Movement quality and body awareness in autism- experiences, assessment, and intervention

Bertilsson, Ingrid

2024

Document Version:
Publisher's PDF, also known as Version of record

Movement quality and body awareness in autism

- experiences, assessment, and intervention

INGRID BERTILSSON
REHABILITATION AND SUSTAINABLE HEALTH | FACULTY OF MEDICINE | LUND UNIVERSITY

Movement quality and body awareness in autism

- experiences, assessment, and intervention

Ingrid Bertilsson

LUND
UNIVERSITY

DOCTORAL DISSERTATION

Doctoral dissertation for the degree of Doctor of Philosophy (PhD)
at the Faculty of Medicine at Lund University
to be publicly defended on October 29th 2024 at 9.00
in the Belfrage Hall, Department of Health Sciences, Forum Medicum,
Biomedical Centre, Klinikgatan 32, 221 85 Lund

Faculty opponent
Professor Jonathan Delafield-Butt
Research unit Health and Wellbeing, University of Strathclyde, Glasgow

Organization: LUND UNIVERSITY

Document name: Doctoral dissertation

Date of issue 2024-10-29

Author(s): Ingrid Bertilsson

Sponsoring organizations:
Region Västra Götaland; the Skaraborg Institute of Research and Development

Title and subtitle: Movement quality and body awareness in autism – experiences, assessment, and intervention

Abstract: Autistic persons often have difficulties with social interaction and communication. Sensory impressions are often processed differently than in neurotypicals. The person may be negatively affected bodily, e.g., being unstable or having reduced body awareness. The body awareness may be observed as an expression in movement quality. However, there is a lack of knowledge about experiences, assessment and interventions of problems with movement quality and body awareness in autistic persons.

The aim of this thesis was to describe experiences of movement quality in autism, to investigate measurement properties of a movement quality assessment, and to study possible effects of a body awareness intervention in autistic young adults.

In a mixed-method study, **Paper I** explored the experiences of body and movements in autistic persons through individual interviews. The participants (n=11) were assessed with two physiotherapeutic instruments: the Body Awareness Scale Movement Quality and Experiences (BAS MQ-E) and Bruininks-Oseretsky's test of motor proficiency (BOT2). Several problems were described, but the participants themselves did not understand that the problems were not a normal condition. The physiotherapeutic instruments could capture the experiences. In a phenomenological study, **Paper II** described physiotherapists' experiences about movement quality in autism (n=10). They confirmed that movement problems often go unrecognized. The general structure of the movement pattern was described as fragmented, restrained and hesitant. Using Rasch analysis, in **Paper III** measurement properties of the BAS MQ in autistic persons (autism group n=108; reference group n=32) were investigated. BAS MQ was found to acceptably measure movement quality in autism, though improvements were possible. In a pragmatic RCT, **Paper IV** evaluated effects of Basic Body Awareness Therapy (BBAT) in autistic persons. The intervention group (n=28) received 12 individual therapy sessions with BBAT and treatment-as-usual (TAU; e.g., psychoeducation or working with structure in everyday life), whilst the control group (n=29) received TAU only. The primary outcome was measures of an individually experienced movement quality problem, as scored on a numeric rating scale. The secondary outcome was BAS MQ measures. The statistically significant results were in favor of the intervention group in both outcomes ($p<0.001$).

In conclusion, autistic persons experience several problems with body and movements, also described by physiotherapists. The problems often go subjectively unrecognized, creating difficulty in understanding oneself. By assessing their movement quality and body awareness with BAS MQ-E, autistic persons that may benefit from BBAT may be identified, and an intervention may be provided to enhance bodily resources and to achieve a better understanding of oneself in everyday life.

Key words: autism; movement quality; body awareness; embodiment; body-mind therapies

Classification system and/or index terms (if any)

Supplementary bibliographical information

Language: English

ISSN and key title: 1652-8220

ISBN: 978-91-8021-613-5

Recipient's notes

Number of pages: 93

Signature

Date 2024-08-15

Movement quality and body awareness in autism

- experiences, assessment, and intervention

Ingrid Bertilsson

LUND
UNIVERSITY

Cover photo by Ingrid Bertilsson '*A pair of grounded feet*'

Faculty of Medicine

Department of Health Sciences

ISBN 978-91-8021-613-5

ISSN 1652-8220

Printed in Sweden by Media-Tryck, Lund University

Lund 2024

To all persons on the autism spectrum.

Table of Contents

Abstract

Autistic persons often have difficulties with social interaction and communication. Sensory impressions are often processed differently than in neurotypicals. The person may be negatively affected bodily, e.g., being unstable or having reduced body awareness. The body awareness may be observed as an expression in movement quality. However, there is a lack of knowledge about experiences, assessment and interventions of problems with movement quality and body awareness in autistic persons.

The aim of this thesis was to describe experiences of movement quality in autism, to investigate measurement properties of a movement quality assessment, and to study possible effects of a body awareness intervention in autistic young adults.

In a mixed-method study, **Paper I** explored the experiences of body and movements in autistic persons through individual interviews. The participants (n=11) were assessed with two physiotherapeutic instruments: the Body Awareness Scale Movement Quality and Experiences (BAS MQ-E) and Bruininks-Oseretsky's test of motor proficiency (BOT2). Several problems were described, but the participants themselves did not understand that the problems were not a normal condition. The physiotherapeutic instruments could capture the experiences. In a phenomenological study, **Paper II** described physiotherapists' experiences about movement quality in autism (n=10). They confirmed that movement problems often go unrecognized. The general structure of the movement pattern was described as fragmented, restrained and hesitant. Using Rasch analysis, in **Paper III** measurement properties of the BAS MQ in autistic persons (autism group n=108; reference group n=32) were investigated. BAS MQ was found to acceptably measure movement quality in autism, though improvements were possible. In a pragmatic RCT, **Paper IV** evaluated effects of Basic Body Awareness Therapy (BBAT) in autistic persons. The intervention group (n=28) received 12 individual therapy sessions with BBAT and treatment-as-usual (TAU; e.g., psychoeducation or working with structure in everyday life), whilst the control group (n=29) received TAU only. The primary outcome was measures of an individually experienced movement quality problem, as scored on a numeric rating scale. The secondary outcome was BAS MQ measures. The statistically significant results were in favor of the intervention group in both outcomes ($p<0.001$).

In conclusion, autistic persons experience several problems with body and movements, also described by physiotherapists. The problems often go subjectively unrecognized, creating difficulty in understanding oneself. By assessing their movement quality and body awareness with BAS MQ-E, autistic persons that may benefit from BBAT may be identified, and an intervention may be provided to enhance bodily resources and to achieve a better understanding of oneself in everyday life.

Svensk populärvetenskaplig sammanfattning

Autism är ett tillstånd där problem med social interaktion och kommunikation är kriterier för diagnosen. Sensoriska intryck från omgivningen och från den egna kroppen processas ofta annorlunda i hjärnan än vad som är neurotypiskt (utan funktionsnedsättning). Det kan leda till inre upplevda konflikter att läsa av olika sammanhang - under varje dag i livet. I individen lagras förvirrande information som försvårar en mängd olika funktioner, såsom att balansera, röra sig, tänka eller känna. Den kroppskännedom man har påverkas, det kan vara svårt att förstå den egna kroppen. Hur väl man är medveten om och känner den egna kroppen kan observeras i rörelsekvalitén hos personen. Men det har saknats forskning om kroppskännedom för autistiska personer och hur det kan bemötas inom vården.

I den första studien i denna avhandling, med mixad metoddesign, intervjuades elva autistiska personer för att undersöka hur de upplevde sin kropp och rörelser och om deras beskrivningar kunde fångas med två fysioterapeutiska instrument, Body Awareness Scale Movement Quality and Experiences (BAS MQ-E) and Bruininks-Oseretsky's test of motor proficiency (BOT2). Flera svårigheter beskrevs, men deltagarna själva hade inte kunnat koppla problemen till rörelsesvårighet, de förstod inte hur de påverkades. Det kunde exempelvis vara upplevelsen av att en kroppsdel plötsligt slängde till och slog ned saker. Vilken tillgång deltagaren hade till rörelsekvalité samstämde med hur man litade till sin kropp i vardagen. Resultatet visade även att de två instrumenten kompletterade varandra och relativt väl fångade deltagarnas upplevelser.

I den andra studien beskrevs svårigheter med kropp och rörelse bland personer på autismspektrumet av tio fysioterapeuter, som var specialiserade på autism och rörelsekvalité. Syftet var att öka förståelsen för funktion i kropp och rörelse hos autistiska personer. Fysioterapeuterna beskrev sina upplevelser av rörelsekvalitén hos dessa personer som fragmenterad, återhållen och tvekande. Deras beskrivningar bekräftade vad som framkommit från de autistiska personerna i den första studien - att svårigheterna i kropp och rörelse ofta inte hade uppmärksammats.

Att inom fysioterapi använda undersökningar som mäter eller beskriver personens problematik ligger till grund för behandlingsinsatser. Syftet med den tredje studien var därför att undersöka om BAS MQ är ett lämpligt instrument för autistiska personer. I denna studie ingick 108 autistiska personer och 32 neurotypiska personer att jämföra mot. Raschanalys visade att BAS MQ hade acceptabla mätegenskaper för att kunna bedöma rörelsekvalité, även om de personer som hade bäst rörelsekvalité inte fick tillräckligt svåra uppgifter som motsvarade deras förmågor, kallat targeting (träffsäkerhet). Detta var förväntat, då redan god rörelsekvalité är svår att särskilja. Konklusionen av studie tre var att BAS MQ acceptabelt kunde användas, även om den kunde förbättras än mer, för att beskriva rörelsekvalité hos autistiska personer och som underlag inför en eventuell behandling.

Den fjärde studien i avhandlingen undersökte om 12 individuella behandlingstillfällen med en kroppskännedomsmetod kallad Basal Kroppskännedom (BK) kunde påverka rörelsekvalitén hos autistiska personer. Deltagarna fick samtidigt sin sedvanliga behandling om sådan fanns planerad, på engelska kallad treatment-as-usual (TAU). Det kunde exempelvis vara att få utbildning om autism eller arbeta med struktur i vardagen. Detta upplägg fick behandlingsgruppen. De jämfördes mot en kontrollgrupp som endast fick TAU. Effekter värderades av deltagarna själva genom att skatta ett problem man upplevde med rörelsekvalité på en 0-10 gradig skala före och efter behandlingsperioden. Dessutom observerades och skattades rörelsekvalitén med BAS MQ av en fysioterapeut. Efter behandlingsperioden fanns en signifikant skillnad till behandlingsgruppens fördel.

Sammanfattningsvis upplevde autistiska personer problem med kropp och rörelse, något som specialiserade fysioterapeuter kunde observera i personernas rörelsekvalité. Rörelsekvalité kan ses som ett uttryck för de upplevda problemen. Att problemen beror på rörelsesvårigheter är ofta något varken individen själv eller personer i dennes omgivning förstått. Ett instrument för att mäta rörelsekvalitén är BAS MQ-E. Med stöd av ett sådant underlag kan de som bedöms kunna ha nytta av BK identifieras och erbjudas denna behandling, då den visat sig ge god effekt på kroppskännedom och rörelsekvalité för autistiska personer. Detta kan ge möjlighet att utveckla en bättre förståelse av sig själv.

List of Papers

I. Bertilsson I, Gyllensten AL, Opheim A, Gard G, Sjödahl Hammarlund C. *Understanding one's body and movements from the perspective of young adults with autism: A mixed-methods study.* Research in Developmental Disabilities. 2018; 78(2018), 44–54. © Elsevier

II. Bertilsson I, Gard G, Sjödahl Hammarlund C. *Physiotherapists' experiences of movement quality in autism: a descriptive phenomenological study.* Physiotherapy Theory and Practice. 2020; 38(2), 299-308. © Taylor and Francis Group

III. Bertilsson I, Melin J, Brogårdh C, Opheim A, Gyllensten AL, Björksell E, Sjödahl Hammarlund C. *Measurement properties of the Body Awareness Scale Movement Quality (BAS MQ) in persons on the autism spectrum: A preliminary Rasch analysis.* Journal of Bodywork & Movement Therapies. 2024; 38(2024): 464-473. © Elsevier

IV. Bertilsson I, Brogårdh C, Opheim A, Gyllensten AL, Melin J, Sjödahl Hammarlund C. *Effects of Basic Body Awareness Therapy on movement quality in autistic young adults: a superiority pragmatic randomized controlled trial.* In manuscript.

Abbreviations

BAS MQ-E: Body Awareness Scale Movement Quality and Experiences
BAS MQ: Part Movement Quality
BAS E: Parts Experiences

BBAT: Basic Body Awareness Therapy

BOT2: Bruininks-Oseretsky's test of motor proficiency version 2

DSM: Diagnostic and Statistical Manual of Mental Disorders

ICD: International Classification of Diagnoses

NRS: Numeric Rating Scale

pRCT: Pragmatic Randomized Controlled Trial

PROM: Patient-Reported Outcome Measure

TAU: Treatment-As-Usual

ToM: Theory of Mind

Thesis at a glance

Aims	Methods	Results	Conclusions
Paper I: To explore the experiences of body and movements in autistic young adults and how two physiotherapeutic instruments may capture these experiences	Primarily qualitative: Mixed-methods design Individual interviews, Body Awareness Scale Movement Quality and Experiences, BAS MQ-E, and Bruininks-Oseretsky's Test of Motor Proficiency, BOT2 Young adults with autism, n=11	Conflicting feelings about body and movement and low understanding of oneself were described. The instruments captured this relatively well. Positive experiences and better movement quality related to having access to more functional strategies for everyday life.	Assessing both motor proficiency and movement quality was optimal for understanding the experiences. Movement quality seemed to influence daily living more than quantity.
Paper II: To describe the meaning of movement quality in persons on the autism spectrum as experienced by specialized physiotherapists	Qualitative: Descriptive phenomenological Individual interviews Physiotherapists, specialized in autism and movement quality, n=10	Persons on the autism spectrum live the body with a need to constantly protect oneself from impressions. The general structure was described as fragmented, restrained, and hesitant. The problems with body and movements were described as often unrecognized.	Difficulties processing sensory impressions were described to obscure the meaning of movements, and rendering the general structure. The problems with body and movements need recognition.
Paper III: To investigate measurement properties of Body Awareness Scale Movement Quality, BAS MQ, to autistic persons and in a neurotypical reference group	Quantitative: Rasch analysis of measurement properties Autism group (n=108), reference group (n=32)	BAS MQ was unidimensional, had good fit statistics and discriminated between the autism and the reference groups, and different movement ability within the autism group. The targeting for the most abled persons was poor.	BAS MQ had acceptable measurement properties, and may be regarded a valid assessment scale in autistic persons. Improvements to be made especially regarding targeting.
Paper IV: To evaluate the effects of Basic Body Awareness Therapy, BBAT, and TAU compared to TAU alone, on a person-reported experienced movement quality problem and observed movement quality in autistic young adults.	Quantitative: Pragmatic RCT Autistic persons, Intervention group (IG; n=28), control group (CG; n=29)	Compared to the CG, the IG improved significantly ($p<0.001$). Within-group, both outcomes: IG improved significantly ($p<0.001$), CG did not. Individual significant improvements of NRS: IG 54 %: CG 11 % of the participants, and BAS MQ: IG 41 %; CG 7 %.	BBAT and TAU were superior to TAU alone, to improve both experienced and observed problems with movement quality. BBAT is relevant to implement as an intervention for autistic persons.

Preface

As a physiotherapist and specialist in Pediatrics and Mental Health, as well as a biologist; my belief is that the best way to support another being to develop, is to respectfully enhance the inner resources of this individual, from where she/he is in her/his development. This is best performed when the person experiences positive emotions connected to body or movements. In this, *understanding* and *meaning* may occur. To me, these two concepts are essential to an individual's well-being.

My beliefs also include that one's body and movements are the prerequisite for being-in-the-world, and remain the base for developing other functions during everyday living throughout one's life. Evolutionary, movement is the first sign of what we call life, be it between exchanging air molecules during metabolism or moving body parts. Without body and movements, few sensory impressions. Without sensory impressions, no input. Without input, no/little affects or emotions, or cognitive development. But on the other hand, life itself may generate impressions from our genetically informed bodies, without external impressions - just because there is life from within.

When working in an intervention with psychological aims for youngsters on the autism spectrum, I - being a physiotherapist - made a lot of observations about their bodies and movements. Something about the quality struck me. I made connections to all the infants I had met with global developmental disorders when working in neonatology care, to their awkward movements and behaviors. Later, I met several of these children in habilitation care - with an autism diagnosis.

Questions arose: How do autistic children and youngsters experience body and movements? Why has the health care not recognized this enough? And after having done literature searches another question appeared: Why is there practically no research where autistic persons themselves tell about their experiences? Instead, the narratives about experiences about body and movements was found in autobiographical novels, written by autistic persons. I set out on my research studies journey to still my questions…

This thesis was carried out within the research group Rehabilitation and Sustainable Health, Faculty of Medicine at Lund University, where the author was accepted for PhD studies in April 2017. The data sampling was performed within the Region Västra Götaland, in cooperation with Region Kronoberg.

Background

Autism

'The eternal mystery of the world is its comprehensibility.'
Albert Einstein

A patient from a clinical setting, told the author several years ago about living in a body that constantly failed her:

> *'My body feels like a vase that constantly breaks, but for each time I try to mend it, I find that the vase has a new unrepairable hole'.*

This experience emanated from a disorder on the autism spectrum, pointing at the lack of comprehensibility of one's body and movements in connection to the world. In this thesis, the focus was to investigate experiences of body and movements for autistic persons, from a physiotherapeutic view within pediatrics and mental health, in order to relevantly address these problems and to establish interventions.

Autism is a neurodevelopmental disorder, diagnosed from core criteria in the Diagnostic and Statistical Manual of Mental Disorders 5 (DSM-5)[1]. In Sweden, the diagnosis coded in the patient records is from the International Classification of Diagnoses (ICD-10)[2]. The prevalence of autism in Sweden is 1.0-2.4 %, depending on age group[3]. The condition is genetically based[4], but is affected by experiences throughout life[5] and with different aetiology[4]. The diagnostic assessment includes psychological testing where cut-off limits are used. The criteria are:

A. Persistent deficits in social communication and interaction across multiple contexts, as manifested by: 1.) deficits in social-emotional reciprocity, 2.) deficits in nonverbal communication, 3.) deficits in developing, maintaining and understanding relationships.

B. Restricted, repetitive patterns of behavior, interests, or activities, manifested by at least two of the following: 1.) stereotyped or repetitive motor movements, use of objects, or speech, 2.) insistence on sameness, inflexible adherence to routines, 3.) highly restricted, fixated interests that are abnormal in intensity or focus, 4.) hyper- or hypo reactivity to sensory input or unusual interest in sensory aspects of the environment.

C. Symptoms must be present in the early developmental period.

D. Symptoms cause clinically significant impairment in social, occupational, or other important areas of functioning.

E. These disturbances are not better explained by intellectual disability or global developmental delay.

A main difference from the former manual DSM-IV, which describe autism with different diagnosis depending on degree of symptoms[6], DSM-5 define the need of support in everyday life in three levels; little, medium or high[1]. Both have been used in the different studies.

Throughout the thesis, and congruent with recent research on how to use concepts the way most persons on the autism spectrum prefer[7-11], the concept 'person on the autism spectrum' has been used to point at the diversity the group comprises, and the identity-first concept 'autistic person' on an individual basis.

Classical characteristics in persons on the autism spectrum

Living as autistic is for every single individual a complex combination of the different diagnostic criteria[1], and therefore become a heterogenous group[12]. A combining factor appears to be the lack of integration and/or flexibility in either of three major cognitive theories. These have for long been the explanations for what defines autism, and are problems with: 1. theory of mind (ToM; to understand that others think or feel differently from myself), 2. executive functions (planning, initiating and driving activities), and 3. central coherence (to grasp the full context out of details)[13].

Combined, these theories may explain why persons on the autism spectrum may have problems with different abilities needed in everyday life, such as estimating time[14], creating structure and perform everyday activities, a rigid behavior, to understand others in social interaction[13], to responsive attention to them[15], or to act with flexibility[13]. As all of these symptoms interact, they may affect everyday life negatively.

The symptoms imply a different way to experience the surrounding world for persons on the autism spectrum, in comparison to neurotypical (having no disability). Besides the support the individuals receive in everyday life from home, school, community or the basic health care system to handle these symptoms, the health care system also supplies specialized interventions.

Specialized interventions to persons on the autism spectrum

For children and adults, the specialized interventions of today in the habilitation services in Sweden are mainly pedagogical and social. These are administered interdisciplinary. Treatment-as-usual includes psychoeducative interventions about autism or information about social support services. Counselling may be given individually when a deeper understanding or processing of being autistic is needed. Communicative difficulties may be met with alternative or complementary communicative aids, e.g., picture support[16]. Autistic persons frequently need structural support in everyday living[13], e.g., schedules or reminding signals from cell phones. Sleep difficulties may render medication[17]. Coordinated care planning with neighboring care providers is often needed in order to create an everyday living that is as functional as possible[18].

Physiotherapeutic interventions for persons on the autism spectrum in Sweden are not as developed as the interdisciplinary ones. National guidelines regarding body and movement functions are missing, probably due to lack of research and evidence.

Physical activity, i.e., voluntary bodily movement produced by skeletal muscles that requires energy expenditure[19], is often something an autistic individual chooses not to perform. It may be caused by experiencing unpleasant signals from it or having problems with multisensory processing and sensory input, which interfere with behaving in a meaningful manner[20]. Having being bullied[21], or not felt participation in physical activities during school time[22] are further reasons for not being physically active.

Ordinations for physical activity ('FaR-recept') may be prescribed in order to achieve a more regular physical activity[23], but often the social context to which these activities are connected, means that the autistic person usually does not cope with it. Others again may exert physical training with high intensity to feel the body and movements positively - or at all. Clarity, structure and a sensorimotor approach from individual adaptations are therefore important to the effect of an intervention with physical activity[24].

Stress management is often asked for in the clinic by many autistic persons, including how to balance one's energy. Several persons also have different forms of pains or aches, often connected to muscular and mental tensions or increased perceptual sensitivity. Disturbed sleep is frequently described[17]. Physiotherapeutic interventions directed to stress, sleep or pain may be administered, individually or in a smaller group context, such as breathing techniques, relaxation or techniques to alleviate pain[16]. To strengthen the bodily resources and the understanding of oneself, different body awareness and movement quality therapies may be used, such as Feldenkrais[25], Basic Body Awareness Therapy[26], Sensory Integration[27] or yoga[28].

Movement quality

'The heavy is the root of the light.
The unmoved is the source of all movement.'
Lao Tzu

The lead words of physiotherapy are *body* and *movements*, considered as prerequisites and means to exist and develop, and to maintain or increase well-being. The physiotherapeutic process includes assessment, intervention and evaluation, and is in need of valid instruments and interventions[29]. Physiotherapy has, as a discipline, a holistic organization, grounded in both biomedical[30] and human sciences[31], thus reaching out to different epistemologies. The holistic organization is considered in physiotherapy since it recognizes the merger of body and mind[32].

Movement quality is about *how* the movements are performed. Movement quality is in a physiotherapeutic sense the expression of one's body awareness and an embodied identity.

In physiotherapy practice, the concept used to define good movement quality is vitality[33]. Physiotherapeutic perspectives describe essential elements for vitality to be: force/energy, time, space, and direction/intention[26]. Vitality in a person is important in order to opening up to and adapt to contexts[34].

The physiotherapeutic perspective of movement quality describes and defines a human in her body and movement expression, in which vitality is equal to health and life in movements; the individual is postural stable, the breathing is free, there is awareness and a sense of being whole. The movements are flexible, coordinated through the center of the body and harmoniously flowing - a vital expression of a lived body that makes embodied sense[26, 33].

In physiotherapeutic body awareness interventions, concepts to describe the movements may be, e.g., stable, relaxed, dragging, weighty or tense. These are according to Stern[34] descriptions of forms of vitality, induced by different levels of arousal. Arousal is the fundamental mechanism behind the initiation, the strength, and the duration of everything we do. It is a physiological activation caused by a stimulus that brings affects/emotions. Different neurotransmitters are used for different types of arousal, thus being capable of eliciting different forms of vitality[34].

Aspects that influence arousal are that movements create perception, and vice versa[35-36], and that movements create emotions and vice versa. Emotions has been described to create meaning, by coupling impressions from the body to our consciousness and cognition[34, 37]. Emotions bring nuances to the form, rhythm, and integration of movements[38].

Movement quality has been described as a general and unifying phenomenon, with four existence perspectives in the Movement Quality Model[39] (Figure 1). The *biomechanical* or *physical* perspective relates to transferring in space, and can be described in postural stability (*'The heavy is the root of the light'*[40]), path, and form of movement. The *physiological* perspective relates to time and deals with processes such as breathing and centering in our bodies, described in aspects of rhythm, flow, start-end or elasticity. The *psycho-social-cultural* perspective relates to the use of energy personally and relationally; movements may be cautious, un/controlled, powerful, or calm. A harmonious movement only uses the energy needed (*'The unmoved is the source of all movement'*[40]). Awareness, with intention, emotion, and socio-cultural aspects are included. The *existential* perspective relates to persons, containing aspects of self-awareness, and unity in movement. All the described movement quality perspectives are, in different degrees, represented in every movement an individual perform[39].

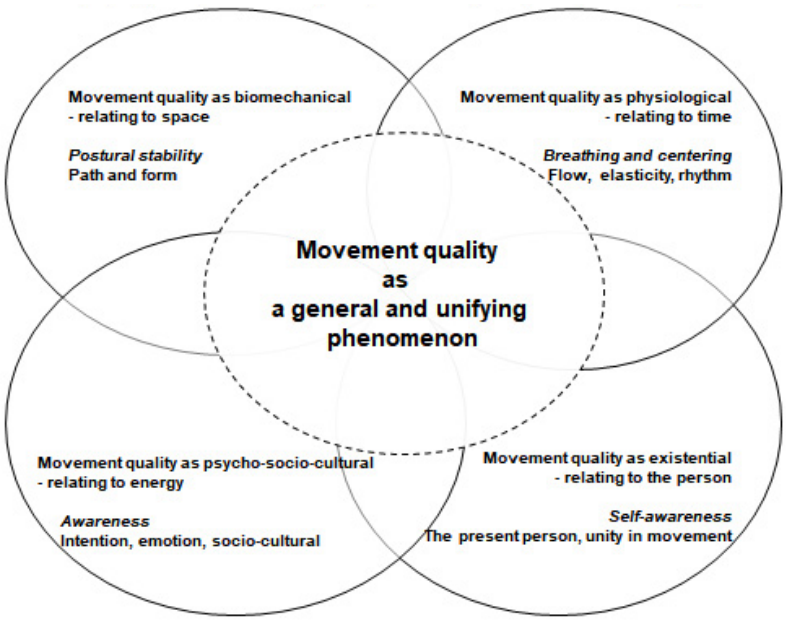

Figure 1.
The Movement Quality Model, with movement quality perspectives as interacting processes[39] (with approval from Taylor and Francis and L Skjaerven).

In autistic persons, adaptation to new context is often a problem[41]. Also, they often have difficulties with arousal levels[42-43]. There are indications that low parasympathetic activity via brainstem dysfunction could partly explain the chronic

sensory hyperarousal state[42, 44], along with being challenged by overwhelming or unintelligible sensory impressions[45]. Perceptual difficulties are frequent[1], thus affecting movement quality.

Inter-related bodily components that underlie the four perspectives and form the movement quality in a person are described below. These are the sensorimotor system, body ownership, agency, bodily self-awareness and an embodied identity (Figure 2). To experience these components, the person needs awareness.

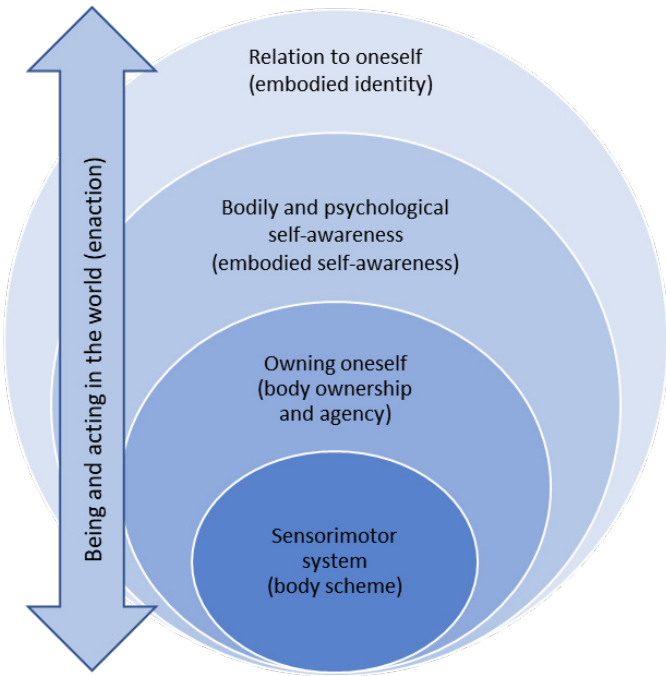

Figure 2.
Components of an embodied identity; the sensorimotor system, body ownership, agency and bodily self-awareness. Enaction is the process that forms the embodied identity.

Awareness

Awareness is essential to experience from within, about oneself and the surrounding world[32], and is therefore essential to movements with flow, stability, and freedom[38]. In this sense, awareness has physiotherapeutically been described as an attentive, relaxed, and alert presence providing heightened sensitivity to experiences, not analogous with concentration[32].

The internal body awareness includes awareness to interoception and proprioception. Interoception may be defined as bodily afferent signals from organs, e.g. being thirsty or hungry[46-47]. Proprioception is also about internal body awareness, from position and movements of body parts, as well as touch and pressure. To autistic persons, interoceptive awareness may be a problem, not least due to lack of multimodal integration (where input from different sensory modalities do not coincide to each other and therefore give conflicting information)[46, 48]. Proprioceptive signals are often overpowered by sensorimotor 'noise' and not as diversified as in typically developing persons[49].

External impressions are brought to a person from perception via the senses (vision, hearing, touch, smell and taste). Differing processing of perception is part of the diagnostic criteria for autism[1].

Motor control and the sensorimotor system

Motor control is the ability to regulate or direct mechanisms essential to movements, from a biomedical perspective. Theories on motor control may answer to *what* movement function there is. The innate ability to move is in need of basic sensory and motor functions to work, such as regulating posture, muscle tone, joint function or perception-action coupling[50], in complex movement patterns[51].

The sensorimotor system, i.e., the body scheme (Figure 2), involves pathways between sensory and motor functions. Its non-conscious automatic processes, are used primarily for spatial organization of action[52]. It is the basis to all motor learning, i.e., the acquisition or modification of movements resulting in new motor behaviors[50]. Merleau-Ponty[36] emphasized the importance of sensory impressions on motor intentionality, i.e., when becoming acquainted with a situation, there is no need to respond in a rule-like manner, but rather to use one's perception and being flexible to the whole to make adaption to each context optimal. With access to sensorimotor intentionality and movements that make sense, the body may emerge as holistically organized and functional in interaction with the environment[53].

Autism is a genetically driven disability, and a sensorimotor dysfunction will act already on the foetus and throughout life, affecting all development in the individual[54]. Symptoms from body and movements vary in persons on the autism spectrum. Increased variability in basic sensory inputs and motor outputs create sensorimotor 'noise', and disturbs the development[49]. Further, there may be a temporal multisensory integration failure[48]. These differing sensory impressions in persons on the autism spectrum may make the impressions hard to understand[45], which may affect comprehensibility, manageability or meaningfulness within the person and about the surrounding world[55].

Ability to motor interaction with the surrounding world relies on the mirror neuron system (neurons that are part of the motor cortex that fire in the same pattern as an

observed movement). There is evidence that persons on the autism spectrum may have deficits in the mirror neuron system[56], but also, a broader deficiency in the whole motor system in the brain has been found[57]. These findings may concur with previous research that autistic persons seem less sensitive to biological movements[58]. Hobson and Lee[59] describe, that it is the imitation of a person's expression rather than the action itself that is missing. Also, persons on the autism spectrum exhibit a weaker postural response to the perception of movement, especially if the impression is fast. It has been proposed that the 'world moves too fast' for persons on the autism spectrum due to sensorimotor differences, and that they therefore need autistic strategies to handle it[60]. Previous research has also found that persons on the autism spectrum exhibit a deficit in chaining motor acts into an action[61-63]. Therefore, being autistic, if one's sensorimotor intentionality does not function as intended, the movements may lack in meaning and sense to the person[54], and the chain of flexible adaptations to each context will not work toward independence[41].

Body ownership, agency and bodily self-awareness

Sensorimotor impressions make possible the sense of owning one's body, described with the concept *body ownership*. A related concept is *agency*, the sense of being in control of one's own actions[64]. Agency and body ownership may bring *bodily self-awareness,* i.e., to be aware of 'I' as a person from bodily experiences[26, 65], separated from others, and as part of one's identity[66]. One's identity include experiences, thoughts, and emotions about the body and its movements. These will form an *embodied identity*, enhancing the undividable link between mind, body and identity[67-68] (Figure 2).

In autistic persons, body ownership has been described to be impeded due to dysregulated interoception[47]. Furthermore, previous research has reported impeded agency[69] and bodily self-awareness [70], due to problems with integrating efferent top-down predictions to afferent multisensory integration.

Embodied identity

In lack of awareness, adequate sensorimotor control, body ownership, agency and bodily self-awareness; body and movements are not always harmoniously integrated in the autistic person, and therefore do not make meaning and sense. One theory states that autistic symptoms are created as an *embodiment* effect from a differently organized and therefore differently developing neural system[5].

The phenomenological concept embodiment defines how each individual acts in and experiences the world through the lived body, to bring meaning and sense, thus forming an embodied identity[5, 36] (Figure 2). All four perspectives in the Movement

Quality Model interact in an embodied identity[26]. Also, embodiment describes what the lived body experiences, which in turn forms and develops all functions in the person[5, 36].

The concept used for the process of embodiment is *enaction*[5] (Figure 2). This concept describes how humans connect with the surrounding world. Enaction brings together sensorimotor, cognitive, social, experiential, and affective/emotional aspects. Enaction emanates from within the body, as well as from actions between individuals. It is important for the development of cognition in the person, including the three theories ToM, executive functions or central coherence, which are described as the most striking difficulties in autism. But these theories do not include explanations of how they are developed in the person. De Jaegher[5] has presented autism as a result from enaction, with the start from sensorimotor function, experience, and social interactions. As an autistic enaction process is built from different perceptual, motor, and affective functions or behaviors than the neurotypical, it will affect the embodied identity.

Basic Body Awareness Therapy

'Two truths approach each other.
One comes from within,
one comes from outside,
and where they meet
you have a chance to see yourself.'
Tomas Tranströmer

Background

Basic Body Awareness Therapy (BBAT) was developed as a physiotherapeutic, relational intervention within psychiatric care by the Swedish physiotherapist Gertrud Roxendal[71], describing movements as behaviors (unconscious movements or postures) and abilities (movement answers to situations in everyday life, e.g., reach for an object)[72]. Roxendal had a close connection and was influenced by the French psychoanalyst and movement teacher Dropsy[73]. He described a theory about the three contact problems, which Roxendal adopted: to oneself, to others and to the external environment. Also, as an expression of body awareness, the four movement quality perspectives in the Movement Quality Model[39] are connected to BBAT[26].

When creating and developing BBAT, Roxendal[71] used the body ego as the theoretical construct of which body awareness a human possesses, and the concept vitality to describe healthy movement quality. During these PhD studies, with ongoing research, the theoretical construct behind BBAT has developed from the body ego to the embodied identity[26]. Previous research found the embodied identity to be related to oneself, to others and in society[67] (Figure 3), in line with Dropsy's described three-folded contact problems. It includes living in the body, to become more aware of it and to experience oneself from within. To relate to oneself and one's needs are important to how one can be in relation to others. Living in relation to others is a way to become more visible and satisfied as a person. Living in society is important, as to interact and increase empowerment through societal participation.

The overall aim of BBAT is to enhance more vital bodily resources in the individual; relation to the ground, free breathing, awareness of the whole, and to integrate these with each other. The ultimate goal is the subjective and vital experience of being stable, free and unified[26, 72-73].

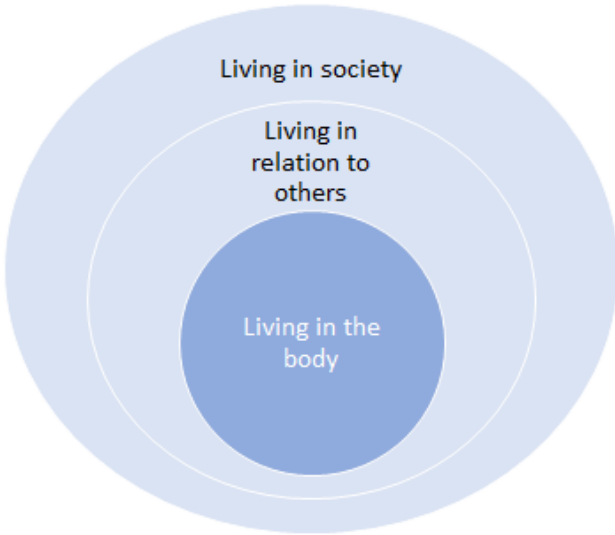

Figure 3.
A model of the embodied identity[67] (with approval from Taylor and Francis and A Gyllensten).

Contextual models and practicing

Body awareness training is about having the opportunity to explore oneself through alternative movements[38]. Therefore, important to BBAT is an assessment about which resources and difficulties the individual possesses in body and movements. With such an assessment, where to start an exploration is understood: which resources or practices to build on, which practices to avoid initially, which communication to use with the patient (e.g., more or less verbal or body language, using metaphors or not), and not least - to reflect on realistic goals together with the patient[26].

The process used, when practicing BBAT[26], has been described in the *Movement Awareness Learning Cycle*[32] (Figure 4). The patient is guided by the physiotherapist to get in *contact* with bodily signals and *explore* alternative experiences in the moment from body and movements through small movements or positions - a sensorimotor approach. The experiences of them may be *integrated* in the being to *create meaning* and *mastering*. By reflecting on this new/changed bodily knowledge, and *conceptualizing* these *reflections* it may more readily be consolidated in the being[32]. Gradually, the patient and physiotherapist build the intervention in interaction[26], with *'one truth from within and one from outside'*[74].

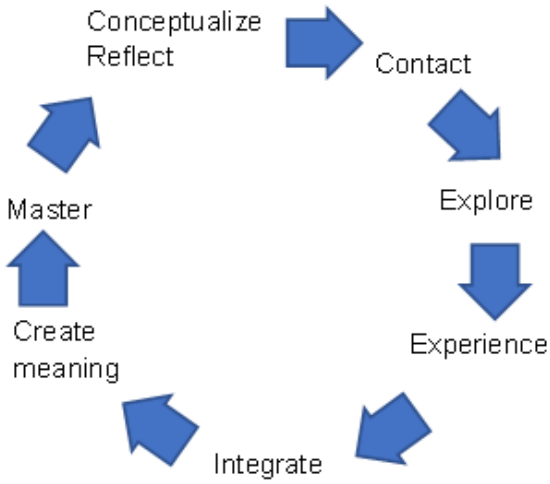

Figure 4.
The Movement Awareness Learning Cycle[32] (with approval from Oxford University Press and L Skjaerven).

Previous research in BBAT has shown that balance and grounding are essential as a basis to improvement of movement quality[75]. Grounding is a broad definition that includes physical postural stability, but also the existential perspective to trust the ground and to let one's weight down[76]. Clinicians have described improved acceptance of oneself in patients from improved grounding[65]. The bodily felt sense of improved grounding has in depressed persons been described as feeling lighter but at the same time heavier and more stable[76]. Autistic persons may have problems with both static and dynamic balance[77]. Therefore, grounding is the start of each practicing.

In BBAT, the non-verbal experiences of the moment are stressed[78]. Further, the movements are performed slowly, i.e., *'stillness-in-movements'*, influenced by Tai Chi-Chuan, and by being consciously aware inwardly about one's body when holding a position, i.e., *'movement-in-stillness'*, from zen-meditation. The 'noise' of the context is cleared, so that only more relevant and concrete sensorimotor impressions may be experienced[26]. As gentle, slow, iterative movements are described to ease stress and create vitality, they may instill calmness to the autonomous system[34] (Figure 5). The prosody (rhythm and melody in speech) and the vitality in the verbal guidance is deliberately kept, depending on what is meant to be achieved, e.g., calm, force, or relaxation to the ground. In order to achieve effects on one's embodied identity, a longer period of intervention is often needed, the tempo being set by the dis/abilities the patient possesses and by what happens in the therapeutic process[26, 79].

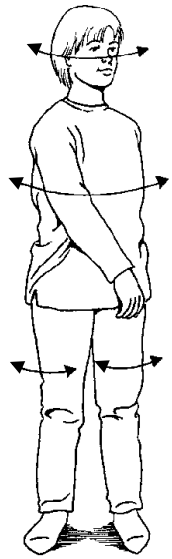

Figure 5.
Example of BBAT exercise: turning around the balance line[72] (with approval from Natur & Kultur, A Winberg and A Dahlström).

Previous research and state of the art in autism

There are several autobiographical narratives about how body and movements fail autistic persons[80-84], including blogs by autistic persons, finding numerous descriptions of problems with movements, embodiment and arousal[43]. These narratives and findings are supported by clinical observations.

Body awareness methods for persons on the autism spectrum have been studied in psychotherapeutic interventions[85-86], but no previous research about effects of the physiotherapeutic BBAT has been found. Physiotherapeutically, several other groups to receive body awareness training have been researched on:

Mattsson[87-88] used an eclectic body awareness therapy approach, which included BBAT, to sexually abused women. The results showed good improved body- and self-image, with an improved relation to one's body. In another study, BBAT to depressed persons showed vitality springing forth and a way to ground oneself, enabling them to better handle everyday life[76]. In people with schizophrenia, BBAT improved the abilities to regulate affects, body awareness, self-esteem and to think[89]. In an RCT study, patients with whiplash injuries improved better with BBAT than with physical exercise in physical and social functioning, as well as reduced pain[90]. For people with fibromyalgia, significant improvements were found for pain, movement quality and anxiety[91]. Another RCT study showed that patients with eating disorders showed significant differences in favor of BBAT and

treatment-as-usual (TAU), compared to TAU alone, of attitude towards one's body and eating[92]. Though recommending cautiousness about BBAT effects, a systematic review showed that BBAT reduced anxiety significantly more than physical activities (e.g., resistance training or stretching). In this review, there were no significant differences between BBAT and physical activities for reduction in depression or in self-reported pain[93].

Rationale

Core criteria for diagnosing autism are behaviors, classically explained by deficits in cognitive functions; ToM, central coherence, and executive functions. However, these may be described to develop through enaction of the lived body in an embodiment process, throughout life[36].

Motor skills at an early age have been shown to be one possible predictor of the outcome of autism severity[94]. Though research has focused on movements in autism[95], most has been on quantity rather than quality of movement ability[96-97]. Body and movement abilities influence the development of the self[15]. Growing up with autism implies a sensitivity to sensory impressions and difficulty with multisensory integration[48]. Along with deficiencies in the motor system in the brain[57], deficient sensory processing may be part of the explanation to the autistic symptoms, as embodiment effects[57, 98-99].

What persons on the autism spectrum experience about body and movements, is not clear and needs further study. Previous studies have often asked relatives, not the autistic individuals themselves, about experiences from body and movement. How first-hand experiences may be captured with physiotherapeutic instruments is key to understand the relevance of the assessments. Physiotherapists who are specialized in autism and movement quality may possess further knowledge about movement quality in autistic persons.

Though body awareness instruments are used to assess movement quality in the clinic, there is a lack of studies that have investigated the measurement properties of them in autistic persons. Consequently, there is also a knowledge gap about relevant physiotherapeutic interventions directed to body awareness and movement quality, aiming at improving the bodily resources of each autistic person.

No previous studies were found, investigating these aspects from a physiotherapeutic perspective in persons on the autism spectrum.

Aim

The overall aim of this thesis was to investigate experiences of movement quality in autism, to investigate measurement properties of a body awareness and movement quality assessment, and further, to study possible effects of a body awareness intervention to autistic young adults.

Specific aims

- To explore the experiences of body and movements in autistic young adults, and to examine how two physiotherapeutic instruments, Body Awareness Scale Movement Quality and Experiences (BAS MQ-E) and Bruininks-Oseretsky's Motor Proficiency test v2 (BOT2), may capture these experiences (Paper I)
- To describe the meaning of movement quality in persons on the autism spectrum as experienced by specialized physiotherapists (Paper II)
- To investigate measurement properties of BAS MQ (observed movement quality, first part of BAS MQ-E) to autistic persons and in a neurotypical reference group (Paper III)
- To evaluate the effects of Basic Body Awareness Therapy (BBAT) and treatment-as-usual (TAU) compared to TAU alone, on a person-reported experienced movement quality problem, and the observed movement quality in autistic young adults (Paper IV)

The papers

Focus of the four papers are movement quality in autistic persons. Paper I used a mixed-method design to explore the *experiences* of autistic persons themselves, and Paper II used a phenomenological design, in which physiotherapists described their *experiences* about the phenomenon. Paper III investigated measurement properties in a movement quality *assessment* to autistic persons, and paper IV evaluated effects of a body awareness *intervention* in autistic persons.

Exploring autistic persons' experiences of body and movements (Paper I)

Methods: Design, participants, data and analyses

Design: Paper I aimed at exploring autistic persons' experiences of body and movements, and also if physiotherapeutic instruments could capture these experiences[100]. The mixed-methods design used qualitative and quantitative data, to optimize outcomes and incorporating patient narratives in physiotherapy research[101].

Participants: The inclusion criteria were having a diagnosis within the autism spectrum[2], age 16–22 years, and disturbed perception from one/several sensory modalities. Exclusion criteria were intellectual disorder, considerable communicative difficulties, and/or moderate to severe depression. The participants were registered patients at a habilitation clinic and had requested care regarding motor performance, body awareness, and/or understanding physical and/or psychological aspects of themselves. The broad inclusion criteria were used as autistic persons may have difficulty recognizing when there are problems that originate from body and movements. Each participant (n=11) was assessed individually at 2-3 sessions. The sample included nine female and two male participants, which reflected the clinical gender distribution.

Data and analyses: The data collection started with an interview, lasting between 45-60 minutes, about experiences from body and movements, rendering qualitative data. The structure of the interview was initially described to the participant, as to

increase the predictability many autistic persons are in need of. The participant was also presented to picture-support in the form of the Bears[102] (Figure 6). These cards could help find bodily expressions or feelings when words failed. Also, the interviewer could offer opposite suggestions, e.g., agile – stiff or pleasant-unpleasant to guide the participant. The participant was examined with Body Awareness Scale Movement Quality and Experience (BAS MQ-E)[33] and Bruininks-Oseretsky's test of motor proficiency (BOT2)[103]. BAS MQ-E render both quantitative and qualitative data, BOT2 quantitative data.

Figure 6.
Four examples out of 48 of the Bears cards, expressing full body emotions[102] (with approval from St Luke´s Innovative Resources).

BAS MQ-E is an instrument with three parts to measure and describe movement quality and body awareness. The first part, BAS MQ, consists of 23 movement quality items, observed and scored by the physiotherapist on a 5-graded scale (0=vitality to 4=pathology/do not perform)[33]. Following the results from previous research, BAS MQ is arranged in three subscales: Stability in function, Coordination/breathing and Relation/awareness[104]. The two following parts, BAS E, consist of a patient questionnaire about the individual's experiences about how body and movements work in everyday life, including one's own belief to be able

to change, and an experienced-based interview whilst performing five selected movements[33].

BOT2[103] is a standardized test to examine level of motor proficiency, for ages 4–22 years, and is valid for high-functioning autism and for neurotypical persons. There are 53 items distributed in four composite subtests: Fine Manual Control, Manual Coordination, Body Coordination, and Strength and Agility. The results are equivalated as to age and gender to compare the results to a neurotypical population within normal distribution, thus presented in percentiles.

The qualitative data in the analyses were interview texts, and texts from the BAS E experienced-based interviews. The quantitative data were results from BAS MQ (average) and BOT2 (total).

Paper I used a parallel mixed-methods analysis[105]. In the first step, data for each participant was processed. It started with a parallel data reduction, in which BAS MQ (average) and BOT2 (total) were calculated according to each manual. Parallel to this, the qualitative data was analyzed, using a deductive approach[106], with BBAT and motor control theories scaffolding the matrix. In the matrix, the columns contained Experiences, Abilities or Behaviors. The rows contained three categories with ten under categories: Awareness (Conscious awareness, Relating to others, Relating to self), Body control (Body coordination, Breathing, Flow and agility) and Postural control (Postural orientation, Postural stability, Joint function, Muscle function). Meaning units from the qualitative data for each participant was analyzed into the matrix. For instance, one participant said from the BAS E experience-based interview: *'I experience the body as whole' (P1).* This meaning unit was sorted to column Experiences and row Awareness (Conscious awareness).

The data was presented in a manual file for each participant's results[105]: qualitative data from the deductive analysis from the interviews and BAS E and quantitative data from the results of BAS MQ (average) and BOT2 (total). Inductive data that did not fit to the matrices were compared to the answers from the BAS E questionnaire, to investigate if these data were captured there, i.e., additional findings.

Thereafter, a first data comparison, by comparing data within each participant was performed. The data were triangulated to obtain a deeper understanding, i.e., analyzing if data from different sources indicated similarities and/or differences concerning experiences, abilities, or behaviors. The next step was data consolidation, making reloops in the material to confirm the results. The result for each participant was compiled in a data set[105].

Thereafter, another data comparison was made parallel between data sets[105]. If a finding was made in one, all other data sets were studied to find if they contained data concerning the same issue, thus integrating the data sets to each other. The result of this comparison gave complementing or crystallizing aspects.

Complementing aspects described findings that complemented each other from different data, e.g., coordination difficulties, bilateral from BOT2 and central in BAS MQ. Crystallizing aspects could be convergent, i.e., representing conceptually similar aspects of a function, e.g., lack of experiencing agency and/or body ownership was findings in data from both qualitative and quantitative data. Crystallizing data could also be divergent, i.e., representing conceptually different aspects. For instance, this could be that differences between body halves were expressed in BAS E but not in BOT2. The third crystallizing aspect was discrepant, i.e., representing contradictory/not connected findings, e.g., discrepancy between what was exhibited in the examinations but not described in experience. Findings that did not fit to the categories of the matrix (Awareness, Body control, Postural control) were added as extra themes.

Lastly, the data were fully integrated, and deductions and inferences were made[105]. The participants' experiences of body and movements were integrated with theories for developing bodily self-awareness. Integration of how the physiotherapeutic instruments captured the experiences of body and movements were made, also going back to item level from BAS MQ and BOT2.

The analyses of quantitative data comprised Spearman rank correlation to investigate possible correlation between BAS MQ (average) and BOT2 (total), using Statistical package for Social Sciences (SPSS®) 25.0[107]. The median values of BAS MQ (average) and BOT2 (total) respectively, were compared to the three diagnoses of the participants: atypical autism, Asperger syndrome and autism in childhood.

Results: Experiences and assessments of body and movements

Fourteen themes were represented in the results of the qualitative analysis (Table 1). Ten of these fitted into the three main categories: Awareness, Body control and Postural control. Four extra themes were either covered by the BAS MQ-E questionnaire or did not describe body functions, but were general results.

Regarding awareness, all findings were convergent. The participants experienced problems with being *consciously aware* of their bodies or experiencing the *body as whole.*

> *'There might be certain things I'm not aware of [bodily]. I don't know.' (P4)*

> *'I think too much, it's not a whole, it's difficult. I think to do one thing at a time, it's difficult to do many things at the same time. It locks up.' (P3)*

Table 1. Results from the deductive analyses, presented in three categories and extra findings from the theoretical framework. The themes for each are presented according to which data aspect it was analyzed to belong to.

Category	Data aspect	Themes
Awareness	Crystallizing-convergent	Problems to be aware of body
		Difficulties experiencing the body as whole
Body control	Complementing	Coordination difficulties
	Crystallizing-convergent	Lack of experiencing agency and/or body ownership.
		Experienced differences in function of body halves
		Inability to perform centered movements
		Problematic breathing
Postural control	Complementing	Results of postural control complemented each other in BOT2 and BAS MQ-E
	Crystallizing-convergent	Postural stability or orientation was not verbalized spontaneously
	Crystallizing-divergent	Differences in function of body halves were expressed in experience-based interview but not measured in BOT2
Extra findings	Crystallizing-convergent	Muscle tensions, pains/aches
		More experienced predominantly good feelings from their bodies were connected to having strategies to handle everyday living
	Crystallizing-divergent	Male participants exhibited divergence between the results from BOT2 as compared to BAS MQ-E's questionnaire
	Crystallizing-discrepant	Differences exhibited in the quantitative examinations but not described in experience

Regarding body control, a convergent finding relating to agency and body ownership were experiences of *not being in control,* which affected their self-confidence and self-esteem negatively. Body control descriptions of *coordination* difficulties were complementary in BOT2, measuring bilateral coordination, and in BAS MQ-E, describing central coordination. Also, convergent findings were differences in function between the left and right sides of the body, inability to execute centered movements and problematic breathing, in which the breath was experienced as hindered.

> *'I know my body a little, but then all of a sudden, one doesn't understand what's happening in my own body.' (P2)*

> *'I don't walk into objects that much, I think. But still I do. I kind of get stuck in chairs all the time.' (P5)*

> *'It feels different in my hands, but I don't quite know how to describe it.' (P7)*

> *'My stomach muscles don't tag along. I kind of flop to the floor when I sit down.' (P2)*

> *'It [breathing] resists over my throat and around my jaws.' (P7)*

Regarding postural control, the participants had difficulties to verbalize their experiences. Complementing descriptions were found about *postural stability* between BOT2, describing differences between having visual input or not, and BAS MQ-E, describing experiences of the left and the right sides of the body. Lack of *postural orientation* was a convergent finding between the two instruments.

> *'I have better balance on my right leg than on my left leg.' (P11)*

> *'My greatest wish is to train for a better posture. I feel my lower back when I always walk leaning forward.' (P4)*

There were three additional findings that emerged inductively, 'access to adequate rest', 'pain/ache' and 'daily strategies'. These were captured by the BAS MQ-E questionnaire. Pain/ache also appeared as a theme in the deductive analysis, along with three other themes (Table 1). One of the extra themes was that experienced good feelings in the body was connected to having more strategies to handle everyday living.

Both male participants exhibited divergence between the quantitative BOT2 (total) and the BAS E questionnaire, as well as discrepancy from expressed problems and observed, which could indicate a difficulty to be aware of subtler symptoms.

Some participants could describe belief in the possibility to develop as individuals, if working with bodily resources, but they also declared the need for help or guidance to do so. Five of eleven participants received a diagnosis of specific developmental disorder of motor function[2] from the assessments in the study, i.e., they were previously unrecognized in their movement difficulties. This had left them with problems in understanding body and movements.

> *'I don't seem to understand my body.... I didn't understand my body better then [when growing up] than I do now.' (P2)*

Several participants described a duality where abilities did not follow each other, that was mirrored in the examinations with an uneven profile in BAS MQ-E and/or BOT2. For instance, one participant expressed access to both positive and negative feelings about the body and movements, as well as a disturbed tactile perception. The feeling of occasionally being bodily whole was present. This experience made possible to trust her body and movements to some extent, making possible some use of bodily strategies to handle everyday life, but not sufficiently so to feel confident.

> *'The body sometimes feels like a whole.' (P9)*

Combined, BAS MQ-E and BOT2 complemented each other, explaining and confirming the expressed experiences to a large extent. The correlation between BAS MQ (average) and BOT2 (total) was r=0.61, thus confirming their association but from different movement aspects. Participants from all three sub-diagnoses exhibited BOT2 (total) results below average. The BAS MQ (average) results indicated no pathology but problems with movement quality.

From the result from Paper I, that movement quality was important as in the handling of everyday life, followed Paper II.

Describing physiotherapists' experiences of movement quality (Paper II)

Methods: Design, participants, data and analyses

Design: The aim of Paper II was to further investigate movement quality in persons on the autism spectrum[108]. The design consisted of individual interviews with physiotherapists within habilitation services. The design followed Giorgi's descriptive phenomenological method[109].

Participants: The participants (n=10) were recruited from purposive snowball sampling. The suggestions for participants came from physiotherapy colleagues within habilitation services nationally in Sweden, as being specialized in autism, body awareness and movement quality. As such, they were considered to have a certain knowledge and understanding about the meaning of the phenomenon 'movement quality in autism'.

Data and analyses: The interviews were held at each participant's workplace, lasting between 44-87 minutes. One week prior to the interview, the participant was contacted and asked to think back on situations in which she had lived experiences of the phenomenon, and to focus on their individual experiences of movement quality in autistic persons. This approach was intended to generate a rich body of data[110]. The interviews were guided by themes to keep focus: 1) the participant's general description of movement quality; 2) movement quality experienced when meeting autistic persons; and 3) perceived similarities or dissimilarities in movement quality between autistic persons. The interview contained open questions, evolving from the narrative by the participant. After having transcribed the interviews, they were sent to each participant to receive feed-back on if adjustments were needed. Only minor editing was required.

Following Giorgi's descriptive phenomenological method in the analysis[109], the aim was to form a *general structure*, consisting of *key constituents*. Key constituents were aspects of movement quality in autism that at least 9 out of 10 participants described. Each key constituent had to be present, otherwise the phenomenon would change[109]. Further, *potential elements* (aspects described by 3-8 participants)[111] were found. The inter-relatedness of the key constituents was analyzed. During the analysis the meaning of the phenomenon revealed itself, that is to say the significant experiences of movement quality in autism. Finally, the essence of the phenomenon described the main, invariant aspects of it as a general structure[109].

The analysis consisted of six critical systematic steps, performed by two of the authors (IB, CSH): 1) Reading the interviews through to gain a sense of the whole, as the phenomenological perspective is a holistic one, focusing on linguistic content and lived experience; 2) establishing meaning units from the texts by the use of

phenomenological reduction and with a psychological attitude; 3) rewriting these meaning units into third-person expressions, as a step from spoken language; 4) transforming these into sensitive expression, making the psychological value in regard to the studied phenomenon explicit. Free imaginative variation was used, i.e., features of the experience was imaginatively altered in order to view the phenomenon from varying perspectives; 5) determining the structure by first distinguishing the constituents of each description, still with imaginative variation, and then analyzing them together to gain an understanding of the general pattern; and 6) performing post-structural analyses[109].

In post-structural analyses the participants' descriptions were stable. The trustworthiness of the results of Paper II was strengthened by the fact that no new information emerged from the final interview and therefore data collection stopped.

Results: Meaning of movement quality in autism

In total there were 251 sensitive expressions from the ten interviews. The general structure of the phenomenon was analyzed to include eight key constituents, of which all were body functions[112], that affected the movement quality, i.e., deficits in:

Postural control; stability was described as being sufficient to maintain an upright position, but at the cost of a high degree of energy expenditure and a lack of flexibility.

> *'...they can't even find movement [to correct their posture].' (P1)*

Muscle tone and tensions; the muscle tone was described as low, but muscle tensions were frequent. Movement patterns became inflexible and unstable. The movements were described as controlled from the upper body, further affecting posture and breathing. The flow of the movements became slow and sequential.

> *'Their muscle tone isn't well-regulated [...]. The exertion of muscle force is poorly adjusted. The whole system is affected, there's no flow. It becomes jerky.' (P1)*

Sensory processing; the reduced access to intelligible bodily signals due to deficiencies in sensory processing was believed to create fear of free movement, and that appearing behaviors did so as to protect oneself.

> *'...a child who found it very difficult to understand sensory impressions [...] She turned from supine to sitting up with fear in her eyes. I believe this shows in how little she has wanted to use her body.' (P3)*

Conscious awareness in one's body; the tolerable level of sensory input for autistic persons when perceiving their bodily signals and surroundings was reduced and was described to lead to a lack of conscious awareness.

> *'I see another kind of presence, or sometimes absence, in their bodies […]. The way you process perceptually is quite critical in how you use your body.' (P3)*

Experiencing one's body boundaries; autistic persons were described to keep their movements to a minimum, thus moving within safe body boundaries, as a difficulty in perceiving their bodies spatially were described.

> *'The body boundaries – where a person experiences that their bodies begin and end – can be difficult [to comprehend]. […] They can't sense their body parts.' (P2)*

Coordination of movements and breathing; coordinating movements, both diagonally in rotation and between body halves or parts, was experienced to be a major problem and also to affect breathing. The flow of movements through the center was hindered, leaving body parts disconnected from each other.

> *'Seemingly simple movements can be difficult.' (P8)*

Anticipation (to unaware predict and prepare one's movements); a lack of responses to expected changes in the environment, for an upcoming bodily action or for postural necessity was described.

> *'…they haven't transferred the weight to the other leg before lifting.' (P3)*

Automation of movements (needing thoughts to control movements); self-cueing or exhortations were described to be used to perform movements. But holding oneself together cognitively required mental and physical energy, making it difficult to focus and created further tensions.

> *'… being constantly in your head and analyzing – it makes automation difficult […], thinking about every little aspect of the movement pattern…' (P5)*

The *interrelatedness* of the key constituents presented a complexity of what interferes in a body and movements that fail you, as to understand the three-folded contact problems; to self, others, and environment[73] in an embodied identity[67]. The sense of a body that was whole and available was lacking.

> *'Trying to put body parts together into a whole, thus making it comprehensible, in order to understand the world and oneself. […] You live your body, and when communication doesn't add up between body and soul, it's difficult. […] Understanding the world emanates from [within] you.' (P10)*

> *'Fragmentation can be seen in both the movement pattern and when it comes to awareness. It's all linked. Fragmentation is where breathing and movement fail to connect. […] Looking at yourself from outside, instead of from within, there´s no sense of being whole.' (P7)*

The physiotherapists perceived that persons on the autism spectrum had a need to protect themselves in everyday living, against overwhelming sensory impressions, which affected the movements. The general structure was described as *fragmented, restrained, and hesitant* - the essence of the phenomenon movement quality in autism. The experiences were described to affect the possibility to feel safe and to be active in one's lived body.

Further, as potential elements the participants described: 1. problems with understanding pain, 2. how joy from moving were curbed during upbringing, 3. how they frequently met children, adolescents or adults on the autism spectrum, that had not been recognized in their problems with body and movements, 4. the experience that deviant sensorimotor impressions negatively affected cognitive development and 5. how persons on the autism spectrum un/aware sought resistance to movements to make sensory impressions more understandable. Hence, these described body functions, as well as activity and participation related elements[112].

Both Papers I and II presented deeper knowledge and understanding about the importance of movement quality in autism. They pin-pointed the need of recognizing, assessing and provide treatments to problems with body and movements when being autistic, thus moving on to Papers III and IV.

Investigating measurement properties of BAS MQ (Paper III)

Methods: Design, participants, data and analyses

Design: Paper III[113] aimed at assessing measurement properties of BAS MQ in persons on the autism spectrum. Rasch analysis was chosen, as this allowed investigation of each item in more detail than is possible under classic test theory. Also, as ordinal data was transformed to equidistant grades in an interval-like scale, the use of parametric methods was possible. Since the five-graded ordinal scale of BAS MQ response categories were judged to differ between items, a partial credit model was used, thus allowing the threshold values to differ from item to item. Calculations in a partial credit model add parameters, by considering number of items and number of response categories[114].

Participants: The autistic participants (n=108, female 67/male 41) were randomly sampled, 20 at a time, from the patient records of the habilitation services of Region Västra Götaland and Region Kronoberg, respectively. The inclusion criteria were being 15-30 years and having an autism spectrum diagnosis. Exclusion criteria were an intellectual disorder, not speaking Swedish, and/or needing more urgent care. A letter with information about the study was sent to the potential participants. The letter also included a specific time when they would receive a phone call from the physiotherapist who would answer potential questions and set up a meeting at the clinic if the person was interested to participate. Neurotypical reference participants, 15-30 years, were recruited from university students or individuals from convenience sampling (n=32, female 23/male 9). Exclusion criteria were an intellectual disorder, a medical condition or not speaking Swedish.

Data and analyses: The 23 items in BAS MQ were observed and scored by the physiotherapist on a 5-graded scale (0=vitality to 4=pathology/do not perform). The neurotypical group was included in the analyses of person and item reliability, differential item functioning (DIF) and discriminative validity, otherwise the analyses only included the autism group. The Rasch analyses comprised nine measurement properties:

> *Targeting:* describes how the set of items represents the abilities of the persons. There must be difficult items in a rating scale to target persons with high abilities, and easy items for persons with low abilities, in order to obtain reliable measures[115]. The scale is on target, if the average person measure is less than one standard error (SE) of measurement from the mean of the item hierarchy at zero logits (>2 SE=poor, 1–2 SE=fair, <1 SE=good, <0.5 SE=very good, and <0.25 SE=excellent)[116]

Response category functioning: describes the ordinal responses for each item, which should orderly increase with an increase in the underlying construct[117].

Unidimensionality: assesses how well the items measure a single construct. It is studied by a principal component analysis of item fit residuals (PCAR). To indicate unidimensionality, the unexplained variance of residuals should be <10 %[116]. Also, in the analysis process the items are distributed in three clusters, according to item difficulty. The clusters were analyzed qualitatively, i.e., how item from the three subscales were distributed in the clusters, and quantitatively, i.e., with disattenuated Pearson correlation of person measures; 0.2 is considered very weak, 0.2-0.4=weak, 0.4-0.7=moderate, 0.7-0.9=strong, and 0.9-1.0=very strong correlation[118].

Fit statistics of items: indicates how the item fits the Rasch model. Mean square (MNSQ) statistics show the size of the randomness. MNSQ values between 0.5 and 1.5 are regarded as fitting the model. Lower values indicate overfit (more predictable than expected), and higher values indicate underfit (more random than expected). Standardized fit statistics (ZSTD) test whether data fit the model, values within -1.9 to 1.9 SD have reasonable predictability[119].

Local dependency: measures the correlation of item residuals for each possible item pair, i.e., how much of their variance is shared[120]. A relative cut-off[121] of 0.16 was calculated in this study.

Hierarchical ordering of items: shows which item is more easy or difficult. The difficulty of an item is the average of the difficulties of the thresholds in the sample[122].

Person and item separation reliability (PSR and ISR) and person and item separation index (PSI and ISI): indicate the internal consistency and how many subgroups of persons and items that can be separated. PSR and ISR values of the internal consistency are interpreted as α <0.67=poor, 0.67-0.80=fair, 0.81-0.90=good, 0.91-0.94=very good, and >0.94=excellent. The PSI and ISI study the ability to respectively differentiate between persons or items (0-2=poor, 2-3=fair, 3-4=good, 4-5=very good, and >5=excellent)[116].

DIF: studies if responses from different groups of persons influence item measures. DIF was analyzed between the autism and the reference groups, and between sexes in the autism group[123].

Discrimination: studies whether groups can be separated from each other and is related to the reliability measure of separation index. Discrimination is assessed with ANOVA[124]. In this study, it was investigated between different diagnoses within the autism group and between the autism and the reference groups.

The data analysis was performed in SPSS® 27.0[125] and Winsteps® 6.8[126]. Each measurement property was analyzed separately. Thereafter, the properties were analyzed regarding if or how they interacted. This rendered further discussions about especially item '19 Relation to mirror'.

Results: Measurement properties of BAS MQ

Targeting: The average person ability measure was -0.68 and 2SE 0.60. As the 2SE value exceeded the person ability measure, a poor targeting was indicated. Person ability measures and item thresholds were negatively skewed (Figure 7). Thirteen persons with high abilities were not targeted by BAS MQ items.

Response category functioning: In eleven out of 23 items, the response categories 3 and 4, reflecting severe problems, were not used. For item '19 Relation to mirror', category 3 had a lower threshold measure than both categories 1 and 2. For items '4 Flexibility in the balance line', '5 Weight transfer' and '20 Eye contact' disordered thresholds were present with one category step.

Unidimensionality: When studying the PCAR, an unexplained variance of 7 % was found, indicating a good unidimensionality. Cluster 1 contained predominantly items from Stability in function. In cluster 2 all aspects were evenly distributed and cluster 3 consisted mainly of items regarding Coordination/breathing and Relation/awareness. The disattenuated Pearson correlation between clusters 1 and 3 was 0.56 (moderate correlation), while between clusters 1 and 2 it was 0.76 (strong correlation), and between clusters 2 and 3 it was 0.77 (strong correlation).

Fit statistics: Most items fitted the model well. Two items showed misfit: '19 Relation to mirror' had an infit MNSQ of 2.15, an outfit MNSQ of 1.78 and an outfit ZSTD of 3.44. Item '22 Meeting' had an outfit ZSTD of 2.02.

Local dependencies: Item residual correlations were present in 17 out of 253 (7 %) item pairs.

Hierarchical ordering of items: Items involving Coordination/breathing were most difficult, followed by Stability in function items and then Relation/awareness items.

Reliability: In the autism group, the PSR was good (0.85), enabling a fair PSI (2.41). The ISR was excellent (0.95) with a very good ISI (4.57). With the reference group included the PSR was very good (0.93) and PSI good (3.71), and the ISR and ISI were excellent (0.96 and 5.07, respectively).

DIF: No item showed significant DIF between sexes within the autism group. Item '6 Balance on one leg', showed significant difference between the autism and the reference groups (p=0.002).

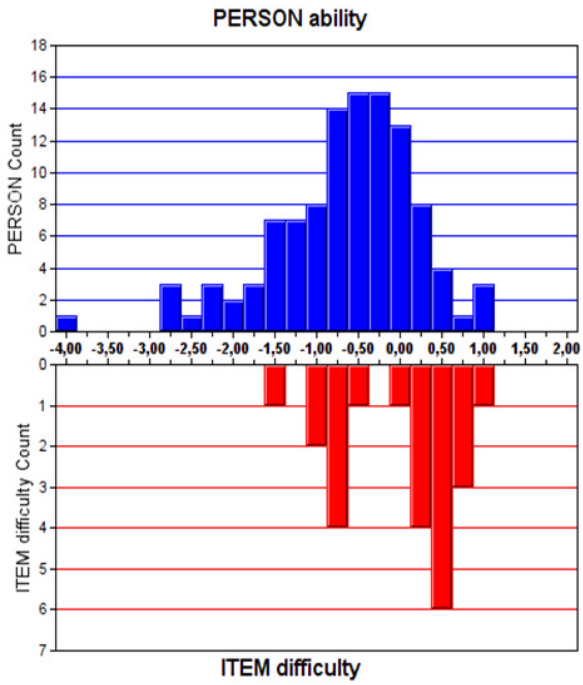

Figure 7.
Distribution of person ability (upper panel) and item difficulty (lower panel) measures of autism group. Measures are presented in logits, the more negative value the better movement quality or the more difficult items.

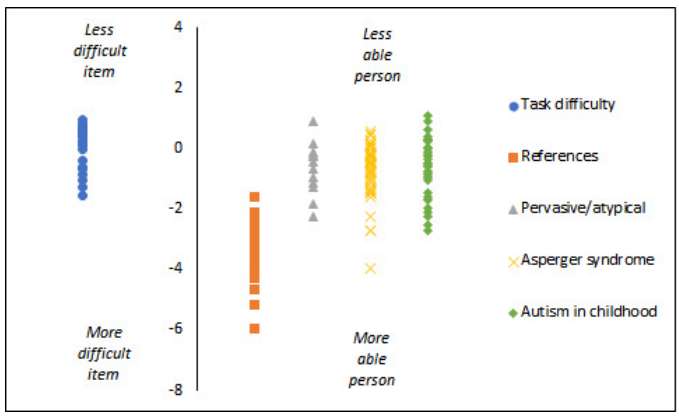

Figure 8.
Item difficulty (left panel) and person ability for reference group and three autism sub-diagnoses (right panel). The more negative the logit measure, the more difficult item and the better person ability, respectively.

Discrimination: There was a significant difference of person measures between the autism and the reference groups ($p<0.001$) (Figure 8). The BAS MQ average scoring patterns in the autism and reference groups were similar, but generally with worse movement quality in the autism group. Within the autism group, there was no significant difference between the three different diagnoses.

There was especially one item that did not fit the Rasch model, item '19 Relation to mirror', concerning response category functioning and fit statistics. In item 19, there was a tendency to not use the middle categories of the scoring, either the participant had little problems (scores 0 or 1) or it was very difficult (score 4).

Another two items often scored high, '4 Flexibility in balance line' and '10 Orientation through movement center'. Both include scoring in two different positions or movements. If differing observations are made in each of these, the higher score should be chosen. Item '20 Eye contact' often scored lower than might be expected by the difficulty persons on the autism spectrum often have with eye contact.

Evaluating effects of Basic Body Awareness Therapy (Paper IV)

Methods: Design, participants, intervention, data and analyses

Design: In Paper IV a pragmatic randomized controlled trial (pRCT) was performed, aiming at evaluating effects of BBAT in young autistic adults[127].

Participants: The participants in Paper IV had autism, with the same criteria as for Paper III. They were recruited from participation in Paper III or from the clinic of habilitation services in either of two Swedish regions. The full BAS MQ-E presented the bodily abilities of each individual, and also guided the physiotherapist to optimally meet the needs and resources in each individual.

Intervention: Participants randomized to the intervention group (IG, n=28) received BBAT and TAU (e.g., psychoeducation, social counselling or working with structure in everyday life). The control group (CG, n=29) received TAU only. Participants in the IG received 12 BBAT sessions, each lasting about 45 minutes and administered on a weekly basis. The participants in the CG were offered BBAT after having completed their participation in the study.

Data and analyses: The primary outcome was a person-reported outcome measure (PROM). An individualized movement quality problem, e.g., 'I feel unstable', was scored on a numeric rating scale (NRS; 0=no problem and 10=extreme problems). The NRS was considered to give less cognitive load on the participants than a multi-item instrument. It was also deemed to be more changeable than the scores of movement quality from the secondary outcome, BAS MQ, since any observable change of movement quality may need some time to consolidate. BAS MQ total measures may range from 0 to 92, the lower the better movement quality.

The analyses aimed at evaluating changes between and within groups, and individually. They were performed in SPSS® 29.0[128] after having transformed the ordinal data to interval-like in Winsteps® 6.8[126], and then transformed back[129]. In the back-transformation the scale steps used for NRS were 0 to 10, and for BAS MQ 4 to 50 (since several response categories were not used in the raw data). Despite the transformation, due to skewness, non-parametric tests were used in the intention-to-treat analyses at group level: Mann-Whitney U test for between group comparisons at three timepoints, baseline (t0), mid-intervention (t1; NRS only) and post-intervention (t2), and the Wilcoxon Signed Rank test to analyze within group changes. Individual changes in person measures in NRS and BAS MQ were assessed with individual dependent samples t-tests[130] and one-sided significance. The significance level was $\alpha=0.05$ in all analyses.

Results: Effects of Basic Body Awareness Therapy

From the analyses, eight different movement quality health problems were identified from the individualized NRS measures, i.e., muscle tension, breath, pain, stability, 'home in oneself', flexibility, posture and awareness.

Between-group analyses showed that the IG reported statistically significant higher NRS measures ($p=0.009$), indicating more problem, than the CG at t0. Statistically significant changes of the NRS measures between the two groups, were revealed in favor of the IG for Δt0-t2 ($p<0.001$), and for Δt0-t1 ($p<0.001$) but not for Δt1-t2 ($p=0.117$) (Figure 9 a. and Table 2). The BAS MQ measures were in favor of the intervention group for Δt0-t2 ($p<0.001$) (Figure 9 b. and Table 2).

Within group, the IG improved significantly in the primary (Δt0-t2; $p<0.001$) (Figure 9 a. and Table 2) and secondary (Δt0-t2; $p<0.001$) (Figure 9 b. and Table 2) outcomes, whilst the CG showed no significant changes (Figures 9a., 9 b. and Table 2).

At an individual level in the IG, 54 % of the participants had improved significantly in the primary NRS outcome Δt0-t2. In the CG 10 % showed significant improvements, 3 % deteriorated. Regarding the secondary outcome, BAS MQ, significant improvements were present in 41 % of the participants in the IG, and in 7 % in the CG (Table 2).

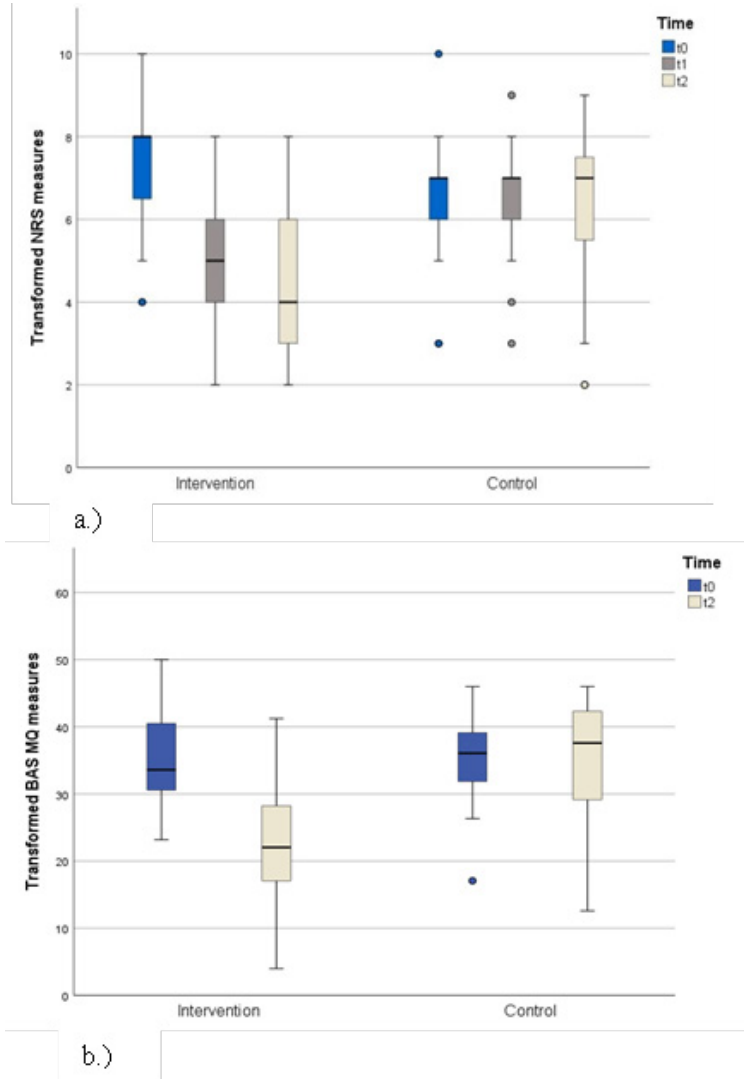

Figure 9.
a.) Clustered boxplot of NRS measures in each group at baseline (t0), mid intervention (t1) and post intervention (t2), respectively. The lower measures, the less experienced problems with movement quality.
b.) Clustered boxplot of BAS MQ measures in each group at baseline (t0) and post intervention (t2), respectively. The lower measures, the better observed movement quality.

Table 2. Results on changes of person-reported experiences of movement quality (NRS), and observed movement quality (BAS MQ) in participants on the autism spectrum.

	Intervention (n=28)	Control (n=29)	Between group p-value	Within group p-value
Primary outcome				
NRS change, median difference (q1-q3) Δt0-t2	4.5 (1.0-7.0)	0.0 (-2.0-2.0)	p<0.001	IG: p<0.001 CG: p=0.78
Persons with significant NRS change, n (%) Δt0-t2	15 (54)	3 (10)		
Secondary outcome				
BAS MQ change, median difference (q1-q3) Δt0-t2	11.4 (4.4-16.0)	-0.7 (-4.0-5.2)	p<0.001	IG: p<0.001 CG: p=0.809
Persons with significant BAS MQ change, n (%) Δt0-t2	12 (41)	2 (7)		

NRS=numeric rating scale; BAS MQ=Body Awareness Scale Movement Quality
t0=baseline; t1=mid intervention; t2=post intervention
IG=intervention group; CG=control group

Ethical considerations

All studies were conducted in accordance with the Declaration of Helsinki. All participants, as well as caregivers to participants younger than 18 years, gave their informed written consent. The studies were approved by the Regional Ethical Review Board of Gothenburg (Paper I n:o 346-14 and Papers II-IV n:o 651-17).

Many of the autistic participants (in Papers I, III and IV) that were recruited, were proud to be asked, and to get the opportunity to participate in research about their condition. As they were thoroughly informed about the designs, content and structure in advance of participating, this part of the research did not create severe anxiety.

In Paper I, the risk to identify the participants through individual data in Table 1 was dealt with by removing gender and additional diagnosis in it, i.e., not being presented together with the results from BAS MQ-E and BOT2.

During the recruitment process of Paper III, potential participants were randomly sampled from the patient records of the habilitation services. Several of them chose not to answer at the proposed telephone time, when the physiotherapist contacted them. Why so is not known, but not answering is very frequent in the clinic as well, as part of the difficulties with social contacts. A few chose to listening in but not to participate.

For persons on the autism spectrum, to optimally support their everyday living, several interventions may be needed in parallel to each other. Thus, in Paper IV, it was not ethically motivated to withhold interventions deemed to be TAU in either group. Using a PROM, discussing the assessment results with the participant and using the participant's reflections in the intervention made the fourth paper well person-centered.

In Paper IV, five participants discontinued participation. Deficiencies in feasibility was an ethical issue of discontinuation since three participants experienced panic or severe anxiety about the travels to the intervention. Also, though continuing the intervention, one participant expressed difficulties with disturbing auditory and visual impressions in the habilitation setting.

Main discussion

General discussion

The main findings of this thesis were that persons on the autism spectrum described experiencing conflicting information from body and movements, which created problems in everyday life. Their descriptions were captured by two physiotherapeutic instruments, BAS MQ-E and BOT2. The narratives from specialized physiotherapists of movement quality in autism, confirmed what autistic individuals themselves had expressed about problems with body and movements. This strengthens the validity of observations made by the physiotherapists. Problems with movement quality often go unrecognized, which was expressed by both the autistic persons and the physiotherapists. Using BAS MQ to assess movement quality and body awareness showed acceptable measurement properties in autistic persons. Treatment with BBAT added significantly improved experienced and observed movement quality to the participants. The overall results bring knowledge that there are problems with body and movements, which may be addressed in assessment and intervention in autistic persons.

Experiences of movement quality - recognition

A first acknowledgement of movement quality in autistic persons is to at all recognize problems they may have regarding body and movements, e.g., with bodily awareness, breathing, coordination, stability, automated movements, or a sense of not owning one's body. This recognition may support the individual to understand one's needs. Otherwise, not recognizing these needs may endanger the possibility of relevant interventions and the health for autistic persons[131].

Autistic persons experience sensory and motor problems. The experienced movement problems are for some so severe that they render a diagnosis of specific motor disorder/developmental coordination disorder[100, 132]. When the autistic individuals themselves have difficulty to ask for help with experienced problems in body and movements, either by not recognizing, reflecting on or understanding them[100], specialized physiotherapists may observe them[108] and assess them with physiotherapeutic instruments[113]. As the need often is not expressed explicitly by the autistic person, listening in to the person's problems with an open mind to what

might relate to body and movements is essential. This is in need of a specialized physiotherapist.

Also, as movements are part of the very first communication in humans[66], having specialized physiotherapists assessing movement quality could be relevant in diagnosing autism early on. One theory describes autism not as a cognitive neuroscience, but as a developmental psychobiological disorder, with a disability of intentional movements[15]. In the light of the theories about enaction and embodiment, such a psychobiological disorder explanation[133] to the *core criteria* of autism, described in DSM 5[1], could be supported by defining *core disabilities* in autism as deficits in sensorimotor function and intention. As the expression of these can be observed in movement quality[15], examining body and movements in infants may give information to an earlier diagnosis of autism. An earlier diagnosis might be important since it has been proven that the earlier intervention, the better prognosis of the autistic symptoms[134-137]. There are methods to study infant movements, e.g., impaired general movements in infants have been predictors for an autism diagnosis later on[138]. Despite this, observed movement behavior is not standard to diagnose any prevalence of autism. To observe movements, qualitatively and quantitatively, could create a possibility to achieve information to support an autism diagnosis. These observations may need a physiotherapist, acknowledged to movement quality and the autistic movement patterns, to fully understand all of it.

Another aim of early recognition would be to decrease arousal. Arousal has been found to often be dysregulated in persons on the autism spectrum[42]. In autistic children, parents may experience difficulties to connect to their child, as the child do not meet them in responsive attention. The implications for the child cannot be fully understood, but as many of these children show irritation or frustration[15], one may interpret it as that the child do not understand the situation, which brings heightened arousal in her/him. Also, the concept unconscious neuroception may heuristically describe how our nervous system enables us to detect cues of safety or threat: if the intention of a movement is interpreted as being safe, then the higher brain structures inhibit our defensiveness and the arousal level may lower[139]. Another aspect on arousal, described by Biddell et al[140], is that arousal coherence between emotions and the autonomic reactions is important to body awareness and adaptive functioning. Autism may be a condition where the cues of intention from an early age cannot be interpreted relevantly, therefore neuroception will signal danger and increase arousal. Generally, hyper-arousal due to repeated trauma or stress has a strong negative effect on physiology and movements, which tend to persist[141-142]. Recognizing the body and movements needs as early as possible to improve body awareness and adaptation in everyday life may therefore be important in autistic persons.

Further, pains and aches have been described, though several autistic persons do not act on these signals to improve their health[100, 143]. Dysregulated sensations of pains have been reported in autism[144-145], but it may also be due to a lack of understanding

that having pains and aches is not the ordinary human status, but that it signals that something is wrong in body and movements. This would be in line with deficits in ToM. As pain and aches are a health risk, recognizing these signals are essential.

A second recognition of movement quality deals with how it may be experienced or perceived. The experiences from body and movements that were described by autistic persons, such as not feeling the body as whole or having problems with centered movements[100], concurred with the general structure of movement quality in autism that were described as fragmented, restrained and hesitant by specialized physiotherapists[108]. These results tell that specialized physiotherapist validly may observe movement quality in autism, an understanding that supports what symptoms to look for in the clinic. Doing so, both qualitative and quantitative aspects of movements may bring information about the person[100]. The three parts of BAS MQ-E include perceived/observed and experiences about movement quality. Previous research has shown that BAS MQ and BAS E questionnaire complement each other to provide information about the person's movement quality[146]. This was also found in Paper I, as inductive findings were captured by the BAS E questionnaire[100].

Sensorimotor impressions from body and movements are the basis of moving. If not optimal, it will negatively affect the experiences of the body and the movements. Fundamental to integrate sensorimotor impressions in the embodied identity is awareness[147]. Awareness was described by autistic persons to fail them[100], thus influencing the understanding of oneself. Deficient awareness was also noted by the physiotherapists, as absence thereof or as another kind of awareness, e.g., not being aware of oneself from within but from an outside perspective, thus endangering the sense of being whole[108]. Previous research in autistic persons has shown an imbalance between interoceptive signals, e.g., heartbeats, and body ownership, in which attention is allocated to the interoceptive signals[47]. This imbalanced allocation may indicate an impeded awareness to the sensorimotor system, which relies on proprioception.

Autistic persons experienced or exhibited differences between impressions from their left and right body halves[100]. Brain imaging studies have shown atypical hemispheric lateralization of the brain in persons on the autism spectrum. Not least are areas for motor and perceptual functions affected, with a decrease of connectivity between the hemispheres[148-151]. These neurological findings may bring understanding to why the body halves do not connect experientially either[100], as sensorimotor impressions may not be processed typically in the brain hemispheres in autistic persons.

Positive emotions related to one's body and movement was found to bring more access to bodily strategies to handle everyday life in autistic persons[100]. Neurotypically, emotions related to body and movements, and the arousal connected to these, are important to which brain regions that may be activated. If the emotions are positive, the brain will broaden the awareness and the repertoire between

thoughts and action, thus improving the possibilities for adaptive motor actions[152-153]. Further, in neurotypical persons, experiencing emotions of fear or anxiety may impede the sense of body ownership[154]. As autistic persons are more prone to anxiety than neurotypicals[155-156], an impact on their body ownership may appear from this.

When conflicting information from body and movements were experienced, some autistic participants described difficulties sensing a whole body and problems to understand oneself[100]. Deviant processing of sensory impressions and lack of bodily centering may bring deviant bodily coherence[108, 127]. One core difficulty in autism is deficient cognitive central coherence[157]. From the theory about enaction and embodiment, it has been discussed if growing up with constantly deviant sensory impressions and/or multisensory integration, thus deviant bodily coherence, will be part of the cause to deficient cognition, in which central coherence is one piece[5]. As central coherence may make meaning or sense about different context to the person[158], an effect of deviant bodily coherence[127] may be obstruction of sense-making.

Further, previous research has revealed that postural stability and grounding are essential to movement quality or making sense of oneself[38, 67, 75]. Also, the combined functions of postural stability and a free breath may establish contact with one's emotions as a prerequisite to develop self-confidence[67], in a complex intertwining of movement quality aspects. This concurs with enaction processes that form the embodied identity[5]. As good postural stability and a free breath was not obvious to autistic persons[100, 108], a negative effect on the overall movement quality may appear. Therefore, in autistic persons, the interaction of reduced functioning in several movement quality aspects may create even less understandable information. This may enhance the autistic symptoms.

The above discussed experiences bring understanding to why the movement quality expression in the general structure in autism was described as fragmented[108]. When the four perspectives of movement quality (Figure 1) do not integrate, such as physical postural stability and physiological breath, experiencing an existential coherent whole body, with the sense of body ownership and agency, may be impeded. Problems with experiencing a whole body may interfere with the intentions of movements. This may explain the movement quality expression as also being described as restrained and hesitant[108]. The possibility to understand and make sense of oneself will be impeded, thus affecting the embodied identity[5].

Assessment of movement quality - a first understanding

Persons on the autism spectrum do have possibilities to change in movement quality and body awareness, but valid instruments to evaluate any intervention effects are needed. Previous research of validity of BAS MQ are but a few[104, 146], but each add

to the understanding of the overall measurement properties of BAS MQ. The results of Paper III, as the first paper to investigate the measurement properties of BAS MQ in autism, and within the Rasch model, should be considered a first understanding that needs further study[113]. Further insights on some of the items are discussed.

Item '19 Relation to mirror' was the item that fitted the Rasch model less. A finding that concurs with clinical experience and previous research[159-161], was that the autistic participants exhibited less smoothness and rougher nuances/flexibility in their movement quality, i.e., the category steps were inclined to be bigger than for participants in the reference group. As inflexibility is a core disability of autism[1, 162], this finding agrees with the disability as a whole. Thus, an understanding of the rougher nuances may be mental inflexibility. But it may also be that the affected key constituents described by the physiotherapists[108], enable a motor learning that does not bring optimal development to subtle, detailed and fluent movements. Also, relation to mirror includes accepting to look at oneself and act in front of the mirror. Many autistic persons have problems with eye contact[163]. Some have trained keeping eye contact as a social function, though they find it taking a lot of energy. With such training, the behavior in front of the mirror will be affected. Hence, due to inflexibility, affected motor learning and a possible training of eye contact, it may be that it is not BAS MQ that is faulty in this item, but that the characteristics of the autism group were expressed. Further research is needed to evaluate this.

Items '4 Flexibility in balance line' and '10 Orientation through movement center' include scoring in two different positions/movements. '4 Flexibility in balance line' is scored in walking and standing, and '10 Orientation through movement center' in standing and lying[33]. A change, that possibly would improve targeting, could be to split each item in two, thus scoring each position/movement separately. As no previous study on BAS MQ was found using Rasch analysis, further research will be needed to investigate this.

Item '20 Eye contact' often scored lower than might be explained by the difficulty autistic persons often have with eye contact, and exhibited a disorder of response categories[113]. It has been reported that eye contact increase arousal in autistic persons[164]. This may in the clinic be noticed as a tension in eye contact. But as the wording in the BAS MQ-E manual[33] does not include tensions in the eye contact if it is otherwise adequate, and as autistic persons often train eye contact to be experienced as 'normal', the energy eye contact takes would not render higher scores. Considerations to this finding by clarifying the wording in the BAS MQ manual could make possible a truer scoring, thereby also improving the response category order.

BAS MQ discriminated between different levels of movement quality in the autism group, but the results showed that there is an insufficient number of more difficult items in BAS MQ, leading to mistargeting of the more abled persons[113]. On the other hand, movement quality is a generic ability that is expected to score low in BAS

MQ measures in a wide population, as compared to persons with diagnoses that affect the bodily symptoms negatively, such as psychiatric disorders[104] or posttraumatic stress disorder[165]. Autism have been described as a heterogeneous condition with many phenotypes[4, 12]. As such, a wide variety of bodily symptoms may be expected. Thus, autistic persons with good movement quality are also relevant to find.

The findings from the third paper resulted in concrete recommendations on what actions that could be made to improve the measurement properties of BAS MQ to persons on the autism spectrum, including the more abled persons. As these recommendations included clarifications of the wording in the manual, as well as splitting two items to improve response category function and targeting, it would possibly improve the measurement properties also in other target groups. Further iterations and research would bring more knowledge.

Intervention of movement quality - limitations and possibilities

Awareness aspects: There was a clear inter-relatedness between the key constituents, described in the general structure of movement quality in autism[108]. One such important relatedness concerns the need for conscious awareness in one's body, in order to experience other functions, such as postural control or body boundaries. As awareness may be a problem in autistic persons[46, 49], lack of it may exclude the person from a BBAT intervention, as reflecting on one's experiences during practicing is an important part of the intervention. On the other hand, a possibility is that awareness may improve with BBAT practicing, if some ability to awareness is there to develop[26].

Sensorimotor aspects: All autistic persons do not experience relevant sensory impressions, thus impeding motor learning. The sensorimotor approach of BBAT may be an explanation to the significant results to autistic persons, as this approach is about dosing the impressions to each individual's bodily resources or problems[26]. In autism, the information about the body in space and in time is sometimes distorted[53], i.e., proprioceptive or sensorimotor 'noise'[49]. Practicing the small, 'clean' movements in BBAT, may help avoid sensory 'noise', making the practice more effective[166]. Rhythmic, stereotyped repetitive movements may instill calm in autistic individuals[167]. In BBAT, the rhythmic movements may instill calm but are instead guided to be iterative, exploring nuances, thus may open up to changes for motor learning[26]. Previous research has also shown that rhythm may help to develop a more stable movement timing[168]. The iterative movements may slow down the impressions, whilst at the same time repeat them. Slower, repeated impressions may make the impressions more understandable, thus stabilizing the movement timing and motor learning.

Another possible effect from the sensorimotor approach may be that it exerts low cognitive load[169]. As autistic persons often need active cognition and concentration to move[108, 170], i.e., the movements are not automated, the sensorimotor approach may reduce the cognitive load.

Taken together, the sensorimotor approach may affect the person from several perspectives. Therefore, given that there is a lack of interconnectivity in the brain[148], sensorimotor exploration to bring experiences of neurological connectivity are interesting directions to future interventions.

Body ownership and agency aspects: Also, as the sensorimotor impressions form the basis to body ownership and agency, these may be influenced by the sensorimotor practicing in BBAT. When body ownership and agency are functional, the body 'knows' how to act. This motor intentionality, i.e., a non-conscious intention, is about automated movements[36], which may bring positive feelings, coherence and meaning to the movements and activities (Figure 10). BBAT has shown to enhance the experience of agency in depressed persons[76]. Also, the feeling of body and movement control, i.e., body ownership and agency, in psychiatric patients, improved with BBAT[75]. Though autism is not a disease to be cured[171], exploring and reflecting on other movement behaviors than the already learned may be a way to reach more understanding about one's body - to enhance the experiences of body ownership, or one's movements - to improve the experiences of agency. BBAT may be one possible intervention in this exploration.

Figure 10.
A young girl exhibiting bodily central coherence that 'hangs together' as a whole body. There is meaning to the movements and therefore the activity. The experience creates positive emotions (free download istockphotos 2023 11 17).

Arousal and emotional aspects: Important to the experiences of body ownership and agency is the arousal and emotions connected to them. Previous research on arousal in neurotypical children, show that disengaging from a negative emotion may help in the short run, but have delayed negative effects for physiological recovery[172]. In autism, hyper-arousal and connected negative emotions may arise from body and movements[100], making the persons disconnect from these emotions and the body or movements. It may be that this strategy works for the moment, but can increase arousal in the long run. As autistic persons are inclined to inflexibility[49], they may not themselves dose the impressions according to what they can handle, but either 'overdo' activities or disengage from them. Thus, they may need guidance on how to dose the impressions, as in BBAT, to explore pleasant impressions from body and movement.

Brainstem regulation, e.g., regulation of autonomic reactions such as arousal,[42] and hemisphere connectivity[148] may be dysfunctional in autism. In neurotypical persons, previous research has shown that positive emotions or arousal do not evoke asymmetry between the brain hemispheres, the way negative emotions do[153]. To direct awareness to autonomic changes, as an intervention to integrate physiological and emotional arousal impressions, may be effective if physical movements are included to ensure bottom-up and top-down information[140]. BBAT combines this information, exploring sensorimotor impressions from movements that preferably evoke positive emotions, and uses verbal reflections connected to the therapy session. The reflections may well include awareness to arousal or autonomic reactions[26]. Thus, the physiotherapist may guide the patient to understand the connection between physiological reactions and emotional arousal, as was done for those participants in the BBAT intervention study that needed such guidance[127]. Enhanced sense-making may be gained. In such an intervention for autistic persons, integrating physiological and emotional arousal impressions need to be met with respect, dosing how much impressions the person can tolerate and handle.

Learning of any kind is about new behaviors or strategies being explored from many sensory modalities, not least bodily[173-174]. During motor learning, the arousal level is at its best, when it is neither to low or high, but balanced to an active but relaxed state (Figure 11). In autism, brainstem-mediated poor arousal regulation is a key feature, often there is hyper-arousal, but it may also be hypo-arousal in other context, thus impeding optimal performance in everyday activities[42]. Aiming at a balanced arousal in the intervention is a core approach in BBAT[26], which may open up for active, relaxed sensory modalities. Therefore, since body and movements respond to emotional contexts, balancing the arousal level in autistic persons may be important for change to occur and to add new learning to one's bodily self-awareness[26, 34, 175].

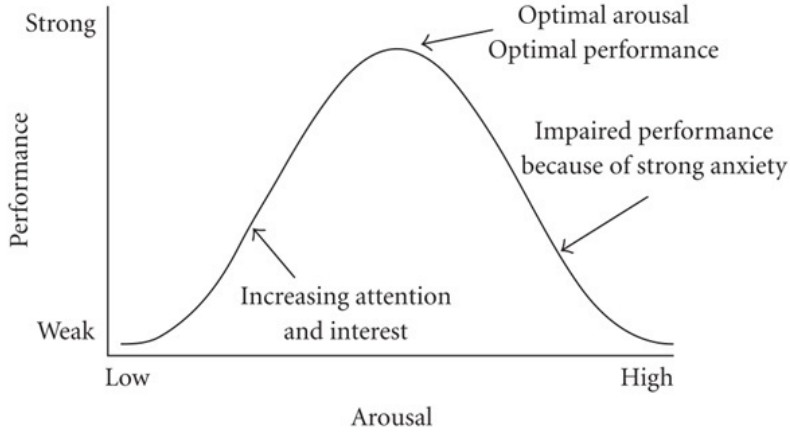

Figure 11.
The level of arousal versus performance curve[176].

Bodily self-awareness and embodied identity aspects: Experiencing integration of a firm relation to the ground, a free breathing and awareness of a whole body and vital, unified movements, are the aims of BBAT. In the person, these aspects are understood from bodily self-awareness in an embodied identity.

Working with grounding brings stability to the person. Grounded bodily stability has proved its importance to mental stability in other conditions than autism, such as schizophrenia[75], depression[76] or anxiety[177]. Schizophrenic participants described improved balance and posture, i.e., postural stability and orientation[75], and in depressed persons, grounding proved to bring certainty, stability and rooting in the reality[76]. Participants with anxiety described improved ability 'to get down-to-earth with oneself'[177]. In Paper IV[127], the autistic participants in the BBAT intervention exhibited significantly enhanced movement quality regarding postural stability. Some of them also experienced a better posture, where they felt a change during the BBAT intervention period, from having the pressure of their weight on the heels to the front of their feet. Thus, the balance became more centered, leading to eased muscle tensions. Experiences of grounding was not expressed explicitly, but the physiotherapist could observe changes, such as less arousal and a sense of that the participant 'landed' by letting one's weight down to the ground. Postural stability and grounding have been described as a central base to other movement qualities[26, 75]. Thus, BBAT may be adequate to improve postural stability and grounding in autistic persons to bring a more stable bodily base.

A free breathing is an inevitably important function in a lived body. Breathing is a vital part of BBAT practicing - as free, not cognitively controlled[26] - and has been proved to balance the autonomic nerve system[178]. The autistic participants in Papers

I, III and IV[100, 113, 127] often described their breathing as problematic, e.g., sensing it blocked, having difficulties to breath and move simultaneously, or needing cues to breath. A cognitively paced breathing needs directed attention which demands energy[179]. This controlled breathing may in part explain why autistic persons often exhibited an affected breathing[100], taking both physical and mental energy[108]. Several of the autistic participants described a more relaxed breathing after BBAT practicing[127], also described previously by depressed persons[76]. The relaxed breathing in the autistic participants could be observed in the BAS MQ results of spreading and integration of the breath to movements[127]. Thus, BBAT may improve breathing in autistic persons.

The experience of being unified and sensing a whole body, may often be compromised in autistic persons[100]. As a self-protection from overwhelming sensory impressions, a mental 'closure' may appear[108]. In intervention, to move away from controlling movements with thoughts, to instead use a sensorimotor approach, may open up brain areas which could be of interest to bring both variety and unity in movement behaviors to create the sense of a whole body. Autistic persons exhibit a differing ability to neuroplasticity than neurotypicals[180], such as that an excess of short-distance brain connectivity has been proposed, compared to long-range connectivity[181]. The neuroplasticity in autistic persons is possible to affect though. For instance, computer-based interventions, to induce changed connectivity of brain regions, has with brain imaging showed activation of other brain regions after treatment[182]. Another study, using neurofeedback training in a sensorimotor task in autistic participants, showed activation of mirror neuron brain areas post-training[183]. In the heterogenic autism group[12], there are many phenotypes and different cells across the brain involved[4]. Therefore, neuroplasticity may function differently between autistic persons. This implicates the need to adapt interventions to each individual's experiences[100], and what may be observed by a physiotherapist in movement quality[108], to build the intervention on each person's resources and to bring understandable and positive impressions[127]. Neurotypical adaptations may be maladaptive to an autistic person[99, 184]. Therefore, considerations of the above discussed limitations and possibilities are needed. BBAT is about exploring and building on the healthy resources in each individual[26]. So, following the results of this thesis, sense-making[5], not 'normalizing' must be the goal of a body awareness intervention in autistic persons, to enhance the sense of grounding, a free breathing and a whole body.

Future research

Altogether, the results of this thesis indicate that there is a need to recognize problems with body and movements in autistic persons, in order to provide relevant interventions. Therefore, further research on interventions directed at movement quality and body awareness should be addressed. Autistic persons have shown

access to brain neuroplasticity[182], so further sensorimotor interventions are relevant to investigate. That previous research has shown that persons on the autism spectrum may have deficits in the connectivity between the brain hemispheres[148-151], and that arousal due to negative emotions has shown a main role in hemispheric asymmetry in healthy individuals[153], concurs with that autistic persons experience differences between body halves and that they have access to more bodily strategies to handle everyday life, if they experience positive feelings about the body[100]. Sensorimotor interventions directed to stimulate the connectivity between the brain hemispheres may be an important research area.

BBAT is inspired by Tai Chi-Chuan movements. These are performed as if one moves against a slight resistance, resembling the physiological perspective with flow and elasticity, which makes the movements feel coherent and whole[26]. Another perspective for future research is that, beyond but adding to BBAT practicing, the bodily grounding may need further clarification in the autistic person, i.e., using resistance training to create intelligible impressions. This may be an appropriate intervention adaptation[108], as by increasing the effort required to generate a given level of force, to increase the effect of motor commands, thus making the proprioceptive information more distinct[185]. Studying effects of resistance training is a further possible research project.

High arousal levels or the need to self-cuing in the absence of automated movements may infer a high cognitive load on the autistic individual. Previous research in amputees has studied the cognitive load with different prothesis during gait[186], a research method to adopt also in autistic individuals to understand their cognitive load, e.g., during gait.

Also, following the results from the Rasch analysis of BAS MQ[113], iterative processing and further analyses may improve this instrument in autistic persons. It may be that improvements of BAS MQ to persons in other target groups could be an additional effect.

Methodological strengths and limitations

This doctoral thesis has been implemented with four rather differing epistemologies, methodologies and hence designs and methods. This was a conscious choice, following the aim of each study and their respective research questions. Each choice presented possibilities and challenges.

Mixed-methods design with deductive analysis (Paper I)

Mixed-methods design was used in Paper I. The strengths with this design were obvious and could not be found in any alternative: 1.) qualitative and quantitative data informed each other, thus increased the trustworthiness and 2.) combining data gave answers that would not have been possible otherwise[187], such as that physiotherapeutic instruments could relevantly capture the participants' experiences.

Mixed-methods design in physiotherapy research has been advocated, as to inform practice in a practical way in a variety of settings[101], but it generates a large amount of data, of both qualitative and quantitative nature. Therefore, the analyses in Paper I demanded a high degree of systematics in several steps to perform, with a need to keep focus on details and overview simultaneously.

The narratives of the participants' experiences of body and movements were deductively investigated[106] as to how they matched BBAT and motor control theories. Thus, in this paper the analysis was not replaceable with inductive analysis. In the analysis process it was important to build matrices that was true to the theories by using specific categories. The most creative part of the analysis was to add the meaning units into the matrices. Therefore, there was a need to repeat these analyses to confirm them.

There are software, such as NVivo[188] to handle, organize and structure qualitative and mixed-methods data. This option was found when the data analysis process had already started. Also, it was experienced as more closeness to the data, and with a more direct overview of it, when handling it analogous. The analogue approach was therefore adopted.

Interviewing people with communicative difficulties (Paper I)

Interviewing people with communicative difficulties raised special demands on knowledge of needs, preparations and performing. On the other hand, using second-hand narratives about persons on the autism spectrum give information, but can never give a first-hand description of the experiences from body and movements in a person. To handle the difficulties, several methods and choices were incorporated

when meeting the participants to meet each participants communicative needs. This approach has been used in previous research[60].

It is ethically right to give persons on the autism spectrum the right to make themselves heard. Experiential results can only be found if the individual her/himself is active and asked.

Phenomenological perspective (Paper II)

There were other designs, that were considered for Paper II than Giorgi's descriptive phenomenological method, namely phenomenological hermeneutic method[189] and content analysis[190].

There are many similarities between the phenomenological hermeneutic method and Giorgi's descriptive phenomenological method, in which both methods follow a structured analysis and reporting of a comprehensive understanding. The big difference is that Giorgi *describes* the results, i.e., what is obvious in the text, with a naïve understanding. In the phenomenological hermeneutic method one is said to always *interpret* the text, via an initial analysis of naïve understanding of the data, but then moving on to interpret it from pre-understanding and adding theories to it[189].

Content analysis[190] was also considered, but rejected since it was deemed to be in risk of ending up in already existing categories and/or concepts. Since seeking naïve new perspectives on the phenomenon 'movement quality in autism' was of interest, Giorgi's descriptive phenomenological approach was chosen.

The difficulty with a phenomenological study may also be considered its strength, letting the experiences of the respondent take place. One might question though, how true a phenomenological approach is to not use pre-understanding - when constructing a research question and the aim of a study, it can only be understood from a certain degree of pre-understanding. In this paper, a pre-understanding was that movement quality probably is compromised in persons on the autism spectrum.

Rasch analysis (Paper III)

Classical test theory could have been used to test BAS MQ regarding reliability and validity aspects. By the use of classical test theory, different properties of the instrument may be studied. But using modern test theory and the Rasch model, also opened up for each item being studied through many properties[115].

In the analysis, using a rating scale model would have assumed no difference of rating scale structure between items, which the partial credit model does. Therefore, a partial credit model is more sensitive to missing scored categories, as the item difficulty hierarchy builds on the categories that are used in all items[114]. In Paper

III, all categories were not used in all items, but the differing threshold structure between items supported the choice to use a partial credit model, instead of a rating scale model.

Rasch analysis rendered a lot of data, all intertwined, which implicated the need to analyze each measurement property first separately and then to the others. Doing so, investigating those items that exhibited worse fit to the Rasch model and comparing them to a clinical perspective came in question. Also, interpretation of the results was analyzed from the perspectives that either it was the instrument that failed/was viable or that the results mirrored the dis/abilities of the target group. Integrating knowledge from the clinic was important in these analyses. The in-depth results were worth the effort: when needed, an item could be scrutinized and discussed, which rendered further insights about strengths, weaknesses and possibilities how to improve the instrument.

Pragmatic RCT (Paper IV)

A pragmatic randomized controlled trial (pRCT) (if an intervention can be effective from a clinical or everyday setting) was used in the fourth paper, since the aim was to inform decision making rather than the alternative to explain effects in an explanatory RCT (if an intervention is effective under ideal conditions)[191]. Explanatory RCT's have been criticized to not relevantly mirror the actual and complex way we live in the world[192]. On the other hand, pragmatism is an emerging research paradigm, also in physiotherapy[101]. The pragmatic approach offers more widely applicable, external validity than an explanatory RCT. Pragmatism is outcome-oriented, deals with practical consequences, and attends to the importance of context. The purpose of a pragmatic trial thus affects the process of implementation[101, 191, 193-194].

As autism aetiologically is a diverse disorder, the group is heterogenous[4, 12]. Autistic persons often have comorbid diagnoses[195] and there are sensory and movement differences[196]. As each individual constitutes a complex composition of symptoms, it was difficult to control or match individuals, making an explanatory RCT difficult to perform. Though there is an obvious drawback with the pragmatic attitude, i.e., the internal validity[191], the research question and aim guided which RCT to choose. Besides the need to meet the persons on the autism spectrum relevantly, the aim of the fourth paper asked for support to decision making for the clinic, thus a pRCT.

Also, in a pRCT, instructions on how to apply the experimental intervention should be highly flexible, offering practitioners considerable leeway in deciding how to formulate and apply it[191]. BBAT is a method that relies heavily on the expertise of the physiotherapist to know body awareness therapy, in order to be compliant to the needs and process of each patient, and hence adjust the therapy accordingly[26]. Further, it would not have been ethically right to withhold any part of a coordinated

plan of the interventions for the individual, often a necessity for persons on the autism spectrum. Thus, the study followed the pragmatic approach used in everyday clinic.

Using a person-reported outcome measure (Paper IV)

Another important aspect to the pragmatic attitude of the RCT, was the choice of using a PROM[197], in this case individually defined movement quality problems deemed to be responsive to BBAT, and rated on an NRS. Using PROM's is a way to measure qualitative outcome experiences, that can't be measured otherwise. The single item design of an NRS is applicable for assessing differing experiential symptoms[198-199]. Single item measures have proved to be adequately valid and reliable for symptoms in research of longitudinal interventions[200]. NRS have been validated when rating pain[201-203], but not for health issues relating to movement quality.

A strength of the individualized PROM was its person-centering. It added feasibility for the participants to the intervention, as it expressed an understanding of what could be expected when working with the health problem, something that mattered to each participant in everyday life[204]. Also, as autistic persons may have less ability to be flexible with word meaning than neurotypicals, defining their own problems in their own words secured the understanding of the scoring[205], thus adding to reliability.

Therefore, despite the internal reliability issue with a single-item measure[200], the choice to use NRS was made to meet each individual in her/his communicative way and to let the health problem be expressed in her/his own words. The individually expressed problem with movement quality, emanated from the assessment with BAS MQ-E and was discussed between the participant and the physiotherapist. This created a shared knowledge what movement quality may be. Hence, choosing individually expressed and discussed NRS's was judged to also have increased validity of the data.

Main conclusions

This thesis, with its four Papers, has provided new knowledge and understanding about the function of body and movements in autistic persons, regarding experiences, assessment and intervention.

- Many autistic persons experience problems with body and movements. They live bodies that not necessarily manifest the intention of movements. They need to protect themselves from non-understandable impressions from within and/or from the surrounding world, which obscures the meaning of body and movement.
- Movement quality influence daily living more than movement quantity.
- Positive experiences of body ownership and agency are connected to having more bodily strategies in everyday life.
- A lack of understanding one's body and movements may suppress the development of bodily self-awareness and negatively affect the embodied identity.
- Problems with body and movements often go unrecognized in persons on the autism spectrum.
- Specialized physiotherapists can validly observe and describe movement quality in autistic persons.
- BAS MQ acceptably describes autistic persons' movement quality and can discriminate between persons on the autism spectrum and neurotypicals.
- BBAT brings significant effects on movement quality and body awareness in autistic persons, thus enhancing the possibilities to increased bodily self-awareness and more bodily strategies in everyday life.

Implications

- Persons on the autism spectrum need to be recognized in their movement problems and offered assessments of movement ability, concerning movement quality and quantity. The examining physiotherapist needs to be experienced in these assessments.
- To positively enhance the bodily self-awareness and embodied identity in autistic persons, there is a need to break a negative spiral of bodily symptoms. Interventions need to be individually adapted to alleviate internal and external sensory 'noise'.
- To build the bodily resources, it is relevant to start by addressing the sensorimotor system as the foundation to other bodily aspects.
- BAS MQ may give guidance as of which persons on the autism spectrum may benefit from a body awareness intervention.
- BBAT is relevant as one possible such intervention.

Understanding and sense-making

Understanding and sense-making were chiselled out as indispensable concepts to the implications of this thesis. This knowledge relates to many perspectives:

- First and foremost, the results stress the importance of the understanding for the individual of her/himself to take care of one's own health.
- It is about understanding that persons on the autism spectrum, because of the disability, have difficulties expressing problems with body and movements, and thus go unrecognized with these problems. In health care, there is a need to respond to these needs, listening to implicit messages in their narratives.
- It is about understanding the high physical and mental energy expenditure autism often results in, as different sensorimotor impressions and dysregulated arousal may affect one's behaviors and energy asset.

- It is an understanding that the autistic person cannot act in a neurotypical way – hence, the wider society needs to adapt and meet this person according to an autistic functioning.
- It is about a first understanding of how BAS MQ may describe movement quality in autism. Validity is a property that is never completed, further studies only add to it.
- Also, understanding the meaning of movement quality in autism renders a basis to better understand non-verbal bodily communication from the autistic person[108], so as to build appropriate interventions. There are possibilities in sensorimotor based interventions.
- Finally, it is about understanding how sensorimotor function in the autistic person may form the basis from foetus and through-out life, to all other functions in the lived body[15].

Trevarthen and Delafield-Butt[15] wrote: *'We propose that faults in higher mind functions of persons with autism arise out of disorder in the early development of primary, non-reflective sensorimotor factors that regulate moving-with-awareness of an integrated Self. These affect vitality dynamics, the qualities of motor control that express essential expectancies of action and enable communication of emotion in purposes.'*

Ergo, understanding impressions from one's body and movements creates meaning and an understanding of oneself from within. Meaning of body and movements may bring sense-making, vitality and an existential meaning to the individual, as an embodied identity.

Epilogue

Attending PhD studies has truly expanded my attention to new perspectives. I have developed project plans and research questions, been the main data sampler, performed the data analyses, and written the manuscripts for all the studies, all in close collaboration with my supervisors, co-authors and expert advisors. I have also written two applications to the Regional Ethical Review Board, applied for external grants, attended fourteen PhD courses and presented my research at twelve scientific conferences. These activities have brought new knowledge to persons on the autism spectrum, to me, the health care system and to the society.

Neurotypical persons need to understand that being autistic is another way to function than theirs. Which is more right – if any? We all exist on a continuum, being more or less autistic. My sincere hope is that this thesis with its four papers will bring more focus on research with autistic persons themselves. Only the person her/himself can tell about experiences and needs that are really the inner felt ones.

The results from this thesis show that autistic persons do experience problems with body and movements, problems that may be hard for themselves to interpret. Also, more knowledge gained from this thesis is that there are possibilities in assessing body awareness and movement quality, and that interventions aimed at these, may make a positive difference to autistic persons. I believe that further scientific studies preferably should be planned and executed in collaboration with autistic persons, to bring even more valid knowledge, combining health care system knowledge with autistic needs, experiences and knowledge, in the study designs.

Autism is a neurodevelopmental condition that affects the person from the very first sign of life until the end of it. During my PhD studies I have even firmer come to realize that this needs to be recognized as important to all autistic persons. An understanding of the complexity of the autism group is needed. It includes that a holistic understanding and an eclectic intervention approach need to be adopted.

During my studies I have enjoyed scientific discussions on various subjects with research colleagues, such as the meaning of concepts, scientific theories or methodologies. In some context these discussions have brought more qualitative perspectives, others more quantitative. I have landed in that I will best serve the autistic population by also in the future stress the importance of human experiences – these are essential to live a life with optimal quality, being autistic or not.

Acknowledgements

I wish to express my deeply felt gratitude to all participants who bountifully shared their experiences, time, movements, and perspectives. It is my hope that participating also rendered them something in return. I would like to extend my deepest thanks to my supervisors, Catharina Sjödahl Hammarlund, Christina Brogårdh and Arve Opheim. Without any of these, this thesis would not have resulted as is. Also, having had contact with Amanda Lundvik Gyllensten, with expertise in body awareness, BAS MQ-E and BBAT, and Jeanette Melin, with expertise in statistical and Rasch analyses, have been of great importance to me and this dissertation.

I gratefully acknowledge the support that I have received from my employer; Habilitation & Health, Region Västra Götaland. Giving the opportunity to both funds and working time during the whole period of research studies were invaluable prerequisites to fulfil the studies. Also, the cowork with the Habilitation in Region Kronoberg has been valuable.

The Skaraborg Institute for Research and Development has contributed with substantial funds. Also, having had contact with the research society and the activities within the institute has stimulated me and improved my research. Practical aid and advise has been awarded me from this institute.

The Renee Eander Fund for Physiotherapists has regularly awarded funds to this research. The support from this collegial foundation has been experienced especially valuable from a vocational perspective.

The Gösta Svensson Foundation and the Solstickan Fund have both contributed with scholarship funds to implement this thesis. Thank you.

Finally, but certainly not least, this doctoral thesis was possible to implement by support from the Faculty of Medicine, Department of Health Sciences at Lund University, Sweden.

References

1. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders, DSM-5*. 5th ed. Washington DC: American Psychiatric Association Publishing; 2013.
2. WHO. *Klassifikationen ICD-10*. 2018 [In Swedish]; Available from: https://www.socialstyrelsen.se/statistik-och-data/klassifikationer-och-koder/icd-10/.
3. Idring S, Lundberg M, Sturm H, et al. *Changes in prevalence of autism spectrum disorders in 2001–2011: Findings from the Stockholm youth cohort.* Journal of Autism Developmental Disorder. 2015; 45(2015): 1766–1773.
4. Thapar A, Rutter M. *Genetic advances in autism.* Journal of Autism and Developmental Disorders. 2021; 51(12): 4321-4332.
5. De Jaegher H. *Embodiment and sense-making in autism.* Frontiers in Integrative Neuroscience. 2013; 7(15): 1-19.
6. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders, fourth edition*. 4th ed. Washington DC: American Psychiatric Association Publishing; 1994.
7. Taboas A, Doepke K, Zimmerman C. *Preferences for identity-first versus person-first language in a US sample of autism stakeholders.* Autism: The International Journal of Research and Practice. 2023; 27(2): 565-570.
8. Buijsman R, Begeer S, Scheeren AM. *'Autistic person' or 'person with autism'? Person-first language preference in Dutch adults with autism and parents.* Autism: The International Journal of Research and Practice. 2023; 27(3): 788-795.
9. Tan CD. *"I'm a normal autistic person, not an abnormal neurotypical": Autism Spectrum Disorder diagnosis as biographical illumination.* Social Science & Medicine. 2018; 197(2018): 161-167.
10. Bury SM, Jellett R, Spoor JR, Hedley D. *"It defines who I am" or "It's something I have": What language do [Autistic] Australian adults [on the autism spectrum] prefer?* Journal of Autism and Developmental Disorders. 2023; 53(2): 677-687.
11. Sinclair J, *Why I dislike person first language. Autism Network International*. Exeter: University of Exeter; 2017.
12. Waterhouse L. *Heterogeneity thwarts autism explanatory power: A proposal for endophenotypes.* Frontiers in Psychiatry. 2022; 13(2022): 1-14.

13. Hill EL, Frith U. *Understanding autism: insights from mind and brain.* Philosophical Transactions of the Royal Society of London Biological Science. 2003; 358(1430): 281-289.
14. Brenner LA, Shih VH, Colich NL, et al. *Time reproduction performance is associated with age and working memory in high-functioning youth with autism spectrum disorder.* Autism Research: Official Journal of the International Society for Autism Research. 2015; 8(1): 29-37.
15. Trevarthen C, Delafield-Butt J. *Autism as a developmental disorder in intentional movement and affective engagement.* Frontiers in Integrative Neuroscience. 2013; 7(49): 1-16.
16. Habilitering och Hälsa. *Stöd och insatser. Habilitering och Hälsa Region Stockholm*. 2022 [In Swedish]; Available from: https://www.autismforum.se/stod-och-insatser/.
17. Hayashi M, Mishima K, Fukumizu M, et al. *Melatonin treatment and adequate sleep hygiene interventions in children with autism spectrum disorder: a randomized controlled trial.* Journal of Autism and Developmental Disorders. 2022; 52(6): 2784-2793.
18. Sveriges Kommuner och Regioner. *Samordnad individuell plan, SIP*. 2020 [In Swedish]; Available from: https://skr.se/halsasjukvard/kunskapsstodvardochbehandling/samordnadindividuellplansip.samordnadindividuellplan.html.
19. WHO. *Physical activity*. 2022; Available from: https://www.who.int/news-room/fact-sheets/detail/physical-activity.
20. Hornix BE, Havekes R, Kas MJH. *Multisensory cortical processing and dysfunction across the neuropsychiatric spectrum.* Neuroscience & Biobehavioral Reviews. 2019; 97(2019): 138-151.
21. Ochi M, Kawabe K, Ochi S, et al. *School refusal and bullying in children with autism spectrum disorder.* Child & Adolescent Psychiatry & Mental Health. 2020; 14(1): 1-7.
22. Arnell S, Jerlinder K, Lundqvist L-O. *Perceptions of physical activity participation among adolescents with autism spectrum disorders: A conceptual model of conditional participation.* Journal of Autism and Developmental Disorders. 2018; 48(5): 1792-1802.
23. Yrkesföreningar Fysisk Aktivitet. *Om fysisk aktivitet på recept*. 2020 [In Swedish]; Available from: http://www.fyss.se/far/om-fysisk-aktivitet-pa-recept-far/.
24. Baranek G. *Efficacy of sensory and motor interventions for children with autism.* Journal of Autism and Developmental Disorders. 2002; 32(5): 397-422.
25. Berland R, Marques-Sule E, Marín-Mateo JL, et al. *Effects of the Feldenkrais method as a physiotherapy tool: A systematic review and meta-analysis of randomized controlled trials.* International Journal of Environmental Research and Public Health. 2022; 19(21): 1-23.
26. Gyllensten AL, Skoglund K, Wulf I. *Basic Body Awareness Therapy. Embodied identity*. Stockholm: Vulkan; 2018.

27. Kilroy E, Aziz-Zadeh L, Cermak S. *Ayres theories of autism and sensory integration revisited: what contemporary neuroscience has to say.* Brain Sciences. 2019; 9(3): 2-20.
28. Amonkar N, Su WC, Bhat AN, Srinivasan SM. *Effects of creative movement therapies on social communication, behavioral-affective, sensorimotor, cognitive, and functional participation skills of individuals with autism spectrum disorder: A systematic review.* Frontiers in Psychiatry. 2021; 12(2021): 1-44.
29. World Physiotherapy. *Description of physical therapy. Policy statement.* 2019; Available from: https://world.physio/sites/default/files/2020-07/PS-2019-Description-of-physical-therapy.pdf.
30. Rose SJ, Rothstein JM. *Muscle biology and physical therapy: a historical perspective.* Physical Therapy. 1982; 62(12): 1754-1756.
31. Wikström-Grotell C, Eriksson K. *Movement as a basic concept in physiotherapy - a human science approach.* Physiotherapy Theory and Practice. 2012; 28(6): 428-438.
32. Skjaerven LH, Kristoffersen K, Gard G. *How can movement quality be promoted in clinical practice? A phenomenological study of physical therapist experts.* Physical Therapy. 2010; 90(10): 1479-1492.
33. Gyllensten AL, Mattsson M. *Manual Body awareness scale movement quality and experiences, BAS MQ-E, movement quality and body experience*. Lund: Lund University; 2015 [in Swedish].
34. Stern DN. *Forms of vitality: exploring dynamic experience in psychology, the arts, psychotherapy, and development*. Oxford: Oxford University Press; 2010.
35. Sheets-Johnstone M. *The primacy of movement*. Amsterdam: John Benjamins Publishing Co; 2011.
36. Merleau-Ponty M. *Phenomenology of perception*. New York: Routledge; 1945/2014.
37. Levy Berg A. *Fokus på affekter*, in *Att förstå kroppens budskap - sjukgymnastiska perspektiv*, Biguet G, Keskinen-Rosenqvist R, and Levy Berg A, Editors. Lund: Studentlitteratur; 2012 [In Swedish].
38. Skjaerven LH, Gard G, Kristoffersen K. *Basic elements and dimensions to the phenomenon of quality of movement – a case study.* Journal of Bodywork & Movement Therapies. 2003; 7(4): 251-260.
39. Skjaerven LH, Kristoffersen K, Gard G. *An eye for movement quality: A phenomenological study of movement quality reflecting a group of physiotherapists' understanding of the phenomenon.* Physiotherapy Theory and Practice. 2008; 24(1): 13-27.
40. Tzu L. *Verse 26*, in *Tao Te Ching*. Australia: Macmillan Collector's Library; 2022.
41. Pugliese CE, Anthony L, Strang JF, et al. *Increasing adaptive behavior skill deficits from childhood to adolescence in autism spectrum disorder: role of executive function.* Journal of Autism and Developmental Disorders. 2015; 45(6): 1579-1587.

42. Burstein O, Geva R. *The brainstem-informed autism framework: early life neurobehavioral markers.* Frontiers in Integrative Neuroscience. 2021; 15(2021): 1-11.
43. Welch C, Cameron D, Fitch M, Polatajko H. *Living in autistic bodies: bloggers discuss movement control and arousal regulation.* Disability & Rehabilitation. 2021; 43(22): 3159-3167.
44. Ming X, Patel R, Kang V, Chokroverty S, Julu PO. *Respiratory and autonomic dysfunction in children with autism spectrum disorders.* Brain and Development. 2016; 38(2): 225-232.
45. Bogdashina O. *Sensory perceptual issues in autism and Asperger syndrome. Different sensory experiences - different perceptual worlds*. 2nd ed. London: Jessica Kingsley Publishers; 2017.
46. DuBois D, Ameis SH, Lai M-C, Casanova MF, Desarkar P. *Interoception in autism spectrum disorder: a review.* International Journal of Developmental Neuroscience. 2016; 52(2016): 104-111.
47. Schauder KB, Mash LE, Bryant LK, Cascio CJ. *Interoceptive ability and body awareness in autism spectrum disorder.* Journal of Experimental Child Psychology. 2015; 131(2015): 193-200.
48. Noel J-P, Lytle M, Cascio C, Wallace MT. *Disrupted integration of exteroceptive and interoceptive signaling in autism spectrum disorder.* Autism Research. 2018; 11(1): 194-205.
49. Torres EB, Brincker M, Isenhower R, et al. *Autism: the micro-movement perspective.* Frontiers in Integrative Neuroscience. 2013; 7(32): 1-26.
50. Shumway-Cook A, Woollacott MH. *Motor control. Translating research into clinical practice*. 4th ed. Baltimore: Lippincott Williams & Wilkins; 2012.
51. Bisi MC, Stagni R. *Changes of human movement complexity during maturation: quantitative assessment using multiscale entropy.* Computer Methods in Biomechanics and Biomedical Engineering. 2018; 21(4): 325-331.
52. Holmes NP, Spence C. *The body schema and the multisensory representation(s) of peripersonal space.* Cognitive processing. 2004; 5(2): 94-105.
53. Grohmann TDA. *A phenomenological account of sensorimotor difficulties in autism: intentionality, movement, and proprioception.* Psychopathology. 2017; 50(6): 408-415.
54. Delafield-Butt JT, Gangopadhyay N. *Sensorimotor intentionality: The origins of intentionality in prospective agent action.* Developmental Review. 2013; 33(4): 399-425.
55. Antonovsky A, Cederblad M, Elfstadius M, Lundh L-G. *Hälsans mysterium*. Stockholm: Natur och kultur; 1991 [In Swedish].
56. Rizzolatti G, Fabbri-Destro M. *Mirror neurons: from discovery to autism.* Experimental Brain Research. 2010; 200(2010): 223-237.
57. Moseley RL, Pulvermüller F. *What can autism teach us about the role of sensorimotor systems in higher cognition? New clues from studies on*

language, action semantics, and abstract emotional concept processing. Cortex. 2018; 100(2018): 149-190.
58. Blake R, Turner LM, Smoski MJ, Pozdol SL, Stone WL. *Visual recognition of biological motion is impaired in children with autism.* Psychological Science. 2003; 14(2): 151-157.
59. Hobson P, Lee A. *Imitation and identification in autism.* Journal of Child Psychology & Psychiatry & Allied Disciplines. 1999; 40(4): 649-659.
60. Robledo J, Donnellan AM, Strandt-Conroy K. *An exploration of sensory and movement differences from the perspective of individuals with autism.* Frontiers in Integrative Neuroscience. 2012; 6(2012): 1-17.
61. Fabbri-Destro M, Cattaneo L, Boria S, Rizzolatti G. *Planning actions in autism.* Experimental Brain Research. 2009; 192(3): 521-525.
62. Cattaneo L, Fabbri-Destro M, Boria S, et al. *Impairment of actions chains in autism and its possible role in intention understanding.* Proceedings of the National Academy of Sciences of the United States of America. 2007; 104(45): 17825-17830.
63. Gowen E, Hamilton A. *Motor abilities in autism: a review using a computational context.* Journal of Autism and Developmental Disorders. 2013; 43(2): 323-344.
64. Pyasik M, Furlanetto T, Pia L. *The role of body-related afferent signals in human sense of agency.* Journal of Experimental Neuroscience. 2019; 13(2019): 1-4.
65. Gyllensten AL, Nyboe Jacobsen L, Gard G. *Clinician perspectives of Basic Body Awareness Therapy (BBAT) in mental health physical therapy: An international qualitative study.* Journal of Bodywork & Movement Therapies. 2019; 23(4): 746-751.
66. Stern DN. *Spädbarnets interpersonella värld ur psykoanalytiskt och utvecklingspsykologiskt perspektiv*. Stockholm: Natur & Kultur; 1991 [In Swedish].
67. Gyllensten AL, Skär L, Miller M, Gard G. *Embodied identity - A deeper understanding of body awareness.* Physiotherapy Theory and Practice. 2010; 26(7): 439-446.
68. Kling J, Wängqvist M, Frisén A. *"This body is me": Discovering the ways in which the body is salient in people's identities.* Body Image. 2018; 24(2018): 102-110.
69. Zalla T, Sperduti M. *The sense of agency in autism spectrum disorders: a dissociation between prospective and retrospective mechanisms?* Frontiers in Psychology. 2015; 6(2015): 1278.
70. Mul C-I, Cardini F, Stagg SD, et al. *Altered bodily self-consciousness and peripersonal space in autism.* Autism: The International Journal of Research and Practice. 2019; 23(8): 2055-2067.
71. Roxendal G, *Body awareness therapy and the body awareness scale, treatment and evaluation in psychiatric physiotherapy*, in *Department of Psychiatry*. Gothenburgh: University of Gothenburgh; 1985.

72. Roxendal G, Winberg A. *Levande människa: basal kroppskännedom för rörelse och vila*. Stockholm: Natur & Kultur; 2002 [In Swedish].
73. Dropsy J. *Den harmoniska kroppen: en osynlig övning*. Stockholm: Natur och kultur; 2004 [In Swedish].
74. Tranströmer T. *Mörkerseende*. Göteborg: Författarförlaget; 1970 [In Swedish].
75. Gyllensten AL, Hansson L, Ekdahl C. *Patient experiences of basic body awareness therapy and the relationship with the physiotherapist.* Journal of Bodywork & Movement Therapies. 2003; 7(3): 173-183.
76. Danielsson L, Rosberg S. *Opening toward life: Experiences of basic body awareness therapy in persons with major depression.* International Journal of Qualitative Studies on Health and Well-Being. 2015; 10(2015): 1-13.
77. Date S, Munn E, Frey GC. *Postural balance control interventions in autism spectrum disorder (ASD): A systematic review.* Gait & Posture. 2024; 109(2024): 170-182.
78. Roxendal G, Nordwall V. *Tre BAS-skalor Body Awareness Scale (BAS), BAS-hälsa, Intervjuskala för kroppsjaget (ISK)*. Lund: Studentlitteratur; 2008 [In Swedish].
79. Gyllensten AL, Ovesson MN, Hedlund L, Ambrus L, Tornberg Å. *To increase physical activity in sedentary patients with affective - or schizophrenia spectrum disorders - a clinical study of adjuvant physical therapy in mental health.* Nordic Journal of Psychiatry. 2019; 74(1): 73-82.
80. Schäfer S, Beckman V. *Stjärnor, linser och äpplen: att leva med autism*. Stockholm: Cura; 1996 [In Swedish].
81. Gerland G. *En riktig människa*. Lund: Cura/Studentlitteratur; 2010 [In Swedish].
82. Johansson I. *En annorlunda barndom: en kvinnas berättelse om sin autistiska uppväxt*. Stockholm: Forum; 2008 [In Swedish].
83. Jansson J. *Mitt liv med Asperger*. LL-förlaget; 2014 [In Swedish].
84. Törnvall C. *Autisterna: om kvinnorna på spektrat*. Stockholm: Natur & Kultur; 2021 [In Swedish].
85. Sossin KM. *A movement-informed mentalization lens applied to psychodynamic psychotherapy of children and adolescents with high functioning autism spectrum disorder.* Journal of Infant, Child & Adolescent Psychotherapy. 2015; 14(3): 294-310.
86. Classen CC, Hughes L, Clark C, et al. *A pilot RCT of a body-oriented group therapy for complex trauma survivors: an adaptation of sensorimotor psychotherapy.* Journal of Trauma & Dissociation. 2021; 22(1): 52-68.
87. Mattsson M, Wikman M, Dahlgren L, Mattsson B, Armelius K. *Body awareness therapy with sexually abused women: Part 1: Description of a treatment modality.* Journal of Bodywork & Movement Therapies. 1997; 1(5): 280-288.

88. Mattsson M, Wikman M, Dahlgren L, Mattsson B, Armelius K. *Body awareness therapy with sexually abused women. Part 2: Evaluation of body awareness in a group setting.* Journal of Bodywork & Movement Therapies. 1998; 2(1): 38-45.
89. Hedlund L, Gyllensten AL. *The experiences of basic body awareness therapy in patients with schizophrenia.* Journal of Bodywork & Movement Therapies. 2010; 14(3): 245-254.
90. Seferiadis A, Ohlin P, Billhult A, Gunnarsson RK. *Basic body awareness therapy or exercise therapy for the treatment of chronic whiplash associated disorders: a randomized comparative clinical trial.* Disability and Rehabilitation. 2016; 38(5): 442–451.
91. Bravo C, Skjaerven LH, Espart A, Guitard Sein-Echaluce L, Catalan-Matamoros D. *Basic Body Awareness Therapy in patients suffering from fibromyalgia: A randomized clinical trial.* Physiotherapy Theory and Practice. 2019; 35(10): 919-929.
92. Catalan-Matamoros D, Skjaerven LH, Labajos-Manzanares MT, Martínez-de-Salazar-Arboleas A, Sánchez-Guerrero E. *A pilot study on the effect of Basic Body Awareness Therapy in patients with eating disorders: a randomized controlled trial.* Clinical Rehabilitation. 2011; 25(7): 617-626.
93. Vancampfort D, Brunner E, Van Damme T, Stubbs B. *Efficacy of basic body awareness therapy on functional outcomes: A systematic review and meta-analysis of randomized controlled trials.* Physiotherapy Research International. 2023; 28(1): 1-12.
94. Sutera S, Pandey J, Esser EL, et al. *Predictors of optimal outcome in toddlers diagnosed with autism spectrum disorders.* Journal of Autism and Developmental Disorders. 2007; 37(1): 98-107.
95. Torres EB, Donnellan AM, *Autism: the movement perspective*. USA: Frontiers in Integrative Neuroscience; 2015.
96. Fournier KA, Hass CJ, Naik SK, Lodha N, Cauraugh JH. *Motor coordination in autism spectrum disorders: a synthesis and meta-analysis.* Journal of Autism and Developmental Disorders. 2010; 40(10): 1227-1240.
97. Gandotra A, Kotyuk E, Szekely A, et al. *Fundamental movement skills in children with autism spectrum disorder: A systematic review.* Research in Autism Spectrum Disorders. 2020; 78(2020): 101632.
98. Eigsti I-M, Rosset D, Col Cozzari G, Fonseca D, Deruelle C. *Effects of motor action on affective preferences in autism spectrum disorders: different influences of embodiment.* Developmental Science. 2015; 18(6): 1044-1053.
99. Björne P, Johansson B, Balkenius C. *Effects of early sensorimotor disorder on contextual learning in autism.* European Review of Applied Psychology. 2006; 56(4): 247-252.
100. Bertilsson I, Gyllensten AL, Opheim A, Gard G, Sjödahl Hammarlund C. *Understanding one´s body and movements from the perspective of young*

adults with autism: a mixed-methods study. Research in Developmental Disabilities. 2018; 78(2018): 44-54.
101. Shaw JA, Connelly DM, Zecevic AA. *Pragmatism in practice: Mixed methods research for physiotherapy.* Physiotherapy Theory and Practice. 2010; 26(8): 510-518.
102. Deal R, Woods B, *The Bears*. Victoria, Australia: St Luke´s Innovative resources; 2010.
103. Bruininks RH, Bruininks BD. *Bruininks-Oseretsky Test of Motor Proficiency, second edition (BOT-2)*. San Antonio: Pearson Assessments; 2005.
104. Sundén A, Ekdahl C, Horstmann V, Gyllensten AL. *Analyzing movements development and evaluation of the Body Awareness Scale Movement Quality (BAS MQ).* Physiotherapy Research International. 2014; 21(2016): 70-76.
105. Onwuegbuzie AJ, Teddlie C. *A framework for analyzing data in mixed methods research*, in *Handbook of mixed methods in social and behavioral research*. Thousand Oaks: Sage Publications: Tashakkori. A & Teddlie, C: p. 397-430; 2003.
106. Elo S, Kyngäs H. *The qualitative content analysis process.* Journal of Advanced Nursing. 2008; 62(1): 107-115.
107. IBM Corp. *IBM SPSS Statistics for Windows, Version 25.0*. Released 2017; Available from: https://www.ibm.com/products/spss-statistics.
108. Bertilsson I, Gard G, Sjödahl Hammarlund C. *Physiotherapists' experiences of the meaning of movement quality in autism: A descriptive phenomenological study.* Physiotherapy Theory and Practice. 2020; 38(2): 299-308.
109. Giorgi A, Giorgi B. *The descriptive phenomenological psychological method*, in *Qualitative research in psychology:Expanding perspectives in methodology and design*. Washington DC, USA: American Psychological Association: p. 243-273; 2003.
110. Englander M. *The interview: data collection in descriptive phenomenological human scientific research.* Journal of Phenomenological Psychology. 2012; 43(2012): 13-35.
111. Broomé RE, *Descriptive phenomenological psychological method: an example of a methodology section from doctoral dissertation*. San Fransisco: Saybrook University; 2011.
112. WHO. *International Classification of Functioning, Disability and Health for Children and Youth (ICF–CY)*, ed. WHO. Geneva: World Health Organization; 2007.
113. Bertilsson I, Melin J, Brogårdh C, et al. *Measurement properties of the Body Awareness Scale Movement Quality (BAS MQ) in persons on the autism spectrum: a preliminary Rasch analysis.* Journal of Bodyworks & Movement Therapies. 2024; 38(2024): 464-473.
114. Linacre JM. *Comparing and choosing between "Partial credit models" (PCM) and "Rating scale models" (RSM)*. Rasch Measurement

Transactions, 2000. 14(3), 768. Available from: https://www.rasch.org/rmt/rmt143k.htm.
115. Bond TG, Fox CM. *Applying the Rasch model. Fundamental measurement in the human sciences. Third ed*. New York: Routledge, Taylor & Francis; 2015.
116. Fisher WP. *Rating scale instrument quality criteria*. Rasch Measurements Transactions, 2007. 21(1), 1095. Available from: https://www.rasch.org/rmt/rmt211m.htm.
117. Linacre JM. *Understanding Rasch Measurement: Optimizing rating scale category effectiveness.* Journal of Applied Measurement. 2002; 3(1): 85-106.
118. Boone WJ, Staver JR. *Disattenuated correlation*, in *Advances in Rasch analyses in the human sciences*, Boone WJ and Staver JR, Editors. New York, USA: Springer; 2020.
119. Linacre JM. *What do infit and outfit, mean-square and standardized mean?* Rasch Measurement Transactions, 2002. 16(2), 878. Available from: https://www.rasch.org/rmt/rmt162f.htm.
120. Baghaei P. *Local dependency and Rasch measures*. Rasch Measurement Transactions, 2007. 21(3), 1105-1106. Available from: https://www.rasch.org/rmt/rmt213b.htm.
121. Christensen KB, Makransky G, Horton M. *Critical values for Yen's Q(3): identification of local dependence in the Rasch model using residual correlations.* Applied Psychological Measurement. 2017; 41(3): 178-194.
122. Linacre JM. *What Use Are Rasch Measures?* Rasch Measurement Transactions, 2007. 21(2), 1104. Available from: https://www.rasch.org/rmt/rmt212g.htm.
123. Hagquist C, Andrich D. *Recent advances in analysis of differential item functioning in health research using the Rasch model.* Health & Quality of Life Outcomes. 2017; 15(2017): 1-8.
124. Kelley T, Ebel R, Linacre JM. *Item Discrimination Indices*. Rasch Measurement Transactions, 2002. 16(3), 883-884. Available from: https://www.rasch.org/rmt/rmt163a.htm.
125. IBM Corp. *IBM SPSS Statistics for Windows, Version 27.0*. Released 2020; Available from: https://www.ibm.com/products/spss-statistics.
126. Winsteps. *Rasch Analysis and Rasch Measurement software. Winsteps*. 2020; Available from: https://www.winsteps.com/winsteps.htm.
127. Bertilsson I, Brogårdh C, Opheim A, et al. *Effects of Basic Body Awareness Therapy for young adults on the autism spectrum: a superiority pragmatic randomized controlled trial.* In manuscript.
128. IBM Corp. *IBM SPSS Statistics for Windows, Version 29.0*. Released 2023; Available from: https://www.ibm.com/products/spss-statistics.
129. Ekstrand J, Westergren A, Årestedt K, Hellström A, Hagell P. *Transformation of Rasch model logits for enhanced interpretability.* BMC Medical Research Methodology. 2022; 22(1): 1-10.

130. Hobart JC, Cano SJ, Thompson AJ. *Effect sizes can be misleading: is it time to change the way we measure change?* Journal of Neurology, Neurosurgery & Psychiatry. 2010; 81(9): 1044-1048.
131. Zampella CJ, Wang LAL, Haley M, Hutchinson AG, de Marchena A. *Motor skill differences in autism spectrum disorder: a clinically focused review.* Current Psychiatry Reports. 2021; 23(10): 1-11.
132. Purcell C, Scott-Roberts S, Kirby A. *Implications of DSM-5 for recognising adults with developmental coordination disorder (DCD).* British Journal of Occupational Therapy. 2015; 78(5): 295-302.
133. Eigsti I-M. *A review of embodiment in autism spectrum disorders.* Frontiers in Psychology. 2013; 4(224): 1-10.
134. Ketcheson L, Hauck J, Ulrich D. *The effects of an early motor skill intervention on motor skills, levels of physical activity, and socialization in young children with autism spectrum disorder: A pilot study.* Autism: The International Journal of Research and Practice. 2017; 21(4): 481-492.
135. Hadders-Algra M. *Early diagnostics and early intervention in neurodevelopmental disorders - age-dependent challenges and opportunities.* Journal of Clinical Medicine. 2021; 10(4): 1-23.
136. Grzadzinski R, Amso D, Landa R, et al. *Pre-symptomatic intervention for autism spectrum disorder (ASD): defining a research agenda.* Journal of Neurodevelopmental Disorders. 2021; 13(1): 1-24.
137. Harris SR. *Early motor delays as diagnostic clues in autism spectrum disorder.* European Journal of Pediatrics. 2017; 176(9): 1259-1262.
138. Phagava H, Muratori F, Einspieler C, et al. *General movements in infants with autism spectrum disorders.* Georgian medical news. 2008; 3(156): 100-105.
139. Porges SW. *The polyvagal theory. Neurophysiological foundations of emotions, attachment, communication and self-regulation*. New York: W.W. Norton & Company; 2011.
140. Biddell H, Solms M, Slagter H, Laukkonen R. *Arousal coherence, uncertainty, and well-being: an active inference account.* Neuroscience of Consciousness. 2024; 2024(1): 1-12.
141. Ogden P. *The different impact of trauma and relational stress on physiology, posture, and movement: Implications for treatment.* European Journal of Trauma & Dissociation. 2021; 5(4): 1-10.
142. Streeck-Fischer A, van der Kolk BA. *Down will come baby, cradle and all: diagnostic and therapeutic implications of chronic trauma on child development.* Australian & New Zealand Journal of Psychiatry. 2000; 34(6): 903-918.
143. Allely CS. *Pain sensitivity and observer perception of pain in individuals with autistic spectrum disorder.* Scientific World Journal. 2013; 2013: 1-20.
144. Grant S, Norton S, Hoekstra RA, et al. *Autism and chronic ill health: an observational study of symptoms and diagnoses of central sensitivity syndromes in autistic adults.* Molecular Autism. 2022; 13(1): 1-17.

145. Failla MD, Moana-Filho EJ, Essick GK, et al. *Initially intact neural responses to pain in autism are diminished during sustained pain.* Autism. 2017; 22(6): 669-683.
146. Hedlund L, Gyllensten AL, Waldegren T, Hansson L. *Assessing movement quality in persons with severe mental illness - Reliability and validity of the Body Awareness Scale Movement Quality and Experience.* Physiotherapy Theory and Practice. 2016; 32(4): 296-306.
147. Skjaerven LH, Mattsson M, Catalan-Matamoros D, et al. *Consensus on core phenomena and statements describing Basic Body Awareness Therapy within the movement awareness domain in physiotherapy.* Physiotherapy Theory and Practice. 2019; 35(1): 80-93.
148. Anderson JS, Druzgal TJ, Froehlich A, et al. *Decreased interhemispheric functional connectivity in autism.* Cerebral Cortex. 2011; 21(5): 1134-1146.
149. Geng X, Fan X, Zhong Y, et al. *Abnormalities of EEG functional connectivity and effective connectivity in children with autism spectrum disorder.* Brain Sciences. 2023; 13(1): 1-12.
150. Floris DL, Barber AD, Nebel MB, et al. *Atypical lateralization of motor circuit functional connectivity in children with autism is associated with motor deficits.* Molecular Autism. 2016; 7(1): 35-49.
151. Li Q, Zhao W, Palaniyappan L, Guo S. *Atypical hemispheric lateralization of brain function and structure in autism: a comprehensive meta-analysis study.* Psychological Medicine. 2023; 17(2023): 6701-6713.
152. Fredrickson BL, Branigan C. *Positive emotions broaden the scope of attention and thought-action repertoires.* Cognition and Emotion. 2005; 19(3): 313-332.
153. Zhang J, Zhou R, Oei TPS. *The effects of valence and arousal on hemispheric asymmetry of emotion.* Journal of Psychophysiology. 2011; 25(2): 95-103.
154. Zhang J, Hommel B. *Body ownership and response to threat.* Psychological Research. 2015; 80(2016): 1020-1029.
155. Wijnhoven L, Creemers DHM, Vermulst AA, Granic I. *Prevalence and risk factors of anxiety in a clinical dutch sample of children with an autism spectrum disorder.* Frontiers in Psychiatry. 2018; 9(2018): 1-10.
156. White SW, Oswald D, Ollendick T, Scahill L. *Anxiety in children and adolescents with autism spectrum disorders.* Clinical Psychology Review. 2009; 29(3): 216-229.
157. Booth RDL, Happé FGE. *Evidence of reduced global processing in autism spectrum disorder.* Journal of Autism and Developmental Disorders. 2018; 48(4): 1397-1408.
158. Frith U, Happé F. *Autism: beyond "theory of mind".* Cognition. 1994; 50: 115-132.
159. Bäckström A, Johansson A-M, Rudolfsson T, et al. *Motor planning and movement execution during goal-directed sequential manual movements*

in 6-year-old children with autism spectrum disorder: A kinematic analysis. Research in Developmental Disabilities. 2021; 115(2021): 1-14.
160. Miller HL, Templin TN, Fears NE, et al. *Movement smoothness during dynamic postural control to a static target differs between autistic and neurotypical children.* Gait & Posture. 2023; 99(2023): 76-82.
161. Cook JL, Blakemore SJ, Press C. *Atypical basic movement kinematics in autism spectrum conditions.* Brain. 2013; 136(9): 2816-2824.
162. Happé F, Frith U. *Annual research review: Towards a developmental neuroscience of atypical social cognition.* Journal of Child Psychology and Psychiatry. 2014; 55(6): 553-577.
163. Pelphrey K, Sasson N, Reznick J, et al. *Visual scanning of faces in autism.* Journal of Autism and Developmental Disorders. 2002; 32: 249-261.
164. Kylliäinen A, Hietanen JK. *Skin conductance responses to another person's gaze in children with autism.* Journal of Autism and Developmental Disorders. 2006; 36(4): 517-525.
165. Nyboe L, Bentholm A, Gyllensten AL. *Bodily symptoms in patients with post traumatic stress disorder: A comparative study of traumatized refugees, Danish war veterans, and healthy controls.* Journal of Bodywork & Movement Therapies. 2017; 21(3): 523-527.
166. Foster NC, Bennett SJ, Causer J, et al. *Facilitating sensorimotor integration via blocked practice underpins imitation learning of atypical biological kinematics in autism spectrum disorder.* Autism. 2020; 24(6): 1494-1505.
167. Heathers JAJ, Gilchrist KH, Hegarty-Craver M, Grego S, Goodwin MS. *An analysis of stereotypical motor movements and cardiovascular coupling in individuals on the autism spectrum.* Biological Psychology. 2019; 142(2019): 90-99.
168. Hardy MW, Lagasse AB. *Rhythm, movement, and autism: using rhythmic rehabilitation research as a model for autism.* Frontiers in Integrative Neuroscience. 2013; 7(19): 1-9.
169. Leech KA, Roemmich RT, Gordon J, Reisman DS, Cherry-Allen KM. *Updates in motor learning: Implications for physical therapist practice and education.* Physical Therapy. 2022; 102(1): 1-9.
170. Gowen E, Earley L, Waheed A, Poliakoff E. *From "one big clumsy mess" to "a fundamental part of my character." Autistic adults' experiences of motor coordination.* PLoS One. 2023; 18(6): 1-26.
171. Lester JN, Karim K, O'Reilly M. *'Autism itself actually isn't a disability': Negotiating a 'normal' versus 'abnormal' autistic identity.* Communication & Medicine. 2014; 11(2): 139-152.
172. Kahle S, Miller JG, Helm JL, Hastings PD. *Linking autonomic physiology and emotion regulation in preschoolers: The role of reactivity and recovery.* Developmental Psychobiology. 2018; 60(7): 775-788.
173. Mathias B, von Kriegstein K. *Enriched learning: behavior, brain, and computation.* Trends in Cognitive Sciences. 2023; 27(1): 81-97.

174. Bhat AN, Landa RJ, Galloway JC. *Current perspectives on motor functioning in infants, children, and adults with autism spectrum disorder.* Physical Therapy. 2011; 91(7): 1116-1129.
175. Mazzola V, Vuilleumier P, Latorre V, et al. *Effects of emotional contexts on cerebello-thalamo-cortical activity during action observation.* PloS one. 2013; 8(9): 1-9.
176. Yerkes RM, Dodson JD. *The relation of strength of stimulus to rapidity of habit-formation.* Journal of Comparative Neurology and Psychology. 1908; 18(5): 459-482.
177. Danielsson L, Hansson Scherman M, Rosberg S. *To sense and make sense of anxiety: Physiotherapists' perceptions of their treatment for patients with generalized anxiety.* Physiotherapy Theory and Practice. 2013; 29(8): 604-615.
178. Shen H, Du X, Fan Y, Dai J, Wei G-X. *Interoceptive sensibility mediates anxiety changes induced by mindfulness-based Tai Chi Chuan movement intervention.* Mindfulness. 2023; 14(7): 1662-1673.
179. Kaplan S. *Meditation, restoration, and the management of mental fatigue.* Environment & Behavior. 2001; 33(4): 480-506.
180. Chen Z, Wang X, Zhang S, Han F. *Neuroplasticity of children in autism spectrum disorder.* Frontiers in Psychiatry. 2024; 15(2024): 1-12.
181. Just MA, Cherkassky VL, Keller TA, Kana RK, Minshew NJ. *Functional and anatomical cortical underconnectivity in autism: evidence from an fMRI study of an executive function task and corpus callosum morphometry.* Cerebral Cortex. 2007; 17(4): 951-961.
182. Calderoni S, Billeci L, Narzisi A, et al. *Rehabilitative interventions and brain plasticity in autism spectrum disorders: Focus on MRI-based studies.* Frontiers in Neuroscience. 2016; 10(2016): 1-7.
183. Datko M, Pineda JA, Müller RA. *Positive effects of neurofeedback on autism symptoms correlate with brain activation during imitation and observation.* European Journal of Neuroscience. 2018; 47(6): 1-13.
184. Shafer R, Newell K, Lewis M, Bodfish J. *A cohesive framework for motor stereotypy in typical and atypical development: the role of sensorimotor integration.* Frontiers in Integrative Neuroscience. 2017; 11(2017): 1-8.
185. Proske U, Gandevia SC. *The kinaesthetic senses.* The Journal of Physiology. 2009; 587(17): 4139-4146.
186. Möller S, Ramstrand N, Hagberg K, Rusaw D. *Cortical brain activity in transfemoral or knee-disarticulation prosthesis users performing single- and dual-task walking activities.* Journal of Rehabilitation and Assistive Technologies Engineering. 2020; 7(2020): 1-8.
187. O´Cathain A, Murphy E, Nicholl J. *Integration and publications as indicators of "yield" from mixed methods studies.* Journal of Mixed Methods Research. 2007; 1(2): 147-163.
188. Alfasoft. *NVivo unlocks the insights in your data*. 2024; Available from: https://alfasoft.com/uk/software/statistics-and-data-analysis/qda-qualitative-data-analysis/nvivo/.

189. Lindseth A, Norberg A. *Elucidating the meaning of life world phenomena: A phenomenological hermeneutical method for researching lived experience.* Scandinavian Journal of Caring Sciences. 2022; 36(3): 883-890.
190. Graneheim UH, Lundman B. *Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness.* Nurse Education Today. 2004; 24(2): 105-112.
191. Thorpe KE, Zwarenstein M, Oxman AD, et al. *A pragmatic–explanatory continuum indicator summary (PRECIS): a tool to help trial designers.* Journal of Clinical Epidemiology. 2009; 62(5): 464-475.
192. Treweek S, Zwarenstein M. *Making trials matter: pragmatic and explanatory trials and the problem of applicability.* Trials. 2009; 10(37): 1-9.
193. Zwarenstein M, Treweek S, Gagnier JJ, et al. *Improving the reporting of pragmatic trials: an extension of the CONSORT statement.* BMJ. 2008; 337(a2390): 1-8.
194. Long KM, McDermott F, Meadows GN. *Being pragmatic about healthcare complexity: our experiences applying complexity theory and pragmatism to health services research.* BMC Medicine. 2018; 16(1): 94.
195. Gillberg C. *The ESSENCE in child psychiatry: Early Symptomatic Syndromes Eliciting Neurodevelopmental Clinical Examinations.* Research in Developmental Disabilities. 2010; 31(6): 1543-1551.
196. Donnellan A, Hill D, Leary M. *Rethinking autism: implications of sensory and movement differences for understanding and support.* Frontiers in Integrative Neuroscience. 2013; 6(124): 1-11.
197. Calvert M, Kyte D, Mercieca-Bebber R, et al. *Guidelines for Inclusion of patient-reported outcomes in clinical trial protocols: The SPIRIT-PRO extension.* JAMA. 2018; 319(5): 483-494.
198. Gries K, Berry P, Harrington M, et al. *Literature review to assemble the evidence for response scales used in patient-reported outcome measures.* Journal of Patient-Reported Outcomes. 2018; 2(1): 1-14.
199. Fayers P, Mache MA. *Quality of Life. The assessment, analysis and reporting of patient-reported outcomes*. Third ed. Hobroken, USA: Wiley Blackwell; 2016.
200. Song J, Howe E, Oltmanns JR, Fisher AJ. *Examining the concurrent and predictive validity of single items in ecological momentary assessments.* Assessment. 2023; 30(5): 1662 –1671.
201. Farrar JT, Young JPJ, LaMoreaux L, Werth JL, Poole MR. *Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale.* PAIN. 2001; 94(2): 149-158.
202. Hjermstad MJ, Fayers PM, Haugen DF, et al. *Studies comparing numerical rating scales, verbal rating scales, and visual analogue scales for assessment of pain intensity in adults: A systematic literature review.* Journal of Pain and Symptom Management. 2011; 41(6): 1073-1093.

203. von Baeyer CL, Spagrud LJ, McCormick JC, et al. *Three new datasets supporting use of the numerical rating scale (NRS-11) for children´s self-reports of pain intensity.* PAIN. 2009; 143(3): 223-227.
204. Walton MK, Powers JH, Hobart J, et al. *Clinical outcome assessments: conceptual foundation - report of the ISPOR clinical outcomes assessment - emerging good practices for outcomes research task force.* Value in Health. 2015; 18(6): 741-752.
205. Cuneo N, Floyd S, Goldberg AE. *Word meaning is complex: Language-related generalization differences in autistic adults.* Cognition. 2024; 244(2024): 1-8.

Movement quality and body awareness in autism

INGRID BERTILSSON

This thesis contributes to new knowledge regarding the experiences of movement quality, measurement properties of a movement quality and body awareness assessment scale, and the effects of an intervention to improve movement quality and body awareness, in autistic persons.

The results found that autistic persons experience problems with their body and movements, making it hard to understand oneself. The problems could be observed and described by physiotherapists, who confirmed them as often unrecognized. For the first time in autistic persons, the Body Awareness Scale Movement Quality was investigated, and found to be valid and able to discriminate between different degrees of movement quality. Basic Body Awareness Therapy brought significant effects on improving movement quality and body awareness, not previously studied in autistic persons. Supporting the person to an increased understanding of her/himself by such an intervention, may enhance the bodily self-awareness and make the individual better equipped to express and handle experienced everyday needs.

For the future, autistic persons would benefit from recognition of body and movements problems, to relevantly act on them. This may be considered from an early age, to improve the possibilities for better health throughout life. Guiding the person to understandable impressions from one's body and movements may create meaning, sense-making and an understanding of oneself from within - as an embodied identity.

Printed by Media-Tryck, Lund 2024 NORDIC SWAN ECOLABEL 3041 0903

LUND UNIVERSITY

FACULTY OF MEDICINE

Department of Health Sciences
Rehabilitation and Sustainable Health

Lund University, Faculty of Medicine
Doctoral Dissertation Series 2024:117
ISBN 978-91-8021-613-5
ISSN 1652-8220