AVANT, Vol. XII, No. 2
ISSN: 2082-6710 avant.edu.pl/en
DOI: 10.26913/avant.2021.02.03

How do dancers solve their choreographic improvisational problems?

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Received 7 December 2020; accepted 26 November 2021; published 17 December 2021.

Abstract

Problem solving as a higher cognitive ability is a theoretical construct operating in cognitive science and cognitive psychology. The founders of cognitive science were united by a shared vision of the mind as a tool similar to a computer – i.e. one serving to solve problems by manipulating non-sensory and abstract symbols inside the system. In interdisciplinary research into dance, the term "choreographic problem solving" (Kirsh, Muntanyola, 2009b; Kirsh, 2011; Clements , Redding , Sell, May, 2018; Stevens & Malloch & McKechnie & Steven, 2003; Leach & deLahunta, 2015) has become current in the context of a broad conception of dance practice as the inventive creation of movement in response to choreographic tasks that are the stimulus for creating motor images (James, 1890) and mental images (Franklin, 1996). The purpose of this article is to present an interpretation of the concept of solving choreographic problems in the course of improvised dance. This analysis falls within the paradigms of embodied cognition and situated cognition concepts and theories and works on the basis of initial reports from research on the influence of metaphorical instructions on the solution of choreographic problems in dance improvisation. These initial reports relate to the first conclusions drawn from analyses of research materials taking the form of video recordings, questionnaires and in-depth interviews.

Keywords: choreographic problem solving; situated cognition theory; embodied cognition theory; dance improvisation; metaphor

1. Introduction

Problem solving is one of the main areas of interest for cognitive science. Classic research treated problem solving in a "hard scientific" manner, usually invoking logical tasks. However, although it is true that issues surrounding problem-solving have appeared mainly in the context of research into artificial intelligence and mathematics, it is becoming more common to apply our developing understanding to research on dance (Kirsh, Muntanyola, 2010a;

Kirsh, 2011; Clements , Redding, Sell, May, 2018; Stevens & Malloch & McKechnie & Steven, 2003; Leach & deLahunta, 2015; Jenkins Lynn, 2005). Problem solving as it appears in situations related to creativity in a broad sense has been the subject of much psychological research (Lubart, 2001). Theoretical and practical aspects of problem solving may serve as tools that stimulate creative processes in a broad sense. Problem solving is also connected to *convergent* and *divergent thinking* (Guilford, 1956; Runco, 2003). Divergent thinking is thought that leads to multiple solutions, as opposed to *convergent thinking* which seeks only one way to solve a problem. Divergent thinking has been identified with creative thinking and three criteria have been identified to evaluate divergent thinking (Guilford, 1950):

1) fluency, the indicator of which is number of solutions. This is an ability manifested by ease of expressing ideas – definite intellectual contents. Fluency offers multiple courses of action to the subject.

2) flexibility, indicated by the numbers of categories of solutions. A high flexibility of thinking enables changes in direction when searching for a solution, the overcoming of faulty attitudes and the ability to look anew at the phenomenon in question.

3) originality, identified by the frequency of solutions appearing. Originality is the capacity to come up with new ideas. This means going beyond stereotypical solutions and at the same time formulating new solutions adapted to the situation at hand.

The search for solutions is often accompanied by so-called "Aha! moment" "defined as a sudden, conscious change in a person's representation of a stimulus, situation, event, or problem" (Carpenter, 2020, p. 2). In dance improvisation, this moment is equivalent to finding a new move, a new solution that has never before been used. In improvisation the dancer both creates and performs a movement which has not been planned earlier. Lynne Bloom and Tarin Champlin (1988) call this this the "creative movement of moment". They described improvisation as a spontaneous creative process, both seeking and executing. In improvised dance there are no strict rules and defined figures, as there are, for example, in classical ballet. During improvisation, the dancer deploys their own unique, individual style, creating a movement almost in the same moment as its execution. Curtis L. Carter (2000, p. 182) has distinguished three kinds of improvisation practise by dancers:

1) Improvisation as an element that diversifies previously set choreography,

2) Improvisation as a dance practice that is a spontaneous process of creating movement, one that aims for find new, original movements which can later be used in performances,

3) "improvisation for its own sake that is brought to is brought to a high level of performance" (2000, p. 182).

A common practice of choreographers during improvisation session is to impose certain limitations on the dancers. For example, the well-known choreographer Wayne McGregor uses tasks taking the form of an (imagined), limited and external structure (like the figure of a cylinder, for example). The dancer has to use this as an element he or she interacts with in movement. Torrents et al (2015) found that choreographic tasks that include deliberately imposed limitations, e.g. keeping one part of the body in a definite position, positively encourage the achievement of originality, novelty in movement.

There is a widespread conviction that dancers and performative artists are only a creative tool, an instrument in the hands of the choreographer: they reproduce the chorographer's ideas or the ideas of other creative artists. As Clements et al (2018) has put it:

> The lack of creativity research within the performing arts more broadly may be due to scientists' misinformed beliefs that performing artists are replicators who express work generated by others, rather than creators, and are therefore not a population of interest. (Clements et al., 2018, p. 2).

With the development of postmodern dance, there has been a practice whereby the dancers and choreographer closely cooperate in dance companies. The dancers take part in the creative process of creating moves: they have become partners with the choreographer. Jo Butterworth (2004, 2009) has noticed that the dividing line between the choreographer as the leader in the creative process and the dancer as the "executive" has blurred. The interdependent relationship of the choreographer (expert, creator) and dancer (instrument) undergoes transformation in the choreographic process. During a five-stage process called the *Didactic- Democratic Spectrum model* (Butterworth, 2009), the third stage already has the choreographer (as "pilot") directing the dancer by means of setting "choreographic problems" to be solved and by providing indications for improvisation. The dancer (as a contributing partner) begins by broadening the initial conception provided by the choreographer, discovering new solutions in movement. In the fourth stage of this process, the dancer as a co-creator works on the choreography, actively participating in the creation of new sequences. At this stage, the choreographer plays the role of a coordinator. In the last stage of this model, creation, the extension of choreographic structures and final decisions are taken between the choreographer and the dancer (Butterworth, 2009, pp. 383-385). As Stevens and McKechnie (2005) write, contemporary dancers take part in the process of developing and creating a kind of repertoire of new moves by 'exploring, selecting, and developing dance material' (2005, p. 40). These kinds of processes of shared creation of moves often turns on the mobile solution of problems – problems that are formulated by the choreographers, usually verbally, as tasks and then solved by the dancers (May et al., 2011).

Research into using improvisational tasks as choreographic tool in improvised dance has enabled us to find a broader conception of what problem-solving amounts to, especially as viewed from the perspective of the theory of situated cognition (Kirsh, 2009a).

The goal this article is to present a conceptual framework for choreographic problem-solving using the background paradigms of embodied and situated cognition and, on the basis of initial conclusions of the research into improvisation, to illustrate cognitive phenomena connected to choreographic problem solving, e.i. metaphorical thinking and creating body images and body schemas (Gallagher, 2005).

The following section of the paper outlines the main tenets of problem solving from situated cognition theory perspective. Next, I describe the conceptual metaphor theory (Lakoff and Johnson, 1980) and the issues of body image and body schema (Gallagher, 2005) as a theoretical background to the research. Subsequent sections cover the research setting and its methodology. The paper ends with a summary, in which I address how situated and embodied

cognition function in problem solving and I present the first conclusions from the research of choreographic problem solving in dance improvisation which are illustrative and supplementary.

2. Problem solving from the perspective of situated cognition theory

The classical theory of problem solving proposed by Herbert Simon and Allen Newell (1959, 1972) positions itself within the paradigm of information processing and represents a computational approach according to which the mind is a system of information processing, coding that information in a symbolic form. According to this approach, thought is identified with processes of copying, reorganising and comparing strings of symbols – processes that carry on in various memory systems.

To solve a problem, the subject has to formulate it as an internal mental representation of the entire problem structure, including the problem's elements, the so-called "problem space". The task environment defines the abstract structure corresponding to the problem. Each well-defined problem can be represented as an abstract task environment reflecting the problem's structure. Solving a problem is the search for the best procedures for action in the given task environment. The subject begins solving problems from an initial state in the mentally represented problem space. It creates possible solution paths, evaluating them and making choices on the basis of heuristic rules, selecting the best from among them.

Problems can be divided into well-defined problems, ones that only require the application of a finite number of rules used in a limited problem situation, and ill-defined problems – the majority of problems encountered in daily life, hard to define in a formal manner. They may possess many so-called solution paths or may lack them entirely (Kitchner, 1983).

In Simon and Newell's conception, contextual factors are excluded from the schema of problem solving – whether social, material or technological. Kirsh (2009a) claims that these factors support cognitive processes of reasoning and action involved in problem solving. He believes we should focus on the interaction between internal and external representations and the transfer of cognitive load between them. According to Kirsh (2009a), the context of problem-solving requires that we also consider the effect of elements of the environment, such as affordances that encourage various kinds of action and cultural, social, psychological and material factors. These factors can optimise the operation of a cognitive system.

According to Kirsh (2009a, p. 264), a theory of situated cognition cannot compete with the classical theory of problem solving as the latter does not offer computational, neurophysiological or mathematical descriptions of the internal processes – descriptions that form the basis of the recognition of a problem. Kirsh claims that, from the perspective of the theory of situated cognition, problems should not be understood as mere abstractions with a formal structure – something that could be the same across various activities. On the contrary, each problem is related to a specific context and is to be solved by reasoning that is specifically related to that situation. Problem solving is a kind of thought process which is closely tied to the actions and context of a given problem situation.

The theory of situated cognition brings out these aspects of problem solving – the marked influence of inferential, computational and representational mechanisms situated in the social, cultural and material aspects of a situation (Kirsh, 2009a). That is why solving choreographic problems, usually ill-defined problems embedded in a socio-cultural context, suits the conception of problem-solving propounded by Kirsh.

As Jonassen (2000) writes, solving problems requires manipulation of the problem space with the aid of an internal mental representation or an external physical representation (Jonassen, 2000, p. 65). In solving choreographic problems – ill-defined problems in the case of improvisation – dancers usually apply internal representations in the form of motor imagination (Jeannerod, 1995) and mental images (Franklin, 1996). External representations like sketches, movement notation or operations on physical objects are made and used more often in solving well-defined problems such as the placing of various dancers in the dance, or choreographic transitions and drawing. This kind of choreographic work demands considerable logical-analytical thought and the application of external representations reduce the cognitive effort involved in solving this kind of problem.

Problem solving is "any goal-directed sequence of cognitive operations" (Anderson, 1980, as cited in Jonassen, 2000). In the process of solving chorographic problems with improvisation, the goal is to create new moves, ones hitherto unused.

In his article *Problem Solving and Situated Cognition* (2009a), David Kirsh presents four processes that play a role in problem solving (embedded in the situated cognition paradigm) and which are also different from the classic theory of problem solving. They will be discussed in this article in the context of solving chorographic problems.

2.1. Framing and Registration

Framing and registration activate interpretative frameworks which prepare agents to be able to find and conceptualise functions of their environment in an action-oriented way (Kirsh, 2009a, p. 271). According to Kirsh, searching in the problem space only makes sense after a stage of framing, i.e. after a precise formulation of the problem. Having received instructions from the choreographer, the dancer “embeds” the problem in their own repertoire of moves and individual propositional knowledge (about the world as well as about dance) and bodily knowledge. Context and experience shape the way the problem is conceptualised and framed, as well the choice of tools used for solving the problem. According to Kirsch, prejudice and mindset also influence framing (Kirsh, 2009a, p. 269). That is why a repertoire of moves, an accepted body schema and the external representation of the movement of another dancer can all represent barriers to the creation of new moves. For example, an obstacle (which is sometimes unconscious) for a dancer of classical ballet might be the limited and strictly defined dictionary of moves and positions.

2.2 Interactivity

At many stages of problem solving there are interactions with persons and other elements of culture: understanding the problem, investigating its scope and limitations or finding possible options for its solution (2009a, p. 270). According to Kirsh, the classical approach to problem-solving neglects this context and poorly understands the complexity and importance of interaction in the context of investigating the problem space. Interactions between the agent and their environment are of the essence for problem solving. These interactions influence both the process as well as the result of the problem solving. Verbal and nonverbal communication with the choreographer is essential in the process of solving choreographic problems. The interaction of choreographer and dancer leads to mutual benefits – dancers benefit from the choreographer's pointers in the search for new moves and chorographers draw inspiration for the development of choreography and performance. Interactions with other dancers can also influence the execution of tasks in two ways: watching dancers executing choreographic instructions may provide inspiration, and impulse to create new moves; but it may also slow down the creative process by excess of a mimetic recreation of others' moves. Sheer contact with one's surroundings can influence the execution of tasks – with space, colours, shapes – these are all elements that can both develop and limit imaginative processes.

Representatives of the classical theory of problem-solving tend to form a general recommendation: "Make a plan, before you start working" (Miller, Galanter, and Pribram, 1960 as cited in Kirsh, 2009a). However, in an approach closer to the theory of situated cognition, the development of the plan is carried on during the course of action. And it is similar with improvised dance – the realisation of the task happens at the same time as its conceptualisation.

2.3 Resources and Scaffolds

The classical theory of problem-solving assumes that solving problems is mostly related to abilities to search, whilst in reality it may be closely tied to our ability to handle artifacts and the effective use of cognitive scaffolding (Kirsh, 2009a, p. 270). The universality of cultural products facilitates specific understanding in a given activity. Scaffolding and resources – including cultural resources like norms, gestures, style or language – are elements that impact problem solving. In the theory of education "scaffolding" has come to refer to a personalised solving of problems. It is the support which an expert can provide to the novice. Scaffolding can improve the achievements of the pupil, but only when the pupil is in a position to make use of it. Once the pupil has internalised the requirement methods, norms, heuristics nad constructive abilities, scaffolding will cease to be needed and will no longer be found in the problem-solving situation (Kirsh, 2009a, p. 285).

Besides the theory of learning, the term "scaffolding" has been used to refer to cultural resources – artifacts, norms, representations, rules and practices that represent our everyday environment and reduce complexity of the tasks to solve.

2.4 Knowledge Rich

Another factor that influences problem-solving is the level of the actor's procedural and propositional knowledge of the domain of the problem. The level of expertise in solving choreographic problems in improvisation can represent both an advantage and a limitation. With contemporary dancers who practice improvisation daily, a high level of experience improves the quality of execution. But with an expert from another genre of dance – such as folk dance where the patterns of movement are more controlled by strict rules and a set repertoire than in for example hip hop dance – the rules may limit and even inhibit the solution of choreographic problems in improvisation.

Kirsh (2009a) suggests that there are four domains which should be developed by situated cognition theory in the context of problem solving: hints, affordances, thinking with things and self-cueing. David H. Jonassen (2000) takes a similar approach to problem solving. He claims that the representation of a problem is influenced by context (cultural, social, historical), hints and modality. There are individual differences which influence the solving of problems. They include: knowledge (domain, structural, procedural, conceptual), cognitive styles, domain-specific reasoning, general problem-solving strategies, motivation and self-confidence (2000, p. 66).

At the heart of research into creativity in dance lies the theory of embodied cognition which claims that our cognitive processes are rooted in the physical experience of the world (Clark, 2008; Pfeifer & Bongard, 2006). Dancers, as Kirsh writes, "thinking with their bodies" (Kirsh, 2010). Based on embodied knowledge acquired through a multisensory experience of the world, they use their bodies to accomplish tasks while solving choreographic problems. While solving choreographic problems, a dancer's cognition is literally *embodied* – the dancers use their kinaesthetic understanding and propositional knowledge about the world or themselves. Solving choreographic problems during improvisation "is a process of using the body in novel ways in response to a task and the ability to successfully and fluidly link body positions into a developed sequence" (Clements et al. 2018, p. 3). These processes also involve mechanisms for memory, imagination and language (Bläsing et al., 2010).

Metaphorical phrases are specific means (tools) in the process of solving choreographic problems in improvisation. They facilitate the solution of specific problems faced by the dancers and help searching new movements. In the following sections I will describe shortly the conceptual metaphor theory (Lakoff and Johnson, 1980) and the issues of body image and body schema (Gallagher, 2005) to finally show how they function in problem solving in dance improvisation.

3. Conceptual metaphor theory – the issues of body image and body schema

The conceptual metaphor theory proposed by Lakoff and Johnson (1980) aims to explain the functioning of abstract thought. In their opinion, metaphor is not merely a stylistic tool, one appropriate in literature, but a means for language, thought and action. The essence of metaphor is the understanding of one concept in terms of another. Metaphor maps a specific feature

of one object onto the understanding of other objects and phenomena. With conceptual metaphor, the source domain is mapped onto the target domain. Thanks to our understanding of the source domain, we are able to properly understand the target domain. Kövecses defines target domains as follows. They are "(...) abstract, diffuse, and lack clear delineation; as a result, they "cry out" for metaphorical conceptualization" (Kövecses, 2002, p. 20). Conceptual metaphors form as a result of our multisensory experience of the world.

In their book *Metaphors We Live By* (1980) Lakoff and Johnson list three kinds of metaphor: structural, ontological and orientational. With structural metaphor, one concept provides metaphorical structure to another, for example TIME IS MONEY. This structure then appears in expressions such as "You are taking my time"; "I have lost a lot of time"; "This appliance will save your time". Ontological metaphors conceptualise phenomena in terms of categories and substance. For dance, the most important metaphors are orientational metaphors – those which are rooted in the physical and cultural experience of the world. When dancers perform definite movements, directed by the instructions of their teacher, they use image schemas (also called image schemata) (Johnson, 1987) which determine how to conceive and understand abstract metaphors appearing at the level of speech and movement. Image schemas are defined as: "recurring, dynamic patterns of our perceptual interactions and motor programs that give coherence and structure to our experience" (1987, p. xiv). Image schemes arise as the result of sensory-motor experiences and relate to spatial experience. They form the basis for orientational metaphors used by dancers and choreographers. They refer to spatial bodily experience, for example: up-down, front-back, centre-periphery. Orientational metaphors are rooted in bodily and cultural experience – how we encounter the world via our body shapes our understanding of abstract concepts in the form of metaphors. This is why metaphors can vary depending on cultural and individual experience. In *Metaphors We Live By* (1980) Lakoff and Johnson claim: "In actuality we feel that no metaphor can ever be comprehended or even adequately represented independently of its experiential basis" (1980, p. 19).

Metaphors have also further diverse experiential bases (1980). Various kinds of bodily experience may concern verticality, so different metaphors can share the same conception of "UP". For example, the metaphorical relation HAPPINESS IS UP has quite a different experiential basis to REASON IS UP. And so it is with dance: relevés or jumps of various kinds can be used to express happiness – but also the unknown or the inexpressible. On the other hand, contraction, where the form of the movement will tend to be directed down, may express pain, sadness, but also pleasure (Zarębska, p. 2019).

The use of metaphors in the choreographer's instructions is a universal method supporting the creation of new moves. The nomenclature of classical dance is full of metaphorical terms, e.g. pas de chat, pas de poisson (Vaganova, 1965). Metaphors are also used by dance teachers working with children (Sawada, Mori, & Ishii, 2002). They aid the memorisation of dance phrases. Once a child has mastered the basic conceptual system, it is possible for them to understand by means of analogy and metaphor. Metaphor is an important supportive element in learning dance; it is a kind of mnemonic device.

Instructions that take a metaphorical form encourage the dancers to form mental images. Applying mental images, so-called ideokinesis, has been proposed by Mabel Elsworth Todd, who has described this method in *The Thinking Body. A Study of the Balancing Forces of Dynamic*

Man (1972). Ideokinesis turns on the projection of mental images formed when motionless. As Bernard (2006) claims, mental images strengthen patterns of muscle function. Lulu Sweigard has defined ideokinesis in a similar way:

> The all-important voluntary contribution from the central nervous system is the *idea* of the movement. Concentration on the image of the movement will let the central nervous system choose the most efficient neuromuscular coordination for its performance, namely, the innate reflexes and feedback mechanisms (Sweigard, 1974, p. 6)

Eric Franklin (1996; 2007) suggests that there does not exist only one kind of mental image and he proposes a precise distinction between images: visual, kinaesthetic, proprioceptive, tactile, olfactory, aural and taste. Mental images can also be divided into direct and indirect. Direct images are nonverbal representations of actually executed movement (Overby, 1990, pp. 24-27), an example of which is a visualisation of stretching gum. Indirect images are metaphorical. They appear, for example, when the choreographer gives instructions, replacing the arm of the dancer with a metal stick. During dance improvisation, mental images are created dynamically and are formed in the course of moving. Both the image and schema of the body play a part in this process as the system functioning in the background of every action.

The terms "body image" and "body schema" have appeared many times in philosophical or cognitive scientists' work (Merleau-Ponty, 1962; Gallagher, 2005). Shaun Gallagher, in his book *How the Body Shapes the Mind* (2005), precisely discusses and distinguishes the concepts of body image and body schema. According to Gallagher, the two terms refer to two different, and yet related, systems. These systems are correlated in the course of intentional action. Defining the two concepts and marking out their characteristic features will help in understanding the complex dynamic of movement and bodily experience (2005, p. 24). Body schema covers human motor abilities that enable people to maintain posture and to move. This is an almost automatic system, functioning outside of awareness and not requiring perceptual control. Gallagher and Cole, in their article *Body schema and body image in a deafferented subject* (1995), describe body schema as follows:

> The preconscious, subpersonal processes carried out by the body schema system are tacitly keyed into the environment and play a dynamic role in governing posture and movement (Gallagher & Cole, 1995, p. 371)

Body schema does not take the form of conscious representation or belief, although it may evoke specific effects in cognitive experience. Body *image* covers the "system of perceptions, attitudes and beliefs pertaining to one's own body" (Gallagher, 2005, p. 24). In researching body image, three phases are often distinguished: the first (body percept), concerns how the subject perceptually experiences their own body; the second (body concept) concerns the subject's knowledge (every day or scientific) as well their conceptual descriptions of their own body; whilst the third component (body affect) relates to the subject's emotional attitude to their own body (Gallagher, 2005, p. 25). In view of the cultural factors involved, or particular differences between individuals, body image can vary. Body image is not inert: it fulfils an active role in shaping the subject's perception. The difference between body image and body schema is that body image refers to the subject's perception and creation of beliefs about their own body, whereas the body schema refers to the possession of mobility abilities and proprioception.

When solving choreographic problems in dance improvisation, body image and body schema undergo modification. Metaphors included in the choreographer's instructions influence body image and schema and these are enactive instructions, encouraging dancers to develop new directions of movement corresponding to real sensory stimuli. While implementing embodied metaphors in movement there is an integration of imagined and procedural movement (Katan, 2016). I claimed in my research that the dancer's perception and understanding of the metaphors used in the choreographer's instructions represents the dancer's embodied activity based on multimodal experience. The metaphors used are communicative means for effecting changes in perception. In solving a choreographic problem, dancers use both kinaesthetic understanding as well as bodily experience and earlier (explicit, declarative) knowledge about the external world. It is possible for the dancers to fluently and effectively shift their bodily position in a developed sequence of moves, something noted by a series of theoreticians of dance (Stevens and McKechnie, 2005; Kirsh, 2011). Embodied metaphors as applied in dance thus enable originality. This originality frequently emerges in the course of dance improvisation and is very often its main goal.

4. Problem solving in dance improvisation – research

In this part of the paper will be presented initial results from research on the influence of metaphorical instructions on the solution of choreographic problems during improvisation which has actively included body image and body schema. The main goal of this research has been to show how the embodied and situated cognition in background of metaphorical thinking impact the creative solution of problems in the course of dance improvisation. In a further part of my considerations, there will be also an attempt to answer the question: How do dancers solve their problems in improvisation? How does a new body image form under the influence of metaphors and how is that image expressed in the body schema? How does the coordination of these structures take place?

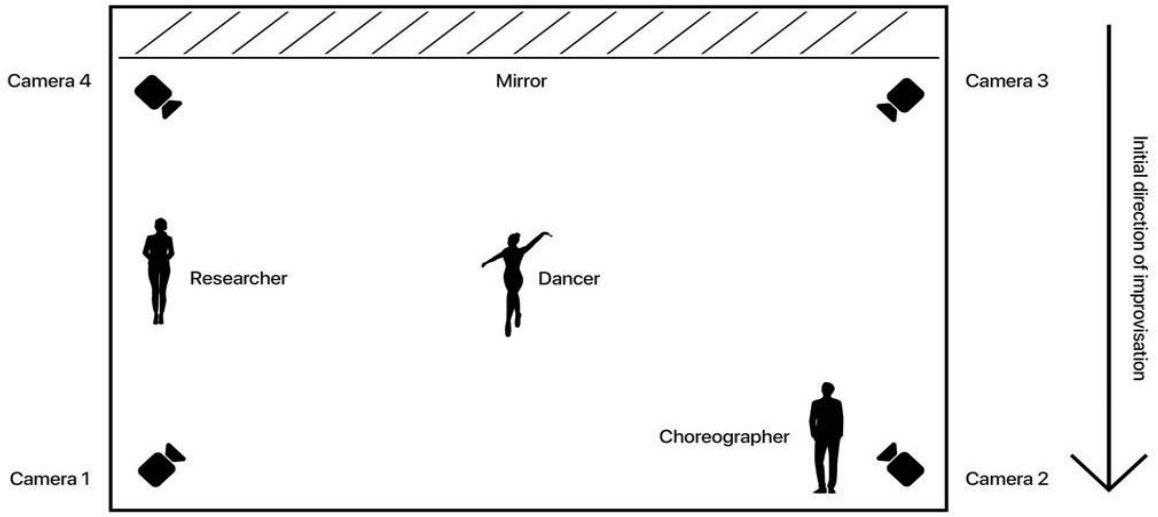
4.1 Materials and methods

4.1.1 Participants

Three groups of dancers took part in the research. They were aged between 18 and 30 and were training classical and modern dance on a daily basis. They were experienced with working with a choreographer and the improvisational tasks. The groups had four members each, three women and one man. The groups were graded according to level: beginners, intermediate and professional. The beginners (who had been dancing for a minimum of 2 years) and intermediates (with a minimum of 4 years' experience) were students at the local UDS Dance School, participants in modern dance and ballet classes. The professionals were dancers from the Musical Theatre in Lublin (Teatr Muzyczny), graduates of the State Ballet School. A choreographer took part as well as a researcher who made observations and research notes during the research. There was also a second researcher, whose task it was also to observe and make notes.

4.1.2 Equipment and space

The research was carried out in a dance hall, with cameras placed in each corner. The space was used without limitation; however, to avoid additional stimuli and interpretations as well as self-control reactions by the dancers, they danced with their backs to the mirror and improvised without the use of music.



Picture 1. Schematic layout of cameras used to film dancers

4.1.3 Methods

The goal of the research was to explore and make an initial appraisal of the creative process taking place when solving a choreographic problem throught dance improvisation – to create a complete record of this process and add precision to the concept of choreographic problem-solving by locating the research problem within the theory of situated and embodied cognition. The following methods and data sources were used in the research, with the data representing the documentation of the process of choreographic problem solving:

1. **Video recording:** A high-definition camera was placed on a tripod in each corner of the room (see figure 1 1). The cameras recorded the execution of tasks by the dancers and the moments when the choreographer presented the tasks to the dancers.
2. **Notes from open non-participant observation:** Notes were made in the course of the task execution by the choreographer, by the researcher and by the second researcher who observed the entire research situation from the side. The notes were then used to add commentary to the video data.

3. **Questionnaires for participants:** Besides the basic sociodemographic particulars, the questionnaire included open question about the scale of difficult involved in executing the tasks, first thoughts before carrying out the task and a request to complete the sentence "GOOD is…" / "BAD is..." The questionnaires served to quickly collect data immediately after task completion and were then used during interviews.
4. **In-depth interviews, recorded on video:** Interviews were carried out with 3 dancers (one from each level). The interviews were video recorded so both researcher and dancer could refer back to any particular move or phrase. Since the video was to be used during the interviews, film was recorded with an additional camera to facilitate later analysis. The interviewees were selected according to the criterion of who was the most representative in terms of recurring examples.

4.1.4 Description of research situation

The research was intended to reveal how choreographic problem-solving proceeds using improvisation suggested by recommendations that include metaphor. The improvisations were both solos and in pairs. The first research situation was based on a solo improvisation, the second was in 2-person groups (see Picture 2). The choreographic task was to execute in improvisation the instruction that contained a fragment of an orientational metaphor which the dancer had to complete using movement. Each improvisation lasted around 1.5 minutes, but there was no time pressure – the dancers decided themselves when to begin and end the task. The choreographic problem to be solved was the execution by the dancer, in movement, the following instructions:

- *The subject for today is **good**. Your task is to improvise in dance and to complete by means of improvisation the sentence "GOOD IS …"*
- *The subject for today is **bad**. Your task is to improvise in dance and to complete by means of improvisation the sentence "BAD IS …"*

The role of the choreographer (and of the researcher) was to instruct, then observe, and finally to draw up a research report.

4.1.5 The course of the research

At the beginning, individual persons danced as a response to an instruction. After that, two persons from the same group-level improvised together. The instructions were the same for individual and duet dancing. The choreographer did not require (or forbid) interaction between the dancers – they were only asked to carry out the task once again. Once both improvisations had been completed, the dancers were asked to fill out the questionnaire. Around a week after the dance hall stage, the dancers met the researcher for an in-depth interview, lasting around 60 minutes and aided by the video recordings produced during the earlier session. The interview was about attitudes, strategies and reflections on body schema and body image, as well as being an attempt to discover the "thought processes" of the dancers when solving choreographic problems.

Picture 2. The photograph presents the second research situation. The choreographer is giving the dancers instructions

Picture 3. Photograph: documentation of in-depth interview with one of the dancers

4.1.6 Preliminary results

The data collected thus far has been analysed using: qualitative coding, writing research notes and the creation of categories on the basis of a conceptual network drawn from Rudolf Laban's (1950) movement qualities with particular attention to the body positions, gestures, spatial movements, reaction times to instructions.

An initial analysis of the questionnaires, video materials of dance and interview videos suggests that the metaphors used in the instructions do influence the creative process involved in

choreographic problem-solving with improvisation. The initial interpretation also suggests that the more emotional the instruction is (in the perception of the dancer), the better it will serve as an impulse for the creation of new and original moves – thereby leading to a better solution to the given problem. Three out of three interview participants stated that the task related to BAD inspired a greater number of original moves, moves that had not been used in the work with GOOD. In the course of the interviews, the dancers referred to emotions (like anger, happiness) that were connected to abstract concepts which indicates that they based their understanding of abstract concepts on bodily experience, expressed in movement in contrast to the abstract. This relationship of abstract concepts to movements illustrates and clarifies, in a practical context, the theory of embodied and situated cognition. The fact that the dancers first of all invoked emotion when solving choreographic problems shows that metaphorical understanding of abstract concepts is multi-dimensional. Before a bodily experience connected to an abstract concept is invoked, it passes through a "filter" of emotion, of image schema or mental space (Kövecses, 2020).

The way the abstract concepts of good and bad are understood is manifested in movements up and down (in accordance with Laban's "upper-lower connectivity" according to his developmental movement patterns) which have a metaphorical character. This relates to the experiential bases of orientational metaphor and confirms its functioning (Lakoff & Johnson, 1980).

The video analyses were based on categories drawn from Rudolf Laban's (Wojnicka, 2010/2011) conceptual network for movement analysis. They suggest that the interpretation of metaphorical instructions for BAD were characterised by a predominance of the following kinds of Laban qualities: bound (determined by a quality of movement related to Flow); strong (in the context of Weight); quick (taking Time); indirect (in Space). Interpretation of the metaphor GOOD was characterised by opposite qualities i.e.: freedom of movement, light, sustained and direct.

It also follows from the initial analyses that carrying out a task, at the same time solving a choreographic problem, was simpler for most dancers when the improvisation was in pairs. In pairs it was easier to place the task in context and solve it by means of interaction. For example, in the improvisation of BAD, there appeared interactions reminiscent of fighting. This conclusion confirms Kirsh's (2009a) assumptions on the essential role of interactivity as one of the problem-solving processes.

Having conducted initial interviews, it can be claimed that the intermediate dancers created more mental images and body images when solving a choreographic problem than professionals. The latter more frequently reproduced body schema from their own existing repertoire, using them as a moment to pause while thinking up subsequent moves. During an interview, in answer to a question on body images, the intermediate level dancers answered:

- *This was connected to people who were in the room, I wanted them to understand me. I wanted to imagine myself from their perspective.*
- *First an image comes to me and then I try to execute that.*
- *I had an image of how to begin, I had thought about the first movement, later on it went smoothly but I still was thinking the whole time.*

- *I think about how this will look and what move I can make afterwards so it will look good.*
- *When I feel that it is an uncomfortable move, that something is not going as I had earlier imagined, then I rethink what I have done and how it must have looked.*

The references to body images and kinetic images in the case of intermediate dancers acted as a control mechanism, sometimes even inhibiting the creative processes. The experience of the more advanced dancers and their familiarity with being on stage allowed them to give themselves over to fantasizing in movement without controlling their movements, even to the extent of not imagining them while performing tasks. Their movements were spontaneous, and the purpose, as one of the dancers admitted during her interview, was the final effect: "I sometimes think about the effect I want to achieve without thinking about how I am going to get there."; "I was thinking about being on that floor, regardless of how – that's why that move came out so strange."

The conclusions I have presented in this article are tentative and require further development in the future. To gather fuller data, it would be necessary to repeat the research with a larger sample including contemporary dancers, those specialising in improvisation, to be able to compare with the other groups investigated. It would be also necessary to improve randomization in future research. There are limitations to the conclusions presented above. Missing is a fuller analysis of movement (e.g. in the ELAN program), one that would fill out the considerations on the particular movement qualities connected to metaphors. Nevertheless, the rich data from video recordings and the interviews allow for the drawing of initial but important conclusions. These conclusions represent a confirmation, illustration and sometimes even an extension of the theories discussed in the first part of the paper. For the research taken as a whole, the in-depth interviews are crucial – providing valuable data on the experiences of the subjects. This material affords unique information, both clarifying and aiding the video analysis.

5. Conclusion

The goal of this research was to present a conceptual framework for choreographic problem-solving using the background paradigms of embodied and situated cognition. The initial conclusions presented from research on choreographic problem-solving with improvisation were illustrative and supplementary and showed the practical aspects of understanding problem-solving issue from embodied and situated cognition theory perspective.

Viewing problem-solving from the perspective of the theory of situated cognition (Kirsh, 2009a) directs our attention to contextual factors – which play a key role in the problem-solving process. Processes and situations like framing and registration, interactivity, knowledge-rich problems and scaffolding diverge from the classical theory of problem solving, but they reveal how internal and external aspects of cognition influence problem solving. The conceptual theory of metaphor from Lakoff and Johnson (1980) reveals the extent to which our knowledge is rooted in an embodied experience of the world. The concept of body image and body schema (Gallagher, 2005), which are systems that take part in intentional action, represent the conceptual background for the topic of choreographic problem solving.

Current initial analyses permit the claim that the metaphors included in the choreographer's instructions influence the creative process of problem-solving for the dancer and, depending on the emotional load of the concepts, this influence may be stronger or weaker. Interactions with other dancers undoubtedly facilitates the task and brings out new, creative moves. Depending on the level of the dancers, their mental images and their body image are formed as support but also as a control on the processes of choreographic problem-solving.

To sum up: the concept of choreographic problem-solving in improvisation is more precisely understood in the context of the theory of embodied cognition and situated cognition.

Funding

The work on the paper was financially supported by National Science Center, Poland, under the grant *The role of embodied metaphors in choreographic problem solving in dance* no. 2019/33/N/HS1/02484.

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