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Research Article

Moving from sandwich to human body: introducing the concept of embodiment to the field of gifted education

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Abstract

Gifted education has followed a paradigm that implies that giftedness is characterized by superior cognitive abilities emanating from the human brain. This view contrasts with a new concept of the human mind: embodiment. Its core message maintains that cognitive processes extend throughout the entire body. Thus, individual perception and action are permanently influenced by the fact that an individual exists within a physical body, situated in a certain environment. This approach is an already highly influential paradigm across various scientific disciplines. Yet, its potential for gifted education remains to be determined. Thus, the main objective of this work is to introduce the concept of embodiment from a gifted education angle. As a first step, the key principles of embodiment along with the most significant criticisms concerning more traditional concepts of cognition are explored. Second, research findings to illustrate embodiment's potential in the realm of gifted education are utilized. Possible changes for gifted education that could result from a consideration of the embodiment approach are addressed. This includes areas such as the conception of giftedness, the role of educators, or gifted identification. It is suggested that gifted education should further examine the potential of the embodiment approach.

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Introduction

In the late 19th and early 20th centuries, pioneers in the field of giftedness research shaped our conceptualization of giftedness. According to early scholars, giftedness is, first and foremost, a matter of the mind (e.g., Galton 1869; Stern 1911, 1916; Terman 1922, 1925). The scientific basis for this view was initially developed by intelligence research (e.g., Spearman 1927; Thurstone 1938), and later amended by cognitive psychology (e.g., Sternberg 1985, 2003). According to this traditional view, human cognition, intelligence and giftedness are localized in the mind and the mind, in turn, is localized in the brain (Neubauer, 2013). Indeed, proponents of the traditional approach to giftedness might ask, *"Where else, if not there?"*

Nonetheless, a new paradigm providing an alternative view is gaining influence in the cognitive sciences and neurosciences: embodiment (Chemero 2009; Lakoff & Johnson 1999; Newen, Bruin, & Gallagher 2018). The central hypothesis is that human cognition is not only located in the brain, but also extends throughout the entire body. From the point of view of traditional giftedness research, this may sound somewhat bizarre. In (2005), Rosenbaum wrote tentatively about embodiment of the, then, Cinderella of psychology, describing the observation of motor control

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receiving only very little attention in psychological sciences. Yet at this time he already noticed a shift in the situation (Rosenbaum, 2005; Willingham, 2004) and until today it has changed markedly: Raab and Araújo (2019), for example, note that there are now more than 10,000 papers and more than 100 reviews on the topic. Consequently, embodiment is no longer an outsider approach that gifted education can continue to ignore.

Initial steps linking embodiment and gifted education have taken place, however, these have emanated from the embodiment camp. One example is a recently published research issue on "Radical Embodied Cognitive Science of Human Behavior: Skill Acquisition, Expertise and Talent Development" (Seifert et al. 2019). Focusing on the embodiment approach, different themes such as improvisation skills (Coste et al. 2019), skill training periodization (Otte et al. 2019), and creativity skills (Malinin, 2019) were examined. This list includes topics that are significantly relevant for the field of gifted education. Therefore, the idea is reinforced that it is time to move past a limited view of cognition. Scholars should focus on establishing links within the confines of gifted education and apply them constructively to its themes, as new and refreshing perspectives reinvigorate the giftedness field.

The aim of this paper is to contribute to fruitful future cooperation between the fields of embodiment and gifted education by encouraging the latter to take a step towards the new paradigm. The manuscript is divided in two parts: First, the main criticisms that the embodiment approach raises against traditional approaches to gifted education will be identified. These criticisms would need to be addressed if constructive cooperation were to take place. Subsequently, a few select examples will be used to demonstrate where the embodiment approach already straddles themes of gifted education.

The Sandwich Metaphor of the Human Mind

In the tradition of intelligence research and cognitive psychology, giftedness research pursued a model of human cognition that consisted of three phases: information input, information processing, and subsequent output or reaction (e.g. Newell 1990; Newell and Simon 1976; Sedlacek 2017). Gifted individuals are characterized by their superior information processing ability, in particular. An illustrative example can be found in the use of an intelligence test for diagnosing giftedness. When taking the test, all subjects receive the same input, that is, they see the same items of the IQ test. However, the gifted individual's diverse way of processing the information constitutes the crucial difference. This enables them to mark the correct answer (output) more frequently compared to non-gifted subjects. Marking the correct answer, however, is regarded as one trivial sub-action within a complex problem-solving process.

Although this description of the human mind is considered by many to be plausible and unquestionable, in recent decades it has been heavily criticized within the fields of cognitive sciences and neurosciences. For example, Hurley (2002) critiqued the view by referring to it as the sandwich metaphor. This metaphor depicts the image of human cognition as purely mental information processing, trapped between perceptions based on physiological processes and subsequent physiological reactions. In particular, supporters of the embodiment approach (Newen et al. 2018; Shapiro, 2004, 2012; Shapiro & Stolz, 2019) regard this view as too simplistic, too reductionist, and far too limited in its practical implications.

Figure 1.
The Sandwich Metaphor of Human Cognition

First, one should consider how the individual understanding of the world is shaped. Observing oneself for a few minutes, one quickly realizes that perception and action in every moment are based on the fact that there is a certain situation and that one exists within his or her (own) human body (Glenberg et al. 2013). As Wilson (2002) has convincingly argued, this essential aspect requires a reconsideration of human cognition. Disembodied and nonsituated explanations of human cognition are insufficient.

For several decades, an extremely active field of embodiment research has focused on this interaction between physical (sensory, emotional, motor, etc.) and information-generating and -processing mechanisms. In contrast to non-embodied cognitive approaches (Sun, 2008), an interconnection of mental and physical processes is implied

(Dijkstra & Post, 2015). Accordingly, the body is not regarded as a mere tool that executes commands from the brain as the central system. It is attributed a much deeper role in cognitive functioning.

The ambition behind the embodiment approach can be derived from the following analogies. The periodic table of elements was an attempt to capture the constituents of matter. Likewise, the postulation of phonemes was an attempt to classify the smallest meaningful sounds composing words. So, what could the "cognitive alphabet" look like? What are the constituents of human cognition? Scientists were unable to find a convincing answer to this question for a long time. The embodiment approach assumes that all our cognitive concepts are based on bodily experiences of everyday life. This means, for example, that all mathematical ideas—regardless of how abstract and complex they may be—can be traced back to concrete bodily experiences (Lakoff, 2002).

The profoundness of this paradigm shift is illustrated aptly by Rolf Pfeifer, who adapted Descartes' famous statement "I think, therefore I am" into "I act, therefore I am" (TEDx, 2013). Thus, not only the mind is regarded as the sole origin of existence, but the acting organism itself, which demonstrates that intelligent behavior is only possible through the integration of the body (Niedenthal et al. 2005). The importance of actions for gifted education in general is already emphasized in the Actiotope Model of Giftedness (Ziegler, 2005; Ziegler et al. 2013). From such a perspective, the gifted are not those who think and process information exceptionally, but those who act exceptionally (although not necessarily at an eminent level). Acting refers to the entire spectrum of skill development from the beginning to extraordinary achievements.

In the following, an analysis is provided as to why gifted education and embodied cognition belong together. The first section provided a review of research findings from five different fields that are important to gifted education and in which the paradigm shift from a traditional to an embodiment view can be intuitively understood through simple examples. In the conclusion, five conceptual levels are identified at which gifted education could be influenced by and would benefit from the embodied cognition approach.

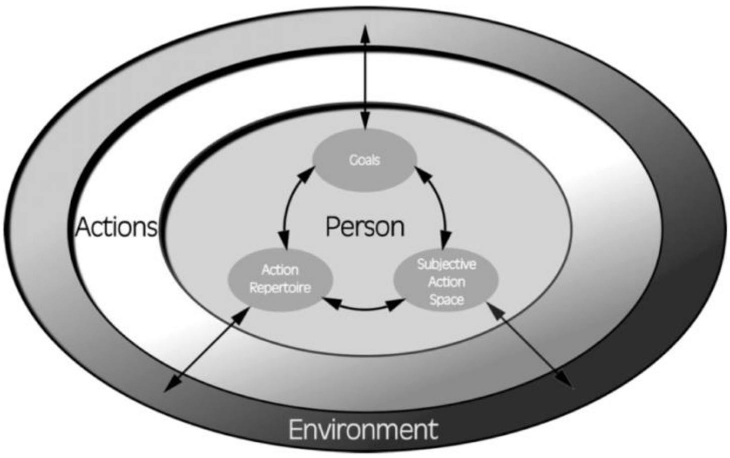

Figure 2.
The Actiotope Model of Giftedness (adapted from Ziegler et al. 2014)

Summary
Embodiment describes a shift from traditional computational theories of cognition to an understanding of cognitive processes as an interaction of mind, body, and environment, as one system. This approach attributes actions an essential function for cognition. A change in the perspective on cognition would also be accompanied by a change in the perspective on giftedness, which has so far been strongly influenced by traditional concepts of cognition.

First Research Field: Math Education of the Gifted
If all mathematical ideas can be traced back to concrete bodily experiences, as the embodiment approach claims, which body experience would be the basis of the mathematical concept of equations, for example? As the term implies, the task in solving mathematical equations is to balance what appears to the left and right of the equal sign. Likewise, the balance of the body must always be maintained.

Research shows that this is by no means an unsubstantiated comparison of superficial similarities between mathematical and motor concepts. For example, students' understanding of equations can be substantially improved by underlining content with gestures symbolizing balance (Núñez et al. 1999).

Figure 3.
Gestures Symbolizing Balance Can Have Beneficial Effects in Math Education

However, the embodiment approach is in no way limited to explaining such basic mathematical concepts as a mathematical equation. For those interested in further literature, Lakoff and Núñez's (2000) book "Where Mathematics Comes From?" illustrates how embodiment justifies even complex mathematical formulas.

Several studies demonstrate correlations among embodied cognition, successful mathematical problem solving, and top performance in mathematics. For example, Walkington et al. (2014) indicated that success in task performance (e.g., proving a mathematical conjecture) was correlated with embodied representations (e.g., gesturing strategies during problem solving such as engaging in fluid transformations or 'collapsing' a triangle formed with their hands into two-line segments on top of each other). In other research, the participants in Gerofsky's (2011) study were representative of 'top', 'average', or 'struggling' mathematics students. One key finding was that in contrast to average students who exhibited static gestures, top mathematics students produced the most dynamic gestures to accompany mathematical tasks. The students struggling in mathematics produced erratic and inaccurate gestures. The differences in gesture use might be due to differences in the mathematically gifted brain.

Research in the field of cognitive neuroscience suggests that mathematically gifted students tend to rely more on their right brain hemisphere (Al-Khalil & O'Boyle, 2018; Kalbfleisch, 2008; O'Boyle, 2008). Therefore, their increased performance is not necessarily due to enhanced basic mathematical skills, but rather to the fact that mathematically gifted students use mental imagery to solve mathematical problems (O'Boyle, 2008). The process is not only based on visual mental simulation but also on motor imagery, due to previous sensorimotor experiences of the body in the environment (Iachini, 2011). Thus, especially for high achievers, there may be significant benefits from incorporating physical actions into learning processes.

Further, not only high achievers can benefit from the incorporation of these findings, but also possible beneficial effects for twice-exceptional learners should be taken into consideration.

Second Research Field: Motionless Bodies – Yet Moving a Lot!

Even if the body remains motionless, its posture alone has been shown to cause significant effects on human experience and information processing. This can be illustrated by the following two examples.

Research suggests that people in upright positions experience a more positive mood and increased confidence in their abilities (Briñol et al. 2009; Canales et al. 2010; Carney et al. 2015; Casasanto & Dijkstra, 2010; Dijkstra et al. 2007; V. E. Wilson & Peper, 2004). Not only do people with a more positive mood and greater self-confidence tend to adopt an upright posture, but conversely these effects can also be achieved through consciously maintaining an upright posture. Such findings have many implications for gifted education. For instance, various studies revealed that people in open postures showed significantly more creative performance than people in closed postures (e.g., Friedman & Förster, 2001; Hao, Xue, Yuan, Wang, & Runco, 2017).

Figure 4.
Sitting Upright can have Beneficial Effects on Students' Mood

Third Research Field: Motor Activities and Learning

Motor activities during learning processes have a positive influence on learning outcomes. This was observed in mathematics, natural sciences, language and music. Consequently, learning can by no means be regarded as an isolated, purely mental activity (Sullivan, 2018). Rather, the effects of gestures during learning are part of the breadth of well investigated angles of embodiment. Learners who use gestures in learning show significantly improved retention and comprehension (Alibali, 2005; Cook et al. 2008; Pouw et al. 2014). Further, the use of gestures by teachers can have a substantially positive impact on students' learning outcomes (Sullivan, 2018).

Information is not only 'stored' neuronally (i.e., in the brain), but also in one's own body or in the environment (Iverson & Goldin-Meadow, 1998; M. Wilson, 2002). Interestingly, parts of cognitive work are off-loaded into gestures or even onto the environment. Basic examples are finger counting to understand numerical concepts (Bahnmueller et al. 2014) or taking notes.

Figure 5.
An Example for Off-loading in Math Education

By transferring cognitive load to visuospatial domains, individuals are able to focus—to a greater extent— their cognitive capacities on solving a given problem (Shapiro & Stolz, 2019). When it comes to supporting students, it is gratifying, especially from the perspective of gifted research, that students with working memory problems can benefit greatly from the use of gestures in learning (Marstaller & Burianová, 2013). This is because problems in working memory, which may be caused by performance anxiety or attention deficit hyperactivity disorders, are a frequent reason why gifted students in particular fail to achieve their full potential.

Earlier in this paper it was indicated, that successful and top mathematics students use dynamic and more elaborate gestures in mathematical tasks (Gerofsky, 2011; Walkington et al. 2014). Thus, gestures can also be considered an outward indication of an advanced level of understanding (Shapiro & Stolz, 2019). Furthermore, gestures can also provide information to regulate the learning process of gifted students. For example, a mismatch of gestures and speech, a so-called 'discordance' (Breckinridge Church & Goldin-Meadow, 1986), allows educators to draw information about the student's learning status such as whether the student is in transition and ready for learning new content. Finally, examples supporting why gifted education could benefit from motor activities during learning can be drawn from highly interesting perspectives arising from education in a digital world. One such point of view includes that of Besnoy, Dantzler, and Siders (2012) who proposed the creation of digital ecosystems for gifted education classrooms.

Fourth Research Field: Mirror Effects

Embodiment evolves not only in one's own actions, but also in the observation of actions in others. This represents an essential insight for gifted education in particular. Research suggests that it is only possible for talents to fully develop with the support of personal mentors (Grassinger et al. 2010; Pleiss & Feldhusen, 1995).

Interestingly, when observing other people's actions, the same regions of the brain are activated that are also operative when those same actions are performed with one's own body.

Figure 6.
In Mentoring Contexts, Students Learn a lot by Imitating Observed Behavior

Thus, observed behavior is unconsciously imitated (Chartrand & Bargh, 1999; Rizzolatti & Craighero, 2004; Sullivan, 2018). Further, it was found that such imitation effects also occur without the mirrored person being physically present (Shapiro & Stolz, 2019; Sullivan, 2018), a finding that may be interesting for virtual learning processes such as the online mentoring of talents (Stoeger et al. 2017, 2019).

Figure 7.
Imitation Effects are Suggested to Play an Important Role in Online Mentoring

Fifth Research Field: Embodied Grounding

Motivation and opportunities are crucial factors in turning abilities into expertise (Kaufman & Sternberg, 2008; Renzulli, 1979; Rinn, 2012; Sternberg, 1998, 2001; Subotnik et al. 2011). In order to reach the goal of expertise, commitment in gifted learners is essential (Subotnik et al. 2011). However, curiosity and joy in learning can quickly diminish when learners feel underchallenged – with gifted students in particular, this point can be reached quickly. Offering a classroom environment that allows for rich learning experiences that match the students' stage of talent development (Subotnik et al. 2018) is key. Learners must be offered a variety of action possibilities, given that actions are limited by the possibilities perceived in the environment. Indeed, the field has already implied that the perception of a stimulus leads to automatic triggering of associated motor or sensory systems (Topolinski, 2012).

For embodied learning environments, studies revealed positive effects on students' learning outcomes (e.g., Jaeger, Wiley, & Moher 2016). Positive effects for embodied learning settings were also revealed for advanced learners (Johnson-Glenberg & Megowan-Romanowicz, 2017). Hence, effects do not only occur in earlier phases of development or in basic contexts and could therefore be of promise for gifted education. For the promotion of a highly gifted high school student who is far ahead of his or her peers in specific domains, these findings can be critical to the development of the student's domain specific abilities and knowledge. Particularly in inclusive settings, individual affordances can allow for diversity and offer both support and stimulation, according to each individual's needs. In order to achieve equity, one of gifted education's primary goals, multiple forms of perception require multiple forms of representation.

Summary

There is a growing body of findings from the field of embodied cognition, which can be applied to the field of gifted education. Within every step of the learning process it should be kept in mind, that students' perception is shaped by their experience of being in a human body, which exists in a certain environment. Above, examples of the following areas have been presented: gifted mathematics education, postures, motor activities and learning, mirror effects, and embodied grounding. Thus, embodiment can provide insights to support gifted students in reaching their potential.

Transfer of Embodiment Findings to the Field of Gifted Education

The embodiment approach has become a strong competitor to the traditional view of human cognition (Raab & Araújo, 2019). Embodiment has convincingly shown that human cognition encompasses sensory, motor skills, emotions, and intellectual skills to an equal measure through their situational integration (Awad, 2019). Gifted education, which has so far been oriented towards intelligence research and cognitive science, is required to respond to this development. This is particularly pertinent given that the embodiment approach is increasingly turning to issues that fall within the original scope of gifted education (e.g., Seifert et al. 2019).

The findings outlined above clearly show that the embodiment approach has numerous implications for gifted education. We want to highlight four exemplary areas in which gifted education can benefit.

Conceptions of Giftedness

Conceptions of giftedness play an important role in several respects. Among other things, they influence what researchers investigate, what gifted program designers construct, the behavior of gifted educators and gifted teachers (Sternberg & Davidson, 2005), and so on. Therefore, a paradigm shift from a conception of giftedness oriented on intelligence and cognitive theories to an embodiment-oriented conception of giftedness would presumably influence all fields of gifted education.

Gifted Educators

The embodiment approach allows us to see more than gifted bodies in a different light; it challenges us to reassess the embodiment of the teacher, as well. Educator embodiment influences, among other things, their self-related cognitions (e.g., self-confidence), their emotions, the comprehensibility of their explanations (Sullivan, 2018), their effectiveness as role models (Cook & Goldin-Meadow, 2006), the attention of their observers (Langten et al. 2000), and so on. In communication, non-verbal behavior has significantly more influence over verbal behavior, and especially in instructional communication, educational research estimates the proportion to be about 70% (Burgoon et al. 2016; McCroskey et al. 2006). Consequently, embodied cognition must urgently become an element in the training of gifted educators and gifted teachers.

Gifted Education Provisions

In recent years, it has become increasingly obvious that a more holistic understanding of giftedness and gifted education is required (Ziegler & Phillipson, 2012). However, while social and emotional needs, for example, are now often taken into account, a holistic approach would also encompass embodiment. The examples in this paper were widely spread and show that it plays a role in almost every aspect of gifted education. Just as social and emotional needs are now obligatory factors considered across a myriad of gifted education provisions, so too should embodied cognition become fixed in the tenets of talent development.

Gifted Identification

So far, gifted identification has focused on maximum cognitive performance. A stronger consideration of embodiment will presumably enrich traditional gifted identification in several respects. For example, if giftedness is assessed on the basis of IQ, people are tested for maximum performance in a relatively artificial setting. Embodiment, on the other hand, emphasizes that concrete actions should be examined in their situational embedding (Newen et al. 2018).

Therefore, the focus is not on identification that focuses on maximum cognitive performance, but on typical performances in representative tasks.

One example is the distinction between typical and maximal performance on intellectual tasks. Goff and Ackerman (1992) criticize that in IQ tests the influence of both the environment and the situation is minimized in order to capture the full potential of the subjects. Instead, they recommend that typical intellectual engagement (TIE) should also be measured. Thus, the question may arise, "What good is a gifted student with an IQ of 160 if he or she is not attentive in the classroom?" His or her effective IQ with regard to the subject matter in class is then zero. It will certainly be exciting to see how additional situational identification tools will complement the traditional identification tools.

Summary

Historically, gifted education has proven itself pragmatic and flexible enough to expand upon its paradigm and respond to new theoretical developments. A prime example is the progress from one-dimensional giftedness models (mostly focused on performance or IQ) to multidimensional giftedness models (e.g., Gagné 2009; Heller, Perleth, & Lim 1978; Tannenbaum, 1986). At that time, it was possible to integrate important factors such as motivation or the social environment into giftedness models. Why should this not be applicable to our understanding of the human body?

The field of gifted education should explore seriously and systematically, whether it can incorporate valuable insights and experience of the embodiment approach into what it means to be gifted. We believe that the time has come for this to be considered by the field.

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