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Article

Gravity's Influence on Human Motivation

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Abstract: Earth's mass generates a definitive Earth-vertical reference, shaping life's evolution. Notably, these gravity models influence self-perception and the first-person viewpoint in the CNS, tied to bodily self-awareness and spatial orientation. Transitioning from Earth's constant gravity to microgravity potentially disrupts the CNS's gravity-representation models, formed since birth. Our study explored if altered gravity triggers emotional and motivational responses in rapid CNS adaptations. A psychological parallel between Earth's gravity and attachment systems in infants and adults is proposed. We measured implicit motives through vocal interactions during demanding tasks, finding that disrupted gravity impacts the implicit affiliation motive, i.e., the subconscious need to restore bonding as soon as there are signals that this attachment or "gravitational" field is disrupted. As expected, this implicit need for attachment was significantly higher in the groups which experienced disrupted gravity. Causation remains unverifiable due to exploratory design.

Keywords: implicit motives; attachment theory; altered gravity; microgravity

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1. Introduction

The gravitational field generated by Earth's mass represents an absolute reference of Earth-vertical direction [1], modelling evolution and the architecture of life on Earth [2,3]. The fundamental reference frame of gravity determines body orientation and movements [2], controls posture [3], and maintains a dynamic body equilibrium through vestibular information [4], which controls the head position in relation to the trunk [3,4]. In parallel with motor regulation, gravity affects cognitive functions related to spatial orientation [3] and behaviour control strategies, such as the balance between exploitation and exploration [5]. Though it is well known that long-duration spaceflight represents an outstanding emotional challenge [6], there is initial evidence that even short periods of weightlessness are capable of inducing physiologically detectable emotional reactions [7,8].

The CNS uses complex and well-regulated internal representational models of gravity [1,9], motion, and body orientation [1,10]. Interestingly, models of gravity represented in the CNS also determine the perception of self [1,11], the subjective first-person perspective [1]. The first-person perspective is closely connected with bodily self-consciousness, the sense of being a subject in a specific body (self-identification) at a given spatial location (self-location) [1,12], which depends on the integration of multisensory signals [13]. In this context, out-of-body experiences (OBE) in neurological patients demonstrated comparable body position illusions as those that occurred in microgravity [1,11,14].

While the physiological effects of microgravity and spaceflight have received a lot of attention, the influence on the human CNS [8] and perceptual functions remains to be determined [15]. Previous studies have reported psychological, neurovestibular, and cognitive alterations [8] as well as adaptation of neuromuscular regulation [16], and of the visual, vestibular, and proprioceptive systems [17]. It can be expected that transition from the constant gravity of Earth into microgravity disrupts internal gravity-representation models of the CNS that have been developed since birth [18]. During birth, the newborn is experiencing a rapid transition from the intrauterine conditions, where many of the physical effects of gravity are attenuated, to the ambient 1 g environment, characterized by a multitude of new sensory stimuli ("sensory attack", [19]), which consequently induces dramatic adaptive responses [19]. While gravity has instructive roles in early development, the immature sensory and motor systems mature after birth [3,20] under the influence of gravity and complex internal representation models of gravity in the CNS [1,9] are formed. During a parabolic flight maneuver, the "sensory attack" [19] during birth is rapidly reversed in form of a reduced gravity-dependent sensory input. Rapid onset of microgravity could probably disturb hippocampal representation models of gravity and therefore induce new learning mechanisms and emotional reactions.

To our knowledge, the deep level emotional and motivational effects of low or zero gravity have not been subjected to systematic and theory-driven investigation. Thus, we investigated if short term periods of altered gravity are capable of inducing emotional and motivational reactions as part of rapid adaptations responses in the CNS. In case that identified short-time effects represent a beneficial aspect for crew performance during long-term space missions, parabolic flights could be considered not only as a training platform for motor skills in microgravity, but also for psychological conditioning or astronaut selection.

We suppose that the gravitational field generated by Earth's mass has a psychological analogy in the attachment (security) system operating in infants and adults. From early childhood on, humans therefore have a life-long strong implicit motive (as described with the affiliation motive) to restore bonding as soon there are signals that this attachment or "gravitational" field is disrupted. Thus, it can be expected that a disrupted, gravitational field yields similar motivational reactions as a disrupted attachment. According to McClelland's motive theory [21], this emotional reaction can be operationalized as affiliation motive. The function of the affiliation motive is to regulate the distance to important others, e.g., the primary caregiver. Because this need for contact develops very early in life, before elaborate language emerges, it can therefore be measured only indirectly by samples of operant writing or speaking.

One established method for this is the Operant Motive Test (OMT) for the three implicit motives: affiliation, power and achievement (see "implicit motives" in "Material and Methods"). The OMT has been validated in a wide range of contexts, including cross-cultural development [. The affiliation motive gets stronger the more people experienced loss of contact in early childhood or later in life. It is associated with activation of thoughts and feelings about reunion and behavioral attempts to restore proximity to significant others. These thoughts, feelings, and behavioral patterns seem to be consistent cross-culturally and thus reflect instinctive human universalities.

Because implicit and explicit motives differ, this motivational reaction to disrupted gravity is supposed not to be measured by self-report. This leads us to the following hypotheses: (I.) Groups that experience a disrupted gravitational field will develop a significantly higher implicit affiliation motive, which can be measured indirectly by content analysis of verbal interactions when compared to similar groups in comparable situations that have not experienced a disrupted gravitational field. (II.) This difference in achievement and power motive, as well as a self-report of the affiliation motive, is not significant. We tested this question on the 3rd Swiss Parabolic Flight Campaign, conducted with the Airbus A310 ZERO-G (Novespace) from the military airbase Dübendorf, Switzerland.

2. Materials and Methods

Study concept and structure: Motives are measured either by questionnaires, i.e., instructed self-reports, or by content analysis, i.e., indirect indications in running text. Instructed self-reports tap self-attributed motives reflecting what individuals think their motives would be. Indirect indications in written text, in contrast, tap implicit motives [22].

Implicit motives reflect recurrent concerns that individuals are not necessarily aware of [21] and that are more predictive than self-attributed motives for "real world" outcomes even over long periods of time when activity incentives are present [23]. Since our experiment is based on the attachment theory and therefore explicitly concerned with the affiliation motive, we will describe the explicit and implicit testing procedures for this particular motive in greater detail. The affiliation motive is concerned with the development, maintenance, or re-establishment of closeness, personal encounter, and friendly relationships with other people. It is linked to the affect dimensions of safety and is associated with the natural stimulus of contact [24,25]. When such motivation is stimulated by a suitable person-environment-transaction, the participant becomes aware of it in the form of mental representations. Because our hypothesis postulates effects of weightlessness on the implicit but not the explicit (i.e., conscious) affiliation motive—due to the deep, yet subtle nature of disturbance of the attachment system—we measured both motive facets.

Explicit questionnaires: We extensively measured explicit affiliation of the participants before and after the parabolic flight through a series of explicit questionnaires (instructed self-report). The following six well established scales were used in order to obtain a better understanding of the explicit cognitive, behavioural, and affective alignment of all team members that are associated with attachment theory:

- group trust [26], i.e., "I can rely on my team members to keep their word."
- group cohesion [27], i.e., "How much do you feel like your team has group spirit?"
- team efficacy [28], i.e., "With focus and effort, my team can do anything we set out to accomplish."
- team potency [29], i.e., "My team feels it can solve any problem it encounters."
- group commitment adapted to teams from [30], for example "I am willing to contribute more than necessary to the success of the team."
- Satisfaction with the group [31], e.g., "I am very happy that I am a member of this team."

Implicit motives: In parallel to these explicit questionnaires, we indirectly measured the implicit motives by coding the vocal interactions of the team's participants while working on a demanding, simulated group task for around 45 min (taking place one hour after the parabolic flight). The vocal interactions were digitalised and then coded automatically according to an algorithm developed from the Operant Motive Test for the three implicit motives (affiliation, power, and achievement) [32,33]. For the operationalisation of the implicit motives, an algorithm was applied to the transcripted voice that was trained according to the Operant Motive Test (OMT) [33–37]. The coding-algorithm was derived from expert codings of the Operant Motive Test (OMT) [35]. The OMT has been validated in a wide range of contexts including cross-cultural development [38,39], eating behaviour [40], stress [41], flow [42,43], and well-being [44–46]. The OMT can be coded automatically by algorithms derived from machine learning in any situation where texts can be digitalised [32].

In summary, the affiliation motive is present when participants spontaneously focus their interpretations on the establishment, maintenance, or re-establishment of a relationship. Positive, friendly, or personal feelings are frequently expressed, but also negative feelings on being left alone and lonely or the end of a friendly relationship may be expressed. Frequently, the intention to re-establish broken relationships is evident. Sometimes, warm or even passionate behaviour is described in the motivation to establish social contact. We measured the three implicit motives and no motive (zero category) by algorithms derived from natural language processing machine learning validated by expert codings [32].

Procedure: A situation for text sampling was created for seven work teams, which were made up of four to six members. Each team was given the same task, to conceptualize an optimized solution of a logistic problem. Each team member had different information about the problem; therefore, it was possible to share this information or to compete with the other members. Group 1 and 2 performed the task about one hour after the parabolic flight (N = 5 resp. N = 6); thus only these 11 participants experienced weightlessness one hour before starting the task. The task was administered in a room at the airport where the parabolic flight started and landed. Group 3 (N = 5) performed the task in the same room of the airport, being exposed to the same arousal and environmental factors as the two flying groups but without having experienced the parabolic flight. The reason for this specific group is to control for arousal and affective influences induced by the setting, the environment, and group effects that originate from being around astronauts, excited passengers, wearing a space suit, or the moment of a benediction ceremony of the A310 Airbus by a Catholic priest underneath the airplane in the presence of passengers, crew, and volunteers. Group 4–7 worked in comparable rooms in the University Campus of the NORDAKADEMIE.

Parabolic flight: The study was conducted with volunteers from the discovery flight of the 3rd Swiss Parabolic Flight Campaign (organized by the Swiss SkyLab Foundation) from the military airbase Dübendorf, Switzerland. During a parabolic maneuver, an aircraft is weightless by flying on a Keplerian trajectory, described as an unpropelled body in ideally frictionless space subjected to a centrally symmetric gravitational field [47]. During this free-fall trajectory, the effect of all forces acting on the aircraft other than gravity is nulled. The scientific community in Europe shares only one larger aircraft that is licensed for parabolic maneuvers, currently an Airbus A310 (F-WNOV, MSN 498) built in 1989 and operated out of the Bordeaux-Mérignac airport (France) by the company Novespace, with maneuvers providing 20 s of microgravity during each flight. The parabolic flight of the Airbus A310 was conducted as a sequence of 15 consecutive gravity conditions including 1 g, 1.8 g, and microgravity (μg) with a quality of 1×10^{-2} to 1×10^{-3} g for 22 s during each parabola.

Calculation and Data Collection: Data were collected by voice recording through clip-on microphones for each individual team member. Recording variability can be influenced by a couple of decisive facts: First, individual differences in speaking habits, such as speaking volume, pace, and clarity, can impact the quality of the recordings. Second, environmental factors, including ambient noise and room acoustics, may introduce variability. Third, participants' comfort and familiarity with the microphone could affect their speech patterns and consequently the quality of the recorded data. To address these concerns, we took several measures. Participants received brief training on microphone usage (including test recordings) to minimize variations due to handling. We also conducted the recording sessions in a controlled and quiet environment (separate room per team) to reduce external noise interference. Moreover, we encouraged participants to speak naturally to mitigate any self-consciousness or artificiality in their speech.

In terms of gender, equal distribution of gender in teams was catered for. No team member knew the task beforehand. Each team was given instructions on what to do and obtained information about the logistic problem. The recordings of each team member were transcribed by the software Amber Script. The software transcription was not edited or corrected afterwards to avoid biases in the data. After transcription, an independent IT-expert blind to the hypothesis coded the text of all groups automatically by the algorithms described above. A sum for the affiliation, power, and achievement motive was calculated, divided by the number of words, and then standardized by a norm sample. In this norm, 100 is the mean and 15 is one standard deviation. The algorithm used for automatic coding can be obtained by any researcher contacting the authors. At present, it is available in German and English.

3. Results

3.1. Higher Affiliation Motive after Altered Gravity Exposure Compared to Ground

Figure 1 shows the results crucial for the verification of our hypothesis. We used SPSS25 to compute means and the 95% confidence interval in form of box plots, which are a simple way of representing statistical data on a plot in which a rectangle is drawn to represent the second and third quartiles, usually with a vertical line inside to indicate the median value. The lower and upper quartiles are shown as horizontal lines on either side of the rectangle. We also conducted a one-way ANOVA to test for statistical significance of mean differences between the groups, because coding of text can be interpreted as interval data. As expected, the medians of the affiliation motive are highest in the two groups (1 and 2) that had previously experienced weightlessness in the parabolic flight. A median test (Kruskal–Wallis Test for differences in the medians, N = 32, df = 6) is highly significant (asymptotic significance $p = 0.001$). The only group that almost reaches the median of group 1 and 2 was group 3; this group also met at the airport. The other group medians are far below those of group 1 and 2.

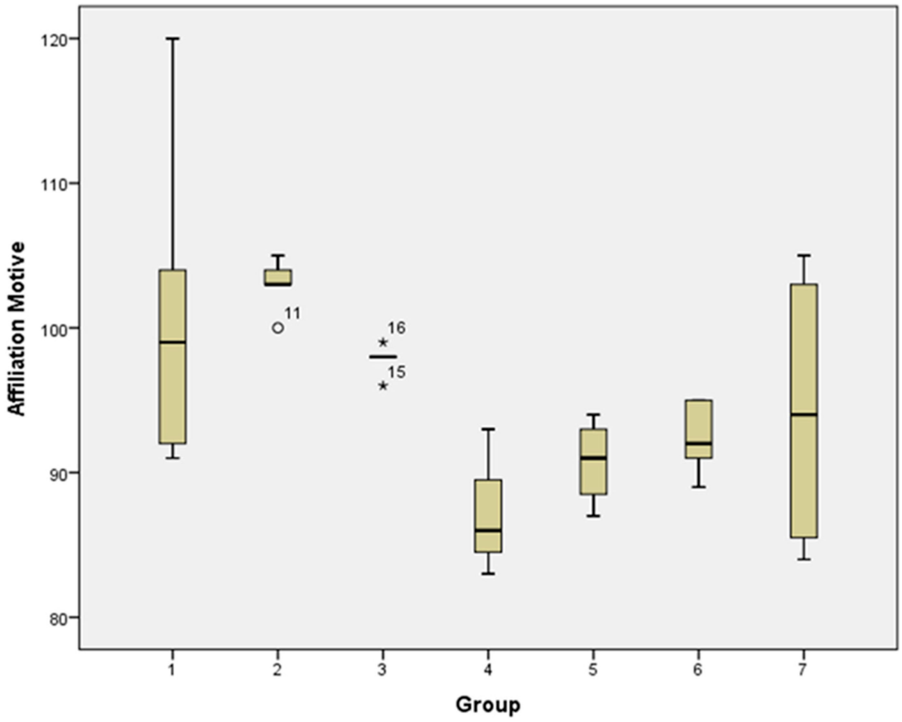

Figure 1. Box plots for the affiliation motive between the groups (group 1 and 2 at the airport after experiencing weightlessness; group 3 also at the airport but without experiencing weightlessness; groups 4–7 in an assessment center (campus of the NORDAKADEMIE). Values that are more than 1.5 times the interquartile range away from the box are considered to be outliers and shown as circles. The whiskers that extend from the box show the minimum and maximum of the remaining, non-outlier values.

A one-way ANOVA with group as independent and the affiliation motive as dependent variables was also statistically significant, but only on the 5%-level ($F (1,7) = 2.87$; $p = 0.03$). The lower band of the 95% confidence intervals of group 1 and 2 are still higher than all other groups.

3.2. Power Motive and Achievement Motive after Altered Gravity Exposure

Unexpectedly, there was also a significant effect of group on the power (Figure 2) and achievement motive (Figure 3). Asymptotic significance was $p = 0.056$ for power and 0.048 for achievement in the same Kruskal–Wallis Test for differences in the medians (N = 32, df = 6). As Figure 2 shows the power motive was far below the median of all groups in group 1 and 2. The median of the achievement motive was lower in group 1 and 2 (Figure 3). However, this significant median difference was due to the very high median of group 4 for reasons that we do not know.

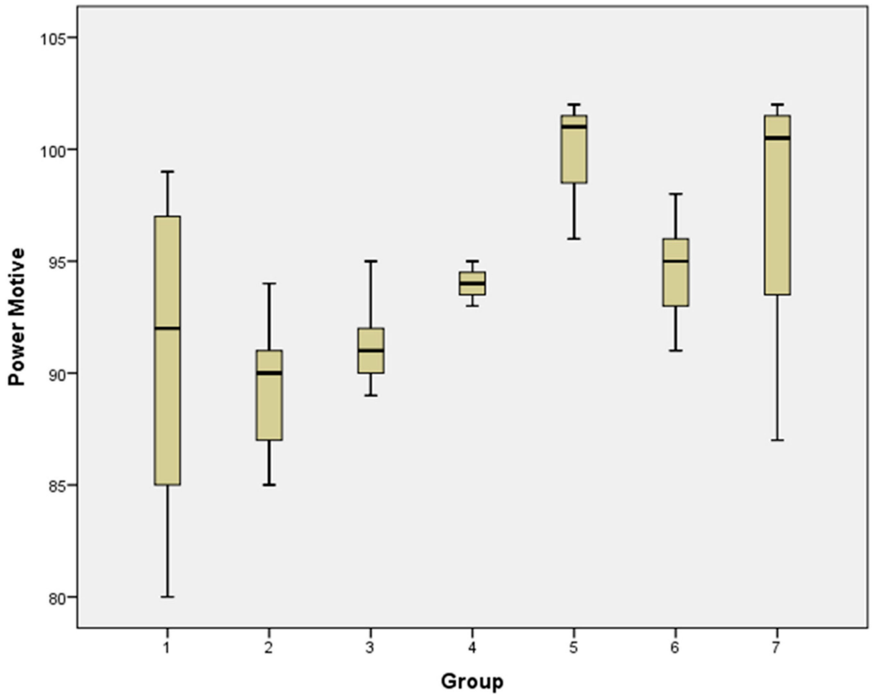

Figure 2. Box plots for the power motive between the groups (group 1 and 2 at the airport after experiencing weightlessness; group 3 also at the airport but without experiencing weightlessness; groups 4–7 in an assessment center (campus of the NORDAKADEMIE).

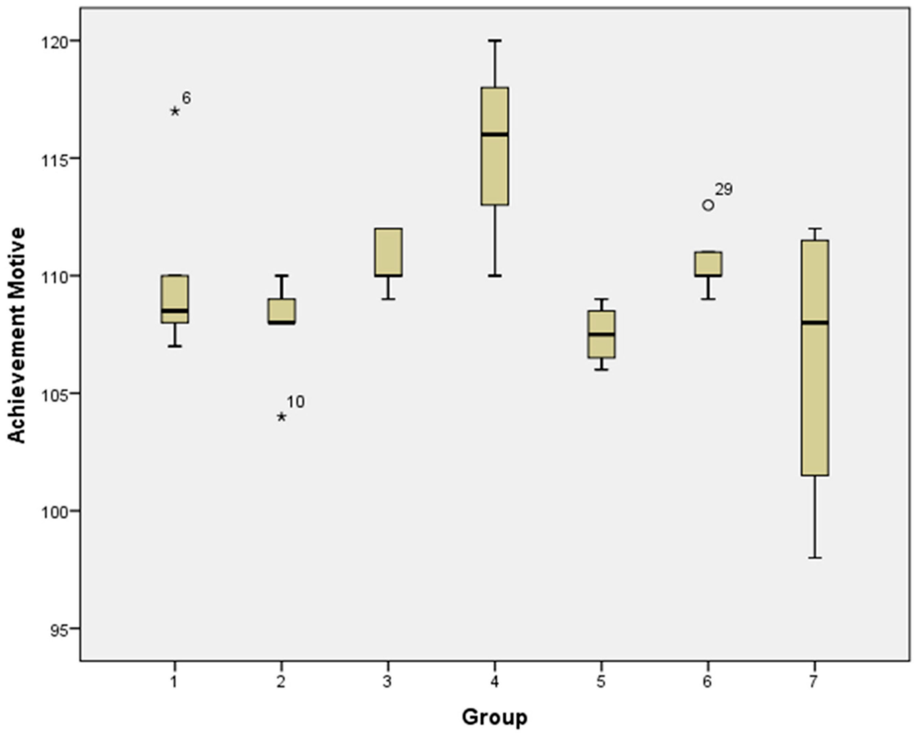

Figure 3. Box plots for the achievement motive between the groups (group 1 and 2 at the airport after experiencing weightlessness; group 3 also at the airport but without experiencing weightlessness; groups 4–7 in an assessment center (campus of the NORDAKADEMIE). Values that are more than 1.5 times the interquartile range away from the box are considered to be outliers and shown as circles. The whiskers that extend from the box show the minimum and maximum of the remaining, non-outlier values.

No significant differences between groups were found for the explicit self-report measures for affiliation. Thus, we conclude that our hypothesis that groups that experience a disrupted gravitational field develop a significant higher implicit affiliation motive when compared to similar groups in comparable situations that have not experienced a disrupted gravitational field. Due to the explorative nature of our study, causal interpretation cannot be drawn.

4. Discussion

Based on evidence, transition from the constant gravity of Earth into microgravity disrupts internal gravity-representation models of the CNS. We hereby follow Meigal's suggestion [19] that during a parabolic flight maneuver, the "sensory attack" during birth is rapidly reversed in the form of a reduced gravity-dependent sensory input. In our study, we provide the first evidence that short term periods of altered gravity are capable of inducing detectable emotional and motivational reactions as part of rapid adaptation responses in the CNS, where the perception of "self" resides [1,11].

Just as groups respond to disruptions in their gravitational environment by developing a heightened implicit affiliation motive, individuals too are guided by their motives, which are the underlying desires and needs that propel them towards certain actions. Motives have been conceptualized as stable, individual differences that can be seen as psychological "energy plants" or recurrent concerns for the initiation, implementation, and evaluation of behaviour [21,48–50]. McClelland [21] defines a motive as a cluster of cognitions with affective overtones organised around preferred experiences and goals.

Research over eight decades suggests that there are three stable human motive dispositions that can be measured by content analysis of written text or speech of an actor [50–53]. The three motives, which have been investigated extensively, are the affiliation, achievement, and power motives. The affiliation motive signifies the content category of being with others in affiliative or intimate relationships. The achievement motive signifies the content category of doing better, implying standards of excellence or efficiency. The power motive signifies the content category of having recurrent concerns about control or influence on another person, group, institution, country or the world at large [54]. Implicit motives reflect recurrent concerns that individuals are not necessarily aware of and that are more predictive than self-attributed motives for "real world" outcomes even over long periods of time when activity incentives are present. In effect, implicit motives are supposed to generate operant behaviour, therefore the measurement of implicit motives has been based on operant behaviour samples since Murray's [49] seminal work on the assessment of human motivation. The Thematic Apperception Test (TAT) [51,52,55] is the most prominent example of an operant measure of implicit motivation. Participants' responses in picture story exercises are not primarily determined by the stimulus cues but are primed by internal processes such as needs and motives in the course of writing stories in relation to the ambiguous pictures [52]. A similar approach has been taken by the Operant Motive Test (OMT) [35]. Samples of speeches and interactions lead to similar results as picture story exercises [53]. Thus, measuring motives from the distance by content analysis of speeches and correspondences between two or more participants is as valid as more structured approaches as the TAT and OMT [32].

A parsimonious explanation of the operant method to measure motives can be based on the widely accepted concept of priming [56]. Contents related to disturbances of the attainability of natural incentives, such as, for example, losing contact to primary caregivers, can increase the activational status of semantically related associations in memory [57,58]. This is to say that loss of an attachment figure can increase the activational status of words like "belonging", "friendship", "love", "exchange", or "mutuality". Positive, friendly, or personal feelings are more frequently expressed, but also negative feelings on being left alone and lonely. Because this activation is part of an unconscious "System 1" [59], motives have been labelled as implicit and differentiated from conscious, explicit motives that are part of "System 2" [60]. Therefore, implicit motives cannot be measured by self-reports but only indirectly by sampling of operant interactions [53].

One intriguing lens through which motives can be examined is attachment theory by John Bowlby [61], who described bonding between children and their caregivers as analogues to gravity. Rooted in developmental psychology, attachment theory explores how our early relationships with caregivers shape our emotional bonds and patterns of attachment throughout life. Just as a group's response to a disrupted gravitational field can be indirectly measured through content analysis of verbal interactions, attachment theory allows us to analyze the ways in which our attachment styles influence our interactions and relationships.

Attachment theory assumes that the operation of the exploration (arousal) and attachment (security) systems are closely intertwined in the human infant [61,62]. Because of the extreme prematurity of human newborns, the attachment (security) system is very strong and holds the infant near the primary caretaker who can be conceived in analogy as a secure base with a gravity field. We argue that a close analogy between gravitational field and attachment as described by the attachment theory of Bowlby [61] and his disciples exists.

To explore the environment and thus demonstrate independence (not attachment) by leaving this gravity field is a prerequisite for experiencing new, stimulating situations. However, exploration and independence are also potentially fear arousing, especially for small and helpless children. This was adaptive in human evolution, because separating from the "secure base" was objectively dangerous and remains so today [62]. Nevertheless, all humans must learn to become independent, so some psychological mechanism had to evolve to ensure this. This mechanism is that a secure attachment to a caregiver has to be established in the first place. Without this inner representation of attachment, which is like an inner representation of a gravitation field [61], exploration arouses fear, not pleasure. As soon as this attachment representation is disrupted, e.g., by the sudden appearance of a stranger, children are motivated to reassure themselves by seeking eye contact with their caregiver [63]. In secure attachment this will go smoothly, and children are therefore able to explore their surroundings without getting into danger.

Because the exploration (arousal) system is as important as the attachment (security) system to humans, a strong but unconscious motive evolved in children and caregivers to form this strong bonding based on intuitive interaction patterns that can be observed by micro analysis and have been compared to "intuitive dance" between child and mother [64]. Elliot and Reis [65] have demonstrated that this mechanism of the two intertwined motivation system prevails into adulthood and that secure adult attachment and mastery-approach are positively associated. Mastery-approach has therefore been conceptualized as the self-regulatory strategy that buffers people against the potentially fear arousing aspects of being independent [42,43].

Consequently, in attachment theory, close mother-child attachment has been conceived in a way very similar to the concept of gravity even earlier by [48]. We will use this analogy to formulate a hypothesis concerning adults experiencing a disrupted gravitational field and test it empirically.

In adults, the motive to form strong attachments as a secure base for exploration has been labelled as the affiliation motive [21,66] and will be explained in more detail below. The functionality of the attachment (security) system remains the same as in children: A disrupted representation model of attachment leads to attempts to restore bonding. This is considered as a coping reaction to a lack of positive interactions with significant others in times of need or threat [66].

We suggest the following learnings and fields of application of our findings:

(1) Insights about human intrinsic motivation: In accordance with the attachment theory, we propose that these detectable emotional responses are tied to the life-long strong implicit motive to restore bonding as soon there are signals that the primal attachment or, in this case, "gravitational" field is disrupted, hence humans compensate with stronger bonding as an instinctive reaction (as shown in Figure 1).

(2) Benefits for teams: weightlessness exposure could benefit teams that need to demonstrate high performance that can be positively leveraged by development, maintenance, or reestablishment of the affiliation motive such as closeness, personal encounter, safety, and friendly relationships with other teammates [25,67]. Hence, microgravity short-duration flights could potentially serve as a psychological training area for high performance teams for which the attributes of the affiliation motives are mission critical, e.g., for sport teams, or teams operating in extreme environments like submarine or special task-force teams.
(3) Benefits for astronaut team training: Following the basic heuristic that a stronger team bonding is mission critical for space teams—as it is proven for teams operating on Earth–astronaut teams could be trained for team success through greater bonding in a microgravity setting. This insight could benefit the functioning of astronaut teams, which is mission critical.
(4) Benefits for astronaut selection: Our results could be considered in astronaut selection in two ways: (a) on the individual level, to determine if this beneficial capacity (trait) of greater bonding occurs in the respective person, and (b) on the team level, to evaluate different team constellations for optimal team bonding. Since the affiliation motive has trait and state character, it can be assumed that astronauts with a higher affiliation motive as a trait (which can easily be tested with classical measures such as the OMT) [35] would exhibit a beneficially low hurdle for arousal of the state of affiliation. Hence, astronauts with a higher affiliation motive could become the better team players in space. This result is particularly critical for selecting astronauts for the mission to Mars, where team functioning is even more mission critical, because they will be separated from family and other humans contacts for even longer, will not see Earth, which lacks the usual favourable psychological overview effect induced by Earth rise, and lack the security of the "emergency to earth procedure".

Despite the here found positive effects on team bonding induced by a microgravity environment, we have no prove yet for long-lasting effects from short-term microgravity interventions on individuals and teams, which should be measured in longitudinal follow-on studies. Furthermore, there is always the possibility that the opposite could be true, too, that spending time in microgravity may possibly exacerbate some "natural" human social bonds, especially in long-term mission flights.

We also can only postulate assumptions (and not clear recommendations) as to what the optimal bonding level for an astronaut team affiliation would be, as it might not be a linear effect between team affiliation and performance, but, to the contrary, a certain level of conflict (especially idea conflict) might be useful to have in a team in order to deal better with unforseeble circumstances, especially during new missions, such as missions to Mars.

Identified short-time effects represent a beneficial aspect for crew performance during long-term space missions. As such, parabolic flights could be considered as a training platform for psychological conditioning or astronaut selection. The interplay between exploration and attachment systems speaks to the delicate balance we strike between independence and security, freedom and fear. The discovery of stronger bonding as a response to disturbances, and the potential applications in team dynamics, astronaut training, and selection, hint at a transformative impact on the realms of space travel, team performance, and individual development.

Author Contributions: Conceptualization, D.S. and S.S.; methodology, D.S. and S.S.; software, D.S.; validation, D.S. and S.S.; formal analysis, D.S. and S.S.; investigation, D.S., S.S., O.U. and J.-F.C.; resources, D.S., S.S. and O.U.; data curation, D.S.; writing—original draft preparation, D.S., S.S. and O.U.; writing—review and editing, D.S., S.S., O.U. and J.-F.C.; visualization, D.S.; supervision, D.S., S.S.; project administration, D.S. and S.S.; funding acquisition, S.S. and O.U. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: All participants were regular guest of a discovery flight of the Swiss parabolic flight program and volunteered for the psychological surveys conducted in the study. All participants were fully informed about the anonymity assured, why the research is being conducted, how their data will be used and if there are any risks associated. Psychological studies do not fall under the scope of the Swiss human research act (https://www.fedlex.admin.ch/eli/cc/2013/617/en, accessed on 2 September 2023) and are therefore not subject to approval. The data presented in this study are available on request from the corresponding author. The data are not publicly available due to the privacy of the volunteers.

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Conflicts of Interest: Oliver Ullrich is president of the board of the Swiss SkyLab Foundation, Switzerland. The Swiss SkyLab Foundation had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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