw, feather
	rock: ball, bag, watch, glove, throne, jewel
	pin: clothes, branch, shoe, saddle, pot, jewel
Post-intervention CFWAT and AUT (C_{post})	table, jar, rock, pin

Notes: CFWAT = Continuous Free Word-Association Task | AUT = Alternate Uses Test.

Table 3.3. Raw Descriptive Statistics of the Dependent and Control Variables

Variable	Group	Min.	Max.	Mean	Std. D.	Skewness	Kurtosis
General Intelligence	Play	1	11	8.2	2.843	-1.154	.482
	SW	2	11	7.28	2.691	-.352	-1.04
	Cont.	1	10	6.44	2.341	-.358	-.485
Open-mindedness	Play	11	19	14.64	2.079	-.17	-.284
(4 items)	SW	9	20	14.06	2.951	.305	-.777
	Cont.	8	19	14.03	3.011	.066	-.799
Playfulness	Play	5	20	13.88	3.407	-.28	.847
	SW	6	18	14.31	3.197	-.992	.42
	Cont.	9	20	15.03	2.741	.105	-.313
Pre-int. SAF	Play	22	72	45.4	13.874	.346	-.828
	SW	31	78	47.69	12.188	.499	-.442
	Cont.	16	69	40.97	14.959	.216	-1.076
Pre-int. NSAF	Play	7	79	34.68	19.725	.791	.007
	SW	8	86	40.31	20.354	.247	-.603
	Cont.	5	77	29.62	18.531	.963	.439
Pre-int. Ideational	Play	13	65	35.6	11.369	.417	.668
Fluency	SW	22	59	39.47	10.169	.126	-.758
	Cont.	16	66	30.91	10.059	1.278	3.287*
Pre-int. Ideational	Play	4	51	20.48	10.349	.828	1.925
Originality	SW	6	36	22.34	8.679	-.222	-1.131
	Cont.	4	46	15.72	9.943	1.209	1.481
Post-int. SAF	Play	24	69	44.6	14.297	.184	-1.457
	SW	18	79	46.5	14.861	.153	-.303
	Cont.	15	79	41.5	18.091	.467	-.959
Post-int. NSAF	Play	8	80	32	20.646	.745 (1.912)	-.577 (4.955*)
	SW	5	114	44.31	25.732	.647 (.847)	.455 (.695)
	Cont.	4	95	37.31	26.698	.944 (1.089)	.112 (.704)
Post-int. Ideational	Play	16	59	34.08	10.943	.398 (1.733)	-.192 (4.824*)
Fluency	SW	19	57	38.69	10.12	-.458 (.752)	-.563 (2.577*)
	Cont.	14	67	32.72	13.125	.666 (.848)	-.177 (.248)
Post-int. Ideational	Play	2	42	16.92	9.878	.663 (2.096*)	.152 (6.313*)
Originality	SW	4	50	21.38	10.679	.779 (1.988)	.683 (5.960*)
	Cont.	3	46	17.47	9.745	.677 (1.613)	.918 (3.114*)

Notes: * = Skewness or kurtosis greater than ± 2 | SAF = Stereotypical Associative Fluency | NSAF = Non-stereotypical Associative Fluency | Play = Play group (n = 25) | SW = Sentence writing group (n = 32) | Cont. = Control group (n = 32) | In parentheses under the columns "Skewness" and "Kurtosis" are the skewness and kurtosis of the dependent variables when the four participants outperforming their groups are included in the dataset.

Table 3.4. Pearson Correlations Between the Dependent and Control Variables

Variable	1	2	3	4	5	6	7	8	9	10	11
1. General Intelligence	1										
2. Open-mindedness (4 items)	.019	1									
3. Playfulness	.094	.125	1								
4. Pre-int. SAF	.199	-.091	-.165	1							
5. Pre-int. NSAF	.028	-.042	-.105	.540**	1						
6. Pre-int. Ideational Fluency	.126	-.105	-.061	.583**	.493**	1					
7. Pre-int. Ideational Originality	.221*	-.068	-.054	.447**	.526**	.847**	1				
8. Post-int. SAF	.191	-.120	-.198	.790**	.566**	.536**	.435**	1			
9. Post-int. NSAF	.046	-.077	-.190	.618**	.863**	.537**	.562**	.630**	1		
10. Post-int. Ideational Fluency	.179	-.159	-.138	.589**	.527**	.792**	.723**	.671**	.658**	1	
11. Post-int. Ideational Originality	.225*	-.067	-.061	.434**	.546**	.633**	.643**	.486**	.641**	.836**	1

Notes: SAF = Stereotypical Associative Fluency | NSAF = Non-stereotypical Associative Fluency.

* $p < .05$ (2-tailed)

** $p < .01$ (2-tailed)

Table 3.5. Multiple Hierarchical Regression Results for Hypothesis 3

	Post-int. Ideational Fluency (DV)				Post-int. NSAF (Mediator)				Post-int. Ideational Fluency (DV)		
	Coeff.	SE	p		Coeff.	SE	p		Coeff.	SE	p
General Intelligence	.574	.284	.047		.725	.460	.119		.410	.270	.133
Open-mindedness (4 items)	-.240	.270	.378		.095	.437	.828		-.261	.253	.305
Playfulness	-.383	.242	.117		-1.143	.391	.005		-.124	.238	.604
Pre-int. NSAF	.107	.042	.013		.995	.068	.000		-.118	.075	.120
Pre-int. Ideational Fluency	.749	.079	.000		.414	.128	.002		.655	.079	.000
Sentence Writing Group	c_1 -2.338	1.828	.205	a_1	-8.615	2.957	.005	c'_1	-.387	1.799	.830
Play Group	c_2 -4.001	1.947	.043	a_2	-14.937	3.148	.000	c'_2	-.619	2.060	.765
Post-int. NSAF (Mediator)	--	--	--		--	--	--	b	.226	.064	.001
	$R^2 = .689$				$R^2 = .822$				$R^2 = .730$		
	$F_{(7, 81)} = 25.572, p < .001$				$F_{(7, 81)} = 53.507, p < .001$				$F_{(8, 80)} = 27.071, p < .001$		

Notes: NSAF = Non-stereotypical Associative Fluency | DV = Dependent variable.

142

Table 3.6. Multiple Hierarchical Regression Results for Hypothesis 4

	Post-int. Ideational Originality (DV)				Post-int. NSAF (Mediator)				Post-int. Ideational Originality (DV)		
	Coeff.	SE	p		Coeff.	SE	p		Coeff.	SE	p
General Intelligence	.635	.314	.046		.559	.470	.237		.537	.307	.084
Open-mindedness (4 items)	-.004	.292	.988		.036	.437	.935		-.011	.283	.970
Playfulness	-.157	.262	.551		-1.135	.392	.005		.042	.267	.877
Pre-int. NSAF	.154	.047	.002		.984	.071	.000		-.018	.085	.830
Pre-int. Ideational Originality	.491	.097	.000		.456	.146	.002		.411	.100	.000
Sentence Writing Group	c_1 -1.639	1.950	.403	a_1	-7.831	2.918	.009	c'_1	-.271	1.976	.892
Play Group	c_2 -4.961	2.108	.021	a_2	-14.774	3.154	.000	c'_2	-2.379	2.308	.306
Post-int. NSAF (Mediator)	--	--	--		--	--	--	b	.175	.072	.018
	$R^2 = .521$				$R^2 = .821$				$R^2 = .553$		
	$F_{(7, 81)} = 12.562, p < .001$				$F_{(7, 81)} = 53.069, p < .001$				$F_{(8, 80)} = 12.387, p < .001$		

Notes: NSAF = Non-stereotypical Associative Fluency | DV = Dependent variable.

Figure 3.1. Conceptual Framework
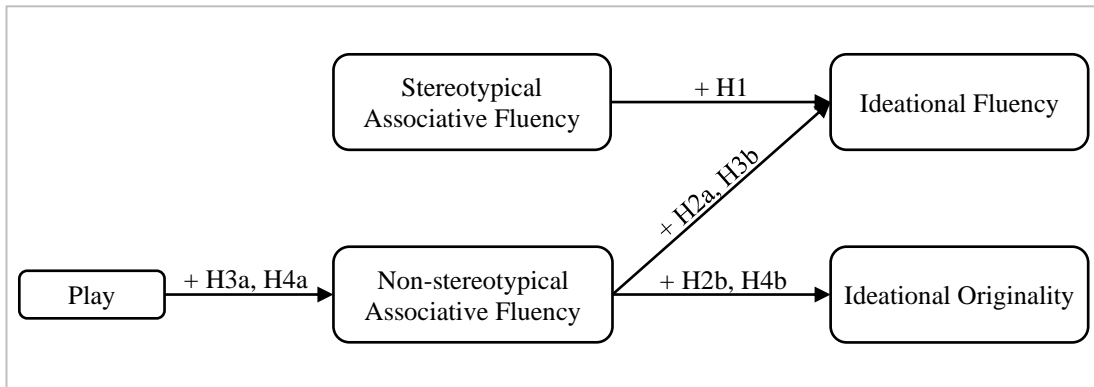
Figure 3.2. Concept Page for the Concept "Table" Presented to the Play Group

You are 8 years old and you are writing sentences describing what you and your friends will be doing during your next playdate.

Write a sentence that includes the words **table** and **hat** in their singular or plural form:

Write a sentence that includes the words **table** and **coat** in their singular or plural form:

Write a sentence that includes the words **table** and **book** in their singular or plural form:

Write a sentence that includes the words **table** and **candle** in their singular or plural form:

Write a sentence that includes the words **table** and **hook** in their singular or plural form:

Write a sentence that includes the words **table** and **file** in their singular or plural form:

3.7. Supplementary Materials

3.7.1. Section A – Consent Form

Research project title: Play and Creativity Experiment 2

Researcher: Name and email address of researcher

Supervisors: Names and email addresses of the two researcher supervisors

Thank you for volunteering to participate.

This experiment examines the mechanisms by which play promotes the creative potential of adults.

As part of the experiment, we will ask you to complete a series of tasks that involve reading instructions on a standard monitor and typing responses using a standard keyboard and a standard mouse on a laboratory computer. Most of the tasks involve typing your thoughts without worrying about misspelling any of the words you type.

Many of the tasks are timed. As a result, you will often be automatically moved to the next task at the end of the appointed time-interval. We have allowed enough time for the completion of each timed task. For that reason, we expect that you will be able to complete all the timed tasks within the appointed time-interval without any sense of time pressure.

However, this may introduce a time constraint, depending on your typing speed. If you think this might be an issue, you may withdraw your participation.

The experiment is divided into two parts, Part 1 and Part 2, with a 10-minute break in between the two parts. Part 1 should take no more than 49 minutes to complete. Part 2 should take no more than 37 minutes or no more than 57 minutes to complete, depending on the group you are randomly allocated into. This means that the anticipated completion time of the experiment is 96 minutes or 116 minutes, depending on the group you are randomly allocated into.

We will compensate you £11.60 for completing all the tasks of the experiment.

Apart from a very short intelligence test at the beginning of the experiment, there are no right or wrong answers. For that reason, we expect that you will be able to complete all the tasks with no difficulty.

All your responses will be anonymised.

You may withdraw your participation at any time, including before, during, and after the experiment, with no negative consequences to yourself or the organisation for which you work. To withdraw your participation, please contact the researcher.

Data collected during this experiment will be analysed by the researcher for the purposes of completing her Ph.D. research and, where relevant, for the writing of associated academic journal articles or monographs.

Anonymised printed transcripts of data and consent forms collected during this experiment will be stored in a locked office at the University of Warwick. Anonymised electronic transcripts of data and consent forms will also be stored on the researcher's password-locked personal desktop computer in password-locked files. All experimental material may be destroyed after 10 years from the completion of the research project. The experimental material from this research project may be published. You can request a copy of the publication from the researcher.

It is not expected that you will experience any risks by participating in this research project.

If you believe that you will need further assistance to complete the experiment, please contact the researcher.

Should you have any further questions about this research, please contact the researcher.

You may also contact the University of Warwick Research and Impact Services, University House, University of Warwick, Coventry, CV4 8UW, UK. 02476575732 should you wish to make a complaint about the conduct of the researcher.

Please select the "I consent to participate" option below if you understand the information provided to you and you wish to participate in this experiment. Then press the "Next" button below to begin Part 1 of the experiment. If you do not wish to participate, select the "I do not consent to participate" option below and press the "Next" button below or close this browser window to withdraw your participation.

Selecting the "I consent to participate" option below indicates that:

- You have read and understood the above information

- You voluntarily agree to participate

- You are 18 years of age or older

   o I consent to participate

   o I do not consent to participate

3.7.2. Section B – Selecting a Measure for Ideational Fluency and Originality

To select the most appropriate measure for ideational fluency and originality, we reviewed three widely used measures of divergent thinking: the Remote Associates Test (RAT; Mednick, 1962; Mednick & Mednick, 1967), the Torrance Tests of Creative Thinking - Verbal (TTCT-Verbal; Torrance, 1966, 1998), and the Alternate Uses Test (AUT; Guilford, 1967). We evaluated these three measures on their ability to measure ideational fluency and originality, their flexibility in choosing stimulus concepts for which to measure the two abilities, and the time required to complete them. Compared to the RAT, the AUT is considered a valid measure for ideational fluency and originality in children and adults (Coney & Serna, 1995; Ochse & Van Lill, 1990; Olczak & Kaplan, 1969). Compared to the TTCT-Verbal, the AUT is flexible in choosing the stimulus concepts and the duration of response production for each stimulus concept. This flexibility can help reduce the time required for the completion of the measure (time required for completion = number of stimulus concepts X duration of response production per stimulus concept). Because of this flexibility, the time required for the completion of the AUT can be adjusted to be well below the total of 90 minutes required for the completion of the TTCT-Verbal. Based on its advantages compared to the RAT and the TTCT-Verbal, we selected the AUT as the measure for ideational fluency and originality.

3.7.3. Section C – Instructions for the Measures and the Interventions

Instructions for the Continuous Free Word-Association Task (CFWAT). The following instructions were given before the task:

What follows is a different task, please read the new instructions.
In the following task, we will ask you to write all the words that come to your mind for four different objects. Press the "Enter" key on your keyboard every time you finish writing a thought.
For example, when asked to write all the words that come to your mind for the object paperclip, you can write:
paper
book
stapler

stationary

desk

metal

plastic

magnet

organised

…

We will ask you to write all the words that come to your mind for each object separately. Take 3 minutes to write as many words as you can think of for each object. At the end of each 3-minute interval, we will automatically ask you to write all the words that come to your mind for the next object. Please try and continue to write until the end of the 3-minute interval.

As the transition from one object to the next is automatic and cannot be paused, please do not leave your computer before the end of the task.

Your responses will be autosaved every 30 seconds.

Do not worry about misspelling any of the words you write.

When you are ready to begin, press the "Begin Task" button below.

The following instructions were given for the stimulus concept "stone":

Write all the words that come to your mind for a stone:

Instructions for the Alternate Uses Test (AUT). The following instructions were given before the task:

In the following task, we will ask you to write all the possible uses of four different objects. Press the "Enter" key on your keyboard every time you finish writing a possible use.

For example, when asked to write all the possible uses of a paperclip, you can write:

hold paper together

bookmark

reset my mobile phone

reset my wifi hub

craft a chain

craft a figure

poke a hole

...

We will ask you to write all the possible uses of each object separately. Take 3 minutes to write as many possible uses as you can think of for each object. At the end of each 3-minute interval, we will automatically ask you to write all the possible uses of the next object. Please try and continue to write until the end of the 3-minute interval.

As the transition from one object to the next is automatic and cannot be paused, please do not leave your computer before the end of the task.

Your responses will be autosaved every 30 seconds.

Do not worry about misspelling any of the words you write.

When you are ready to begin, press the "Begin Task" button below.

The following instructions were given for the stimulus concept "stone":

Write all the possible uses of a stone:

Instructions for Concept-dependent Play (Play Group). The following instructions were given before the task:

Imagine that you are 8 years old. You, your teacher, and your classmates are writing an article for the school newspaper, describing what you and your friends will be doing during your next playdate. Your teacher asked each one of you to write 24 sentences for the article. To make the task more interesting and fun, your teacher gave you 24 pairs of words and explained that, for each pair, you need to write a sentence that includes both words in their singular or plural form.

For example, for the pair table and chair, you can write:

"We will put all the chairs on the table and turn it into our fortress!"

or

"We will put two chairs one opposite the other and pretend it is our kitchen table."

Do not worry about misspelling any of the words you write.

When you are ready to begin, press the "Begin Task" button below.

Instructions for Concept-dependent Sentence Writing (Sentence Writing Group). The following instructions were given before the task:

In the following task, we will provide you with 24 pairs of words. For each pair of words, we will ask you to write a sentence that includes both words in their singular or plural form. For example, when asked to write a sentence for the pair table and chair, you can write:

"The table was surrounded by four wooden chairs."

or

"The room was full of tables, but a chair was nowhere to be found!"

Do not worry about misspelling any of the words you write.

When you are ready to begin, press the "Begin Task" button below.

3.7.4. Section D – Scoring of the Measures

Table 3.7. CFWAT Responses Scored Together for Representing the Same Noun

Response	Scoring	Response	Scoring
0.5/half	0.5/half	silicon/silicone	silicon/silicone
4/four	4/four	stats/statistics	statistics
cobble/cobblestone	cobblestone	sweet/sweets	sweet
decor/decoration	decoration	tv/television	television
flingshot/slingshot	slingshot	uni/university	university
flint/flintstone	flintstone	window/windows	window
fort/fortress	fort/fortress	wood/woods	wood
gem/gemstone	gemstone		
glass/glasses	glass		
grandma/grandmother	grandmother		
gray/grey	grey		
id/identity	identity		
indoor/indoors	indoor		
info/information	information		
jello/jelly	jello/jelly		
lab/laboratory	laboratory		
mom/mommy	mommy		
outdoor/outdoors	outdoor		
phone/telephone	telephone		
photo/photograph	photograph		

| rolling stone/rolling stones | rolling stones |
| short/shorts | short |

Table 3.8. CFWAT Responses Scored Together for Representing the Same Verb

stone	drum	cup	spear
beat/beating	annoy/annoying	bake/baking	aim/aiming
break/breaking	back/backing	break/breaking	attack/attacking
build/building	bang/banging	brew/brewing	carve/carving
camp/camping	beat/beating	brush/brushing	cut/cutting
carve/carving	club/clubbing	clean/cleaning	fight/fighting
climb/climbing	dance/dancing	cook/cooking	fish/fishing
colour/colouring	disturb/disturbing	drink/drinking	hunt/hunting
construct/constructing	hide/hiding	eat/eating	impale/impaling
cook/cooking	hit/hitting	heat/heating	joust/jousting
create/creating	light/lighting	hold/holding	kill/killing
cut/cutting	live/living	make/making	mark/marking
draw/drawing	march/marching	measure/measuring	pierce/piercing
fall/falling	play/playing	offer/offering	plant/planting
form/forming	practise/practice/practising	paint/painting	poke/poking
game/gaming	roll/rolling	share/sharing	practise/practice/practising
hike/hiking	sing/singing	sip/sipping	shape/shaping
hit/hitting	skin/skinning	spill/spilling	stab/stabbing
juggle/juggling	time/timing	sport/sporting	threaten/threatening
kick/kicking	wash/washing	stack/stacking	throw/throwing
kill/killing		store/storing	
mark/marking		pour/pouring	
mine/mining		warm/warming	
paint/painting		wash/washing	
sharpen/sharpening			
sink/sinking			
skim/skimming			
skip/skipping			
sling/slinging			
smoke/smoking			
step/stepping			
throw/throwing			

Table 3.8. CFWAT Responses Scored Together for Representing the Same Verb (Continued)

table	jar	rock	pin
book/booking	annoy/annoying	beat/beating	bank/banking
buy/buying	break/breaking	break/breaking	bleed/bleeding
chop/chopping	carry/carrying	build/building	bowl/bowling
clean/cleaning	collect/collecting	camp/camping	carve/carving
cook/cooking	cook/cooking	carve/carving	design/designing
dine/dining	crack/cracking	climb/climbing	display/displaying
draw/drawing	drink/drinking	cook/cooking	fix/fixing
drink/drinking	fall/falling	decorate/decorating	glue/gluing
eat/eating	fill/filling	draw/drawing	hang/hanging
fish/fishing	keep/keeping	fish/fishing	hurt/hurting
fold/folding	organise/organising	floor/flooring	knit/knitting
gather/gathering	paint/painting	garden/gardening	lose/losing
hide/hiding	pickle/pickling	hike/hiking	mark/marking
learn/learning	pour/pouring	hit/hitting	organise/organising
meet/meeting	prep/prepare	hunt/hunting	pierce/piercing
network/networking	recycle/recycling	hurt/hurting	pinch/pinching
paint/painting	rotate/rotating	jump/jumping	poke/poking
place/placing	shatter/shattering	mine/mining	prick/pricking
play/playing	shop/shopping	landscape/landscaping	sew/sewing
prep/prepare	smash/smashing	mark/marking	stick/sticking
read/reading	store/storing	paint/painting	stitch/stitching
relax/relaxing		play/playing	study/studying
serve/serving		practise/practice/practising	tap/tapping
set/setting		roof/roofing	
sit/sitting		scream/screaming	
sleep/sleeping		sharpen/sharpening	
socialise/socialising		sit/sitting	
stand/standing		skim/skimming	
store/storing		skip/skipping	
study/studying		stand/standing	
talk/talking		stone/stoning	
type/typing		throw/throwing	
wipe/wiping		tripped/tripping	
wire/wiring		walk/walking	
write/writing			

Table 3.9. AUT Responses Categorised as Inadequate

auction it	make money
become famous	performance
buy it	rock it (verb)
clean it	see the world
craft it	sell it
genre	store ghost
hold it	trade it
make friends	wash it
make history	

Notes: CFWAT = Continuous Free Word-Association Task | AUT = Alternate Uses Test.

3.7.5. Section E – Actions Taken to Address Threats to Validity

1. That participants completed the experiment in a single session helped minimise maturation, history, seasonality, and attrition biases.

2. To minimise the effects of respondent fatigue bias and attention loss bias, we added a 10-minute break between the two parts of the experiment.

3. To minimise experimenter bias, all data was anonymised and the first author, who scored the responses of all the participants, was unaware of the participants' condition groups.

4. To minimise selection bias, participants were randomly allocated to one of the three condition groups using the "Randomizer" and "Group" elements of Qualtrics.

5. To minimise confounding bias, we accounted for other variables known to influence ideational fluency and originality: general intelligence, open-mindedness, and playfulness.

6. To minimise common method bias, we used two different instruments to measure the dependent variables of the study: we used the CFWAT to measure stereotypical associative fluency (SAF) and non-stereotypical associative fluency (NSAF) and the AUT to measure ideational fluency and originality.

7. To minimise any possible training effects of the pre- on the post-intervention measures, we used different concepts in the pre-intervention (C_{pre}) and the post-intervention (C_{post}) CFWAT and AUT. We selected the four concepts in C_{pre} and the four concepts in C_{post} so that the two sets were analogous in terms of

abstractness (four concrete), form (four nouns), frequency in the English language (two lower and two high), and associative hierarchy (two steep and two flat).

8. To minimise training effects on ideational fluency and originality, we administered the AUT before the CFWAT both before and after the interventions.

9. To minimise demand characteristics bias, we informed participants of the general purpose but not of the hypotheses of the study. Furthermore, we did not inform the participants about the tasks that constituted the interventions of the experiment.

10. To minimise order effect bias in the CFWAT, the AUT, and the interventions, we presented the concepts in the CFWAT and AUT and the concept pages in the interventions in a random order using the "Randomizer" element of Qualtrics.

11. We expected that the control group would complete the experiment and leave that laboratory earlier than the play and sentence writing groups. To minimise the effects of some participants leaving the laboratory earlier than others, we informed participants that some of them would complete the experiment earlier than others depending on the condition group they were randomly allocated into and implemented a procedure to ensure that participants left the laboratory as quietly as possible.

12. Since the sample consisted of university students and did not fully represent the adult population, we did not fully minimise sample representativeness bias.

3.7.6. Section F – Additional Lessons Learned

1. The 10-minute break between Part 1 and Part 2 of the experiment appeared to be a long break for the participants. In the future, we could consider including a shorter break or requiring participants to complete the two parts of the experiment on two different days.

2. We scheduled back-to-back sessions in the laboratory. In the future, we could introduce a 15-minute break between the sessions so that the facilitators have enough time to resolve any issues occurring during the sessions.

3. We only recruited 20-25 participants per session. In the future, we could recruit more participants.

4. One participant needed a lot longer than 2 hours to complete the experiment and 2 participants needed a couple more minutes to complete the experiment. We

stopped participants at the 2-hour mark and compensated them in full for their time. This should also be the practice in future experiments, as all participants should be compensated for their time regardless of their completion status.

5. Some participants accidentally minimised their browser windows during the experiment. Technical staff was immediately contacted to maximise the participants' browser windows. This should also be the practice in future experiments.

6. We found some participants using their mobile phones during the experiment and asked them to stop. This was the case even after warnings and reminders that they were not allowed to use their mobile phones during the experiment. In the future, we could consider forbiting the presence of mobile phones inside the laboratory.

7. One participant appeared to be aware of the AUT and of how to achieve a high originality score on the measure. For the analysis, we detected and managed potential error outliers. This should also be the practice in future experiments.

8. Some participants continued giving alternate uses to the CFWAT despite the written warning for the change of task in the description of the CFWAT. In the future, we could consider adding a bolder warning or providing verbal instructions rather than written instructions for the tasks.

9. Some participants found the 3-minute response intervals of the CFWAT and AUT to be long. In the future, we could consider reducing the interval durations.

10. The high number of stimulus concepts included in the C_{pre} and C_{post} increased the duration of the experiment as well as the duration of scoring the measures. In the future, we could consider reducing the number of stimulus concepts.

11. Some participants provided short or long phrases to the CFWAT. In the future, we could further emphasise that we are looking for single-word responses.

12. Some participants were not familiar with the word "spear". Some participants provided responses for different definitions of the "spear" (e.g., the tip of a plant instead of the pole weapon), "drum" (e.g., the container instead of the musical instrument), "pin" (e.g., the password instead of the piece of metal with a sharp point), and "rock" (e.g., the music genre instead of the solid mineral material). In the future, we could consider introducing pictures of the concepts and selecting more everyday objects.

13. "Stone" and "rock" appeared to be very related concepts and "cup" and "jar" appeared to be somewhat related concepts, generating similar responses to the CFWAT and AUT. In the future, we could consider all the concepts in order to select less related ones.

14. Participants were able to change the order of their responses and delete their responses to the CFWAT and AUT at any point during the 3-minute intervals. In the future, we could consider forbiting the change of the order or the deletion of responses.

15. The transition from one concept to the next during the CFWAT and AUT was automatic. This could have slowed down response production in the early stages of production as participants had to disengage from responding for one concept and engage in responding for the next concept. In the future, we could consider introducing a short break between two concepts to allow participants to disengage from the first concept before engaging with the second.

3.7.7. Section G – Data Preparation

We present the results of the boxplot and the standard deviation analysis in Tables 3.10 and 3.11 below. The numbers in the boxplot and standard deviation analysis results represent the rows of the participants flagged as potential error outliers in the dataset when participants are sorted based on their participant ID in ascending order.

Table 3.10. Participants Flagged as Outliers in Boxplots

Variable	Control Group	Sentence Writing Group	Play Group
Pre-intervention Continuous Free Word-Association Task (CFWAT)			
Stereotypical Associative Fluency (SAF)			
Stone	42		
Drum			
Cup			
Spear			
Sum			
Non-stereotypical Associative Fluency (NSAF)			
Stone	53	5, 75, 38	91
Drum	53		
Cup	53, 90	38	91
Spear	53		91
Sum	**53**, 90	**38**	**91**
Pre-intervention Alternate Uses Test (AUT)			
Ideational Fluency			
Stone	14, 53, 73		
Drum			76, 91
Cup	14, 42, 53, 73		91
Spear	53, 73		91
Sum	**14**, **53**, 73		**91**
Ideational Originality			
Stone	14, 53, 73	5, 38	91
Drum		38	26, 76, 91
Cup			91
Spear	14, 53, 73, 80		91
Sum	**14, 53**	**38**	76, **91**
Variable	Control Group	Sentence Writing Group	Play Group
Post-intervention Continuous Free Word-Association Task (CFWAT)			
Stereotypical Associative Fluency (SAF)			
Table	83	46	
Jar			
Rock			
Pin		61	
Sum		46	
Non-stereotypical Associative Fluency (NSAF)			
Table		38, 46, 75	34, 91
Jar	53	38	91
Rock	53, 73	46	
Pin	53, 73, 80	38	91
Sum	**53**	**38**	**91**
Post-intervention Alternate Uses Test (AUT)			
Ideational Fluency			
Table			91
Jar		38	26, 34, 76, 91
Rock	53	38	76
Pin		38, 46	91
Sum		**38**	**91**
Ideational Originality			
Table	14, 53	3, 38	19, 26, 34, 91
Jar		38	91
Rock	14, 53	38, 104	
Pin	53	38	91
Sum	**14**, 42, **53**	3, **38**	**91**

Note: Participants highlighted in bold consistently outperformed their groups.

Table 3.11. Participants Flagged as Outliers in Standard Deviation Analysis

Variable	Control Group	Sentence Writing Group	Play Group
Pre-intervention Continuous Free Word-Association Task (CFWAT)			
Stereotypical Associative Fluency (SAF)			
Stone	42		
Drum	83, 116		
Cup			28
Spear	73		
Sum		46	
Non-stereotypical Associative Fluency (NSAF)			
Stone	53	38, 75	91
Drum	53	38	34, 91
Cup	53	38	91
Spear	53	38	91
Sum	**53**	**38**	**91**
Pre-intervention Alternate Uses Test (AUT)			
Ideational Fluency			
Stone	14, 53, 73		91
Drum	73	38	91
Cup	53		91
Spear	53, 73		91
Sum	**53**, 73		**91**
Ideational Originality			
Stone	14, 53, 73	38	91
Drum	14	38	91
Cup	42	46	91
Spear	14, 53	74	91
Sum	**14, 53**	**38**	**91**
Variable	Control Group	Sentence Writing Group	Play Group
Post-intervention Continuous Free Word-Association Task (CFWAT)			
Stereotypical Associative Fluency (SAF)			
Table	83	46	
Jar	83		
Rock		16	
Pin	90	61	
Sum			
Non-stereotypical Associative Fluency (NSAF)			
Table	90		91
Jar	53	38	91
Rock	53, 73	46	91
Pin	53, 73, 80	38	91
Sum	**53**	**38**, 46	**91**
Post-intervention Alternate Uses Test (AUT)			
Ideational Fluency			
Table	53		91
Jar	42	38	91
Rock	53	38	76
Pin	53	38, 46	91
Sum	**53**	**38**	**91**
Ideational Originality			
Table	14	3, 38	91
Jar	42, 68	38	91
Rock	14, 53	38	76
Pin	53	38	91
Sum	**14, 53**	**38**	**91**

Note: Participants highlighted in bold consistently outperformed their groups.

3.7.8. Section H – Demographic Characteristics

Table 3.12. Descriptive Statistics of Demographic Characteristics

Variable	Value	Freq.	Perc. (%)
Age	18 – 24 years old	82	92.1
	25 – 34 years old	6	6.7
	35 – 44 years old	1	1.1
English language fluency	Excellent	65	73.0
	Good	24	27.0
Gender	Female	49	55.1
	Male	40	44.9
Ethnicity	White	27	30.3
	Black/African/Caribbean/Black British/African American	2	2.2
	Asian/Asian British/Asian American	58	65.2
	Mixed/Multiple ethnic groups	1	1.1
	Prefer not to answer	1	1.1
Educational level	High school graduate, diploma, or equivalent	50	56.2
	Some college, but no degree	16	18.0
	Associate's degree	4	4.5
	Bachelor's degree	14	15.7
	Master's degree	4	4.5
	Professional degree	1	1.1
Employment status	Full-time student in undergraduate degree	73	82.0
	Full-time student in postgraduate degree	15	16.9
	Unemployed	1	1.1
Highest educational level of parent(s) or guardian(s) by the time the participant was 18 years old	Less than high school diploma	9	10.1
	High school graduate, diploma, or equivalent	15	16.9
	Some college, but no degree	3	3.4
	Bachelor's degree	29	32.6
	Master's degree	26	29.2
	Professional degree	3	3.4
	Doctorate degree	2	2.2
	I do not know	2	2.2
Employment status of main/highest income earner (parent or guardian) when the participant was about 14 years old	Modern professional occupations	16	18.0
	Clerical and intermediate occupations	2	2.2
	Senior managers and administrators	31	34.8
	Technical and craft occupations	6	6.7
	Semi-routine manual and service occupations	3	3.4
	Routine manual and service occupations	4	4.5
	Middle or junior managers	7	7.9
	Traditional professional occupations	14	15.7
	Long term unemployed	1	1.1
	Not applicable	3	3.4
	I do not know	1	1.1
	Prefer not to answer	1	1.1

Table 3.13. Comparisons Between Condition Groups on Demographic Characteristics

Variable	Fisher's Exact Test		Likelihood ratio	
	Statistic	p-value	χ^2	p-value
Age	3.430	.496	3.797	.496
English language fluency	.492	.869	.467	.832
Gender	2.281	.364	2.306	.364
Ethnicity	5.493	.868	6.573	.863
Educational level	13.286	.125	15.581	.160
Employment status	2.025	.913	2.279	.913
Parent(s) or guardian(s) educational level	10.705	.716	13.468	.729
Parent(s) or guardian(s) employment status	22.032	.328	28.642	.291
Day slot (day of completing the experiment)	1.256	.886	1.209	.871
Time slot (time of completing the experiment)	2.452	.894	2.393	.892

3.7.9. Section I – Homoscedasticity and Homogeneity of Regression Slopes

Table 3.14. Levene's Tests for Homoscedasticity and ANCOVAs for Homogeneity of Regression Slopes

	Levene's Test		ANCOVAs	
Variable	F (2, 86)	p-value	F-statistic	p-value
Post-int. NSAF	.560	.573	F (2, 71)	
General Intelligence			.043	.958
Open-mindedness (4 items)			2.654	.077
Playfulness			1.451	.241
Pre-int. NSAF			1.269	.288
Pre-int. Ideational Fluency			.402	.671
Post-int. NSAF	.529	.591	F (2, 71)	
General Intelligence			.157	.855
Open-mindedness (4 items)			2.639	.078
Playfulness			1.290	.282
Pre-int. NSAF			1.199	.307
Pre-int. Ideational Originality			.193	.825
Post-int. Ideational Fluency	.791	.457	F (2, 68)	
General Intelligence			.161	.852
Open-mindedness (4 items)			.255	.776
Playfulness			1.173	.315
Pre-int. NSAF			1.290	.282
Pre-int. Ideational Fluency			.419	.660
Post-int. NSAF			1.360	.264
Post-int. Ideational Originality	1.561	.216	F (2, 68)	
General Intelligence			1.428	.247
Open-mindedness (4 items)			.495	.612
Playfulness			1.065	.350
Pre-int. NSAF			.837	.437
Pre-int. Ideational Originality			2.646	.078
Post-int. NSAF			.092	.913

Notes: Levene's tests based on the median | NSAF = Non-stereotypical Associative Fluency.

Conclusion

A number of studies in the developmental psychology literature (Dyson et al., 2016; Karakelle, 2009; Karwowski & Soszynski, 2008; Lewis & Lovatt, 2013; Russ & Wallace, 2013; Silverman, 2016) and the management literature (Kirsten & Du Preez, 2010; Nisula & Kianto, 2018; West et al., 2017) suggest that play activities designed to primarily and directly stimulate organisational creativity can be a viable option for business leaders interested in promoting creativity in their organisations. However, much research is needed to develop robust, evidence-based guidance on designing and implementing this type of play activities, which we call *serious play for organisational creativity (SPOC)*. An important limitation of the available literature that hinders the design of effective SPOC is the lack of rigorous research examining the potential mechanisms of the play-creativity relationship and linking play design characteristics, mechanisms, and creativity-related outcomes. This limitation is the central thread that connects the three essays of this thesis.

In Essay 1, we highlight the need to clearly communicate and empirically test the play-creativity mechanisms put forth in the literature and the need to understand how play design characteristics and their interactions can facilitate these mechanisms. We also identify five important play design characteristics – dosage, materials, social content, cognitive content, and freedom (Dansky, 1999; Mellou, 1995; Wyver & Spence, 1999) – and synthesise the current state of knowledge on the relationship between these play design characteristics and creativity. As part of this synthesis, we discuss how each of these play design characteristics and their interactions might relate to the play-creativity mechanisms proposed in the literature. We also consider how play design characteristics might help create an enjoyable play experience and facilitate the affect-related mechanisms of the play-creativity relationship.

In Essay 2, we take the effort to connect play design characteristics, mechanisms, and outcomes one step further. We focus on one of the mechanisms proposed in the literature and scrutinise its relationship to the five important play design characteristics and to creativity-related outcomes. Specifically, we draw from

the theory of associative hierarchies (Mednick, 1962) to explain how the formation of non-stereotypical concept associations that might occur in play (Dansky & Silverman, 1973) could lead to improvements in ideational fluency, originality, and flexibility – three cognitive abilities important to creativity (Runco, 2011; Russ, 2018). Once we describe the mechanism, we explore how the five play design characteristics could facilitate the mechanism by enabling the formation of non-stereotypical associations. By doing so, we create a direct link between the five play design characteristics, the mechanism we describe, and creativity-related outcomes. Finally, in Essay 3, we follow a pre-test-post-test experimental design and use mediation analysis to test the effects of a play intervention on ideational fluency and originality through the mechanism we elaborate on and explore in Essay 2.

Overall, each essay makes distinct contributions in the literature on play and creativity inside and outside the organisational context. Essay 1 reviews the available literature on play, serious play, and creativity and provides an agenda for future research on SPOC design and implementation. Essay 2 explores a possible mechanism of the play-creativity relationship and connects play design characteristics, the mechanism, and divergent thinking abilities. Essay 3 takes an empirical approach to test the mechanism explored in Essay 2. Essays 2 and 3 also provide directions for future research investigating the mechanism they discuss. In addition, the three essays contribute to the broader literature on organisational creativity by adding to the limited number of studies discussing play as a way of stimulating creativity at work and encouraging more theoretical and empirical research on the topic.

Published Research

During the four-year doctoral programme, I and Dr Tamara Friedrich published a book chapter titled "Creativity and innovation in the context of firms". In the chapter, we discuss how top management teams, departmental management teams, the human resources department, the finance department, the purchasing department, the marketing department, the sales department, and the legal department can promote organisational innovation through their unique strategies and practices as well as through their strategic alignment and collaboration (Hadjikosta & Friedrich, 2019). The chapter is not part of the materials to be examined for the degree of Doctor of Philosophy.

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