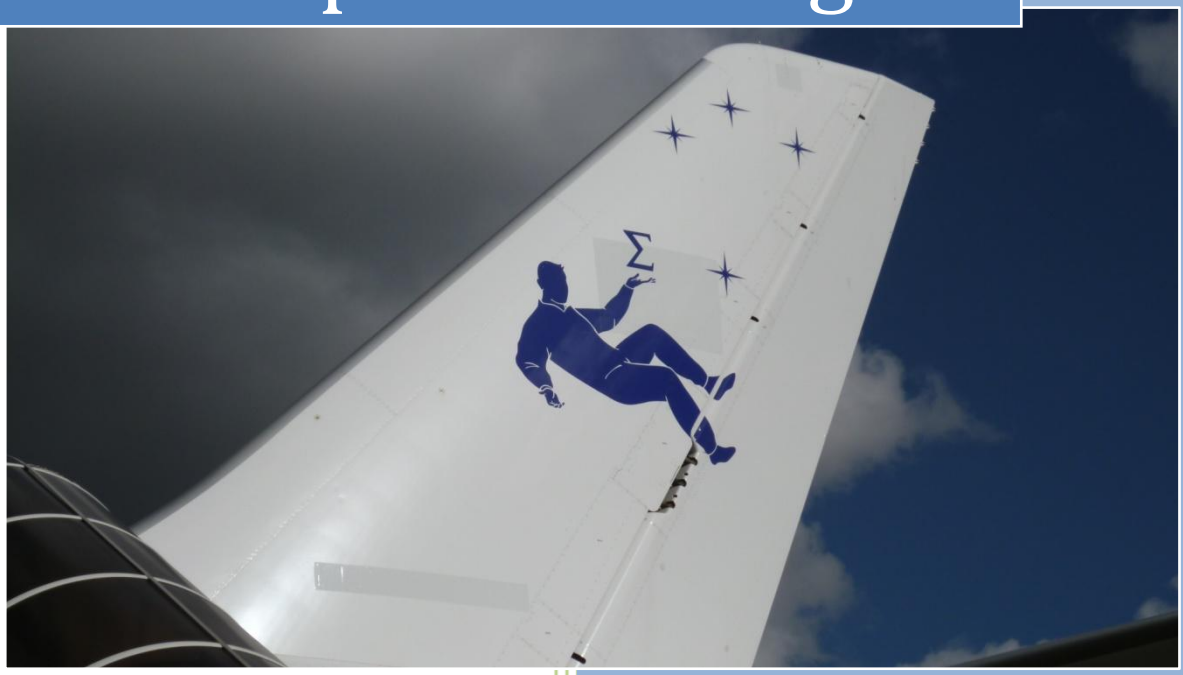
2017

Study about Zero-G flashbacks after parabolic flights



Dipl.-Ing. (FH) Tanja Lehmann

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1. Summary

1.1. General definition

A flashback, or involuntary recurrent memory, is a psychological phenomenon in which an individual has a sudden, usually powerful, re-experiencing of a past experience or elements of a past experience. These experiences can be happy, sad, exciting, or any other emotion one can consider.

The term is used particularly when the memory is recalled involuntarily, and/or when it is so intense that the person "relives" the experience, unable to fully recognize it as memory and not something that is happening in "real time".

Flashbacks can be caused by a smell from childhood, through hearing old favorite songs or the recognition of a location known from the past. During this event the person feels for a short time – mostly a few seconds and rarely more than three minutes – to be transported back to the situation or reliving it. This kind of flashback is therefore only a special form of intense memory.

In traumatized people, key stimuli like people wearing uniform, news, noise and tightness or anniversaries of imprisonment could act like triggers for a threat and lead to flashbacks.

Source: Wikipedia (https://de.wikipedia.org/wiki/Flashback_(Psychologie))

1.2. Definition in the context of parabolic flights

In this document a flashback is denominated as perception illusion, which is an aftereffect of parabolic flight or other weightlessness experiences. This perception illusion lets the affected person relive a feeling of floating without being subjected to real weightlessness, which eventually can be combined with other perceptions and feelings typical to weightlessness.

According to Cmdr. Ronnie Nader of the Ecuadorian Space Agency EXA flashbacks are experienced most likely by first time flyers. They can happen spontaneously, but they can also be triggered on purpose. Methods to achieve this will be discussed below. Flashbacks normally can be experienced up to a week after a weightlessness experience, but in some cases longer time spans have been observed.

According to EXA if an electro-encephalogram (EEG) is taken during a flashback event, it can be stated that the measured brainwave patterns are similar to the brainwave patterns measured during the weightlessness portions of the (preceding) parabolic flight.

This document describes the authors' own experiences from self-experiments and conclusions drawn from them in accordance to flashbacks (scientific correctness cannot be guaranteed due to insufficient data). Also it contains the evaluation of questionnaires, which were distributed to parabolic flight participants within several years (2013 – 2017).

A few statements point to flashbacks also being experienced after spaceflights. But further information on this issue is pending.

Another testimony (report from Luftsportmagazin 1/2009, but available only in German, see Appendix B) describes the recall of similar feelings after an acrobatic glider flight. This could eventually also be a flashback.

2. Trigger methods

2.1. Spontaneous flashbacks

Most flashbacks after parabolic flights occur spontaneously (without intent). This can happen without any evident trigger, but also preoccupation with the flight (e.g. being remembered of it, watching videos of the flight, also see section 2.2) can trigger spontaneous flashbacks.

2.2. Flashbacks caused on purpose

There is also the possibility to induce flashbacks on purpose, if a preceding weightlessness experience exists. Normally this concerns people who already experienced spontaneous flashbacks. It is not known if people without such flashback experiences can also trigger them through the described methods below.

The following methods can be used to purposely induce flashbacks:

- Viewing of zero-g videos or pictures
- Reading of texts about weightlessness experiences
- Active recall of being weightless
- Standing and movement on unstable ground (e.g. balance board, trampoline)
- Positioning of the body in a similar position to the neutral 0 g body posture
- During or after a weightlessness simulation in water
- Talking about a zero-g experience (only first-hand experience)
- Music (only first-hand experience)
- Virtual Reality weightlessness simulation (Assumption, not experimentally verified)

A combination of the above mentioned methods is also possible and may have more effect than one single method.

3. Symptoms

Against the conclusions of Cmdr. Nader the author and several other persons experience the symptoms to the present day with spontaneous flashbacks occurring irregularly. The author has already flown several parabolic flights.

Some of the persons interviewed for this study are eventually able to actively trigger flashbacks with using the methods stated in section 2. Preferred methods are the active recall and also viewing of pictures and videos, but reading texts about foreign weightlessness experiences can be just as effective (texts can be found on the internet).

For the author the participation in an underwater weightlessness simulation has proven to be very effective (measuring of neutral body posture during 10 minutes of submersion with closed eyes in 4 m deep water).

3.1. Feeling of floating weightlessly

The main symptom is the feeling of floating, depending on the intensity this can reach from feeling slightly lighter up to being convinced to be about to take off. When not familiar with these symptoms or in a situation of reduced alertness this can lead to the concerned person grabbing for a hold (e.g. chair or door frame) to hinder the body from floating away or to overcome an unstable feeling. Also a feeling could be produced to have more power than usual with the possibility of overestimating one's muscle power.

But if there is awareness of the situation this feeling (and most of the side effects listed in the following) can be experienced as amusing and relaxing and to be an enrichment of one's own world of experiences.

3.2. Spatial illusions

Besides the feeling of floating, spatial illusions can be experienced in different ways.

A change of head and/or body posture with the eyes open can cause a different spatial perception of the surroundings, e.g. perceiving a wall as floor or not perceiving an inclined floor as inclined. Dizziness can result from this and hence a danger of tripping.

One participant described her aftereffects experience as the feeling of a wave rolling beneath her feet, as if the floor was moving and like the onset of an earthquake. This happened after both of her zero-g flights, about 2 days after the flight and lasted a few seconds.

In a relaxed state and with closed eyes the orientation of the body can be perceived as different in an arbitrary manner. The body orientation can be perceived as upright or upside down or there could be a feeling as if drifting or turning in the middle of the room. Also feelings of falling have been experienced, especially during initialization of a flashback. In self-experiments it was possible to change these perceptions at will.

3.3. Changed body perception

Changes in body perception were also observed. They reach from feeling warmth especially in the face and upper torso to feeling the body posture being altered, disappearance of the feeling for the position of the limbs to a complete disappearance of body awareness. Except for the heat perception all here mentioned symptoms were only experienced when the flashbacks were triggered in a comfortable lying posture and there was enough time to succumb to the floating feeling.

3.4. Unpleasant side effects

Rarely unpleasant side effects are experienced. Cmdr. Nader reported from a case where through flashbacks the affected person experienced the same nausea as during the parabolic flight in full force. But this seems to be an exception.

In the evaluation of the questionnaires (see section 4.2) none of the interviewed persons experienced the flashbacks as unpleasant or has been adversely affected in daily life.

3.5. Other aftereffects possibly caused by flashbacks

The most bizarre aftereffect was observed by the author shortly after her first parabolic flight: One of the fellow flyers imitated the pilot announcements during the flight in the moment of weightlessness onset, whereon the victim of the prank let himself drop to the ground and had to be caught by his friends.

The story behind this is that the participants of the flight were instructed before the flight, that during the moment of transition into weightlessness, they should let themselves drop. This is to prevent that they fly into the ceiling of the aircraft due to the force of their legs. The onset of weightlessness was always announced by the pilot with the command „Injection".

The assumption is now that the fellow flyer, through the conditioning by the „Injection" command, was transported back into the flight situation and reacted accordingly. Also see section 3.1, regarding the behavior during unexpected experience of this floating feeling.

Also it was perceived that the flashback symptoms can have a pain-reducing effect. The cause is to date unknown.

4. Statistics

4.1. Oral interview to occurrence of flashbacks

Several people were questioned about occurrence of flashbacks after a parabolic flight. The following table quantifies their statements.

	Number of people	Flashbacks		Remarks
		Yes	No	
Women	14	8	6	Persisting for two people
Men	25	12	13	2 people experiencing no flashbacks reported to be very occupied with their experiment, one person with flashbacks persisting
Total	39	20	19	

According to the current statistics – sadly only 39 interviews (for occurrence of flashbacks only) – 51% of the participants experience lesser or stronger symptoms. For three persons the symptoms are persistent for many years now and can be triggered on purpose. Two of them have a gymnastic background: One was a dancer; the other is the author, with long experience in artistic gymnastics. One person has a long experience as parabolic flight instructor.

One person had flashback experiences for up to 2 years after the last parabolic flight.

17 people didn't experience flashbacks. Two of them were very busy with their experiment and couldn't focus on their perceptions. Another person reported that his feelings during the flight were as expected beforehand and were not particularly thrilling.

These statements point to the occurrence of the symptoms being possibly dependent on how big the impression is that the weightless experience has made on the respective person.

4.2. Evaluation of questionnaires

The oral interviews above was substituted by a detailed questionnaire, to gather more elaborate information about the occurrence or non-occurrence of flashbacks, to better characterize this experience, and also to find out about possible correlations with other boundary conditions of parabolic flight (for latest questionnaire see Appendix B).

Sadly not all orally interviewed people filled out the questionnaire, so currently only 23 answers are available. This means that the statistic evaluation is still somewhat slim and the activity will be continued.

The questionnaires were evaluated statistically with the help of an Excel table; possible correlations were depicted in the following diagrams.

About the diagrams:

The bars were normed on the respective participants of the depicted group, so the percentage is always based on the total number of the respective group, which therefore is 100% (e.g. the proportion of first-time flyers in the whole group is 70%, the proportion of first-time flyers among the men is 71% of all men).

Before coming to the evaluation of the flashback characteristics I want to state here a general statistic evaluation related to gender, first-time flyers, and motion sickness, medication against motion sickness and also workload and expectations during the flight. This is important insofar; as they provide a general overview and that the follow-up statistics regarding the flashback characteristics refer solely to the participants experiencing them.

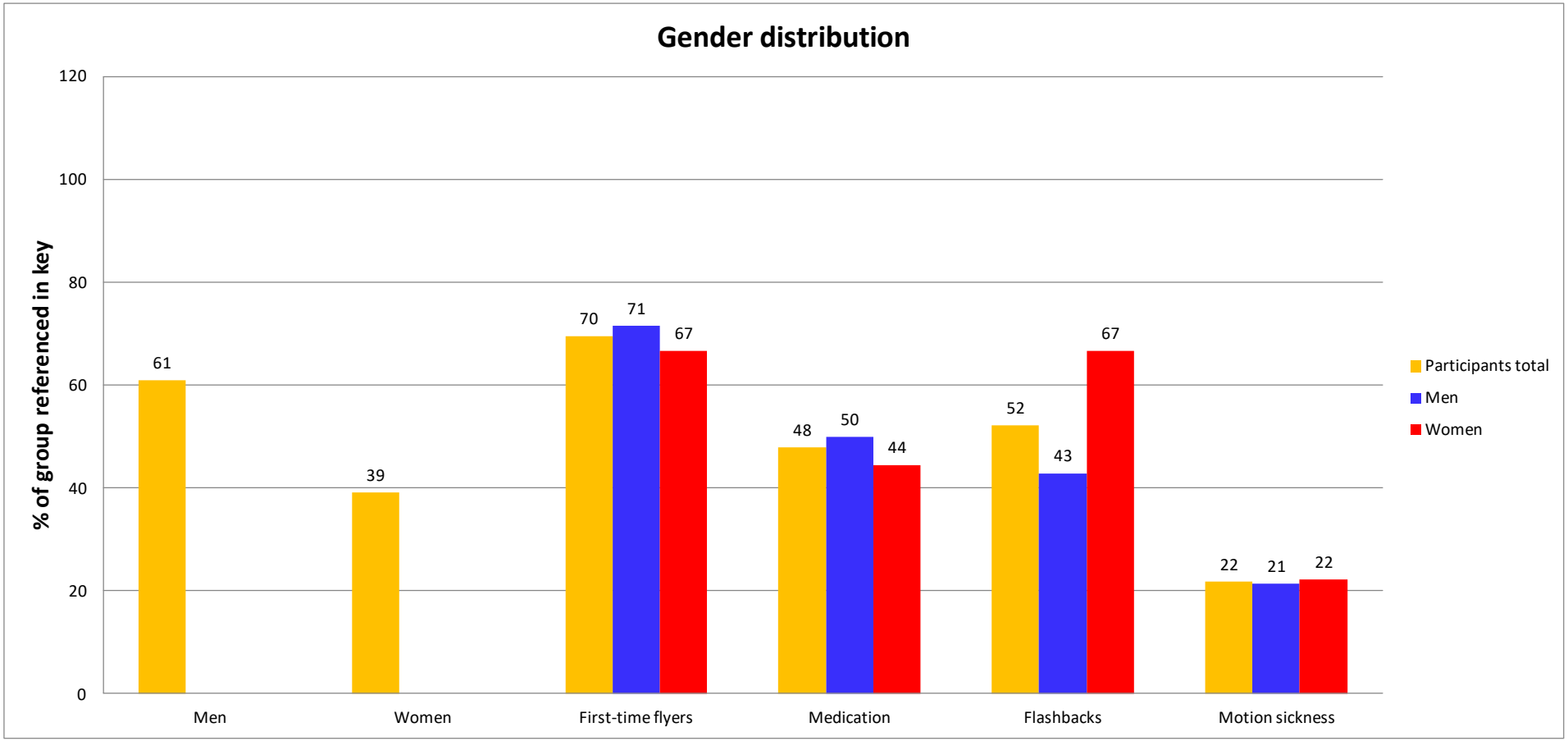

Figure 4-1: Gender distribution

Approx. 2/3rd of the study participants were men, 1/3rd were women, and the percentage of first-time flyers is in total at about more than 2/3rd, but is about evenly distributed among the sexes (a bit more for men). The proportion of people that took anti-sickness medication was at almost 50%. But obviously men were more willing to take the medication. Regarding the percentage of participants experiencing flashbacks, it stands out that this is more than 50% of all participants (52 %). But especially eye-catching is that especially women are more prone to experience flashbacks than men. The occurrence of motion sickness is not gender-specific and is generally at about 20% of the participants.

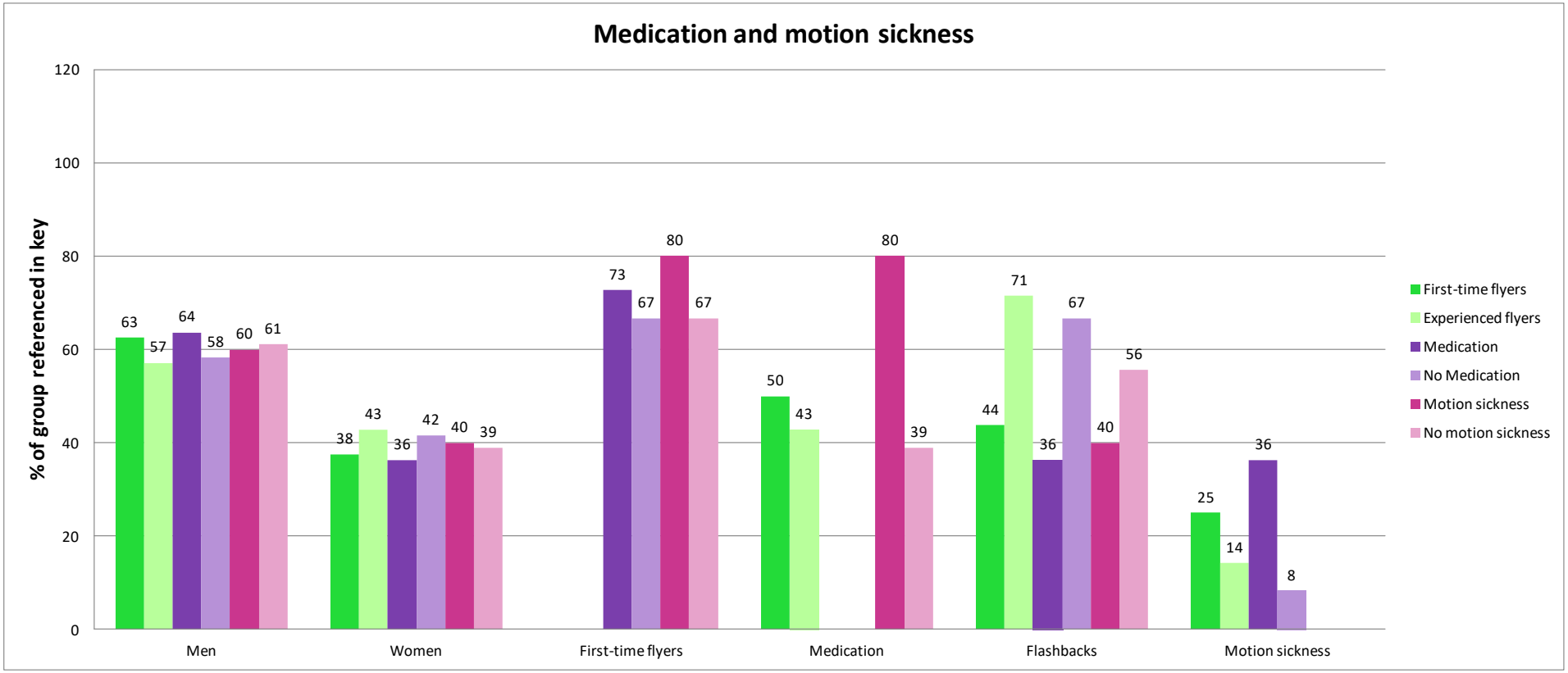

Figure 4-2: Occurrence of motion sickness and taking of medication

The majority of participants who took anti-sickness medication and also the majority of sufferers of motion sickness are first-time flyers (73% resp. 80%, column „first-time flyers“). 50% of the first-time flyers have opted for medication. For the experienced flyers this proportion was slightly less (column “medication”).

Concerning the flashbacks, they were much more often experienced by experienced flyers (71% of experienced flyers vs. 44% of first-time flyers). Also remarkable: It is much more likely to experience flashbacks when not taking any anti-sickness medication (67%) and if not experiencing motion sickness (56%).

80% of the participants who experienced motion sickness also took the medication, compared to only 39% of the participants with no symptoms of motion sickness. In the last column it is stated that 25% of first-time flyers and only 14% of the experienced flyers experienced motion sickness. A remarkable find is that only 8% of the people taking no medication suffered from motion sickness, but 64% of the ones that took the medication. It therefore cannot be excluded that the medication is not always well coped with. A hint to this was given by one of the participants who reported having this problem.

It must be admitted that the number of participants in this study is not very high for a proper statistic evaluation, but at least according to the available data it can be assumed that the medication against motion sickness is not the cause for the flashbacks, but instead are counterproductive. The same accounts for motion sickness, but in a smaller scale.

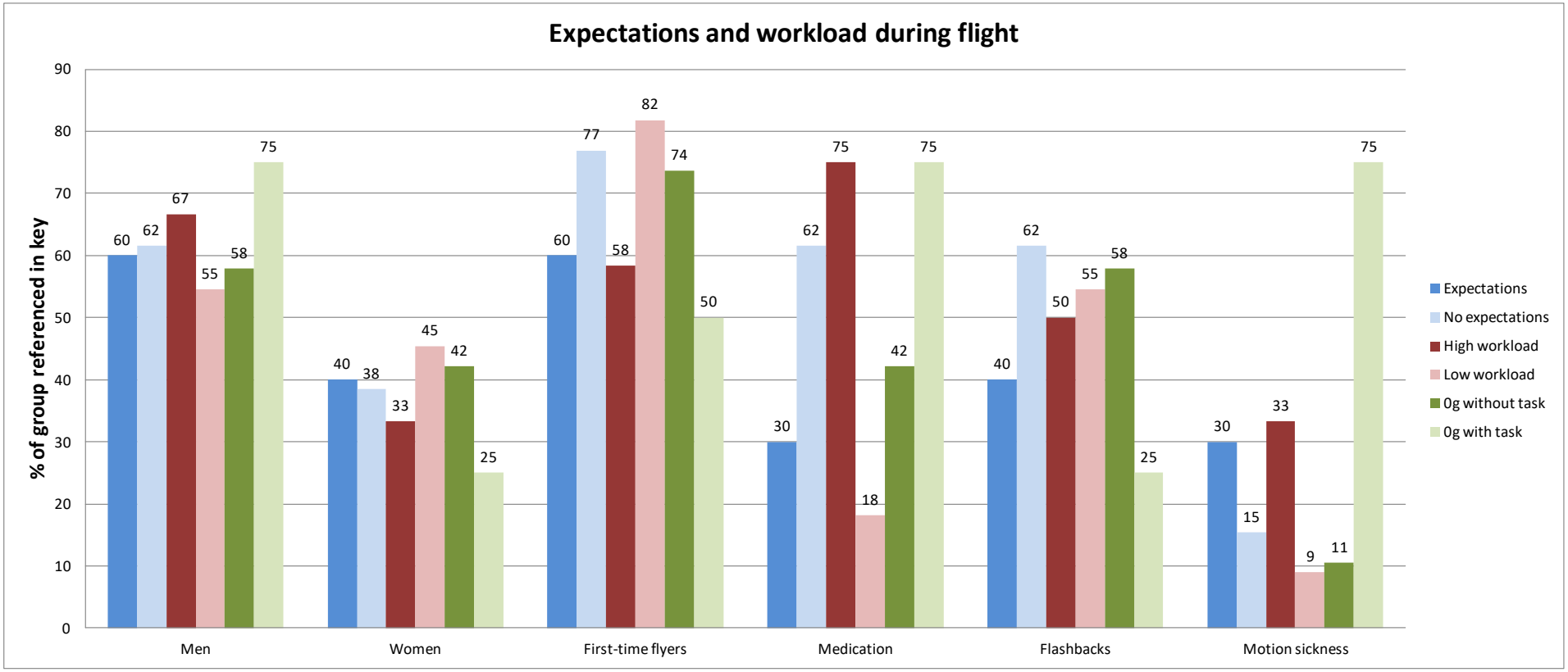

Figure 4-3: Expectations of the participants and workload (e.g. performance of experiments)

Note: The percentage values always refer to the group mentioned in the key, e.g. 60% of participants with expectations were men, and 77% of participants without expectations were first-time flyers.

Before we go into detail with the flashbacks, a diagram is shown concerning expectations and workload during a flight.

Very noticeable with this diagram is that people who had no expectations to their flight, had a low workload or could experience weightlessness at least once without task like operating an experiment (e.g. tourist flight or parabola in free float area during a science flight) were much more likely to experience flashbacks (column "Flashbacks") and also were much less prone to motion sickness (column "motion sickness").

The proportion of first-time flyers among the participants without expectations, with low workload and also with the possibility to experience a parabola without performing a task is quite high (77% without expectations 82% with low workload and 74% without task, column "first-time flyer"). But this might as well be accounted to the high amount of first-time flyers or that even on science flights; most first-time flyers get the chance to enjoy at least one or two parabolas without task. Among the people who always had to perform a task, the percentage of first-time and experienced flyers is 50% each.

The percentage of people with a high workload or with a task which took medication is very high (75% each, column "medication"). This may be appointed to the fact that for the science flights, the participants were advised to take airsickness medication and that most experimenters comply with this advice, whereas for tourist flights, this is only mentioned at the side or left to the participants. .

Much more people with a high workload and without possibility to enjoy weightlessness for themselves are suffering from motion sickness (75% vs. 11% of the ones with low workload, column "motion sickness"). Possibly the additional effort in performing work could be the cause, which adds up to the physical strain of the flight. But it could also be the lack of data screwing the statistics, because since as before mentioned, many people also on science flights can take one parabola off for free time.

The following diagrams refer to the experience of the flashbacks.

Explanations:

Expectations:	The respective participant occupied himself with the upcoming experience and thought about it how it might be (e.g. how it feels to be weightless or if motion sickness could be a problem for him).
No expectations:	The respective participant went into the flight unprejudiced and did not think about it beforehand.
High workload:	The participant had many tasks to fulfill (e.g. was engaged in an experiment).
Low workload:	The participant had no or few tasks to do (e.g. experiment runs without operator input, or participation on a tourist flight).
0g without task:	The participant had at least one parabola only for him/herself, without taking part in any other activity.
0g with task:	The participant was busy during the whole duration of the flight (e.g. being an instructor or an operator of an experiment) and did not have the time to experience weightlessness "just for fun".

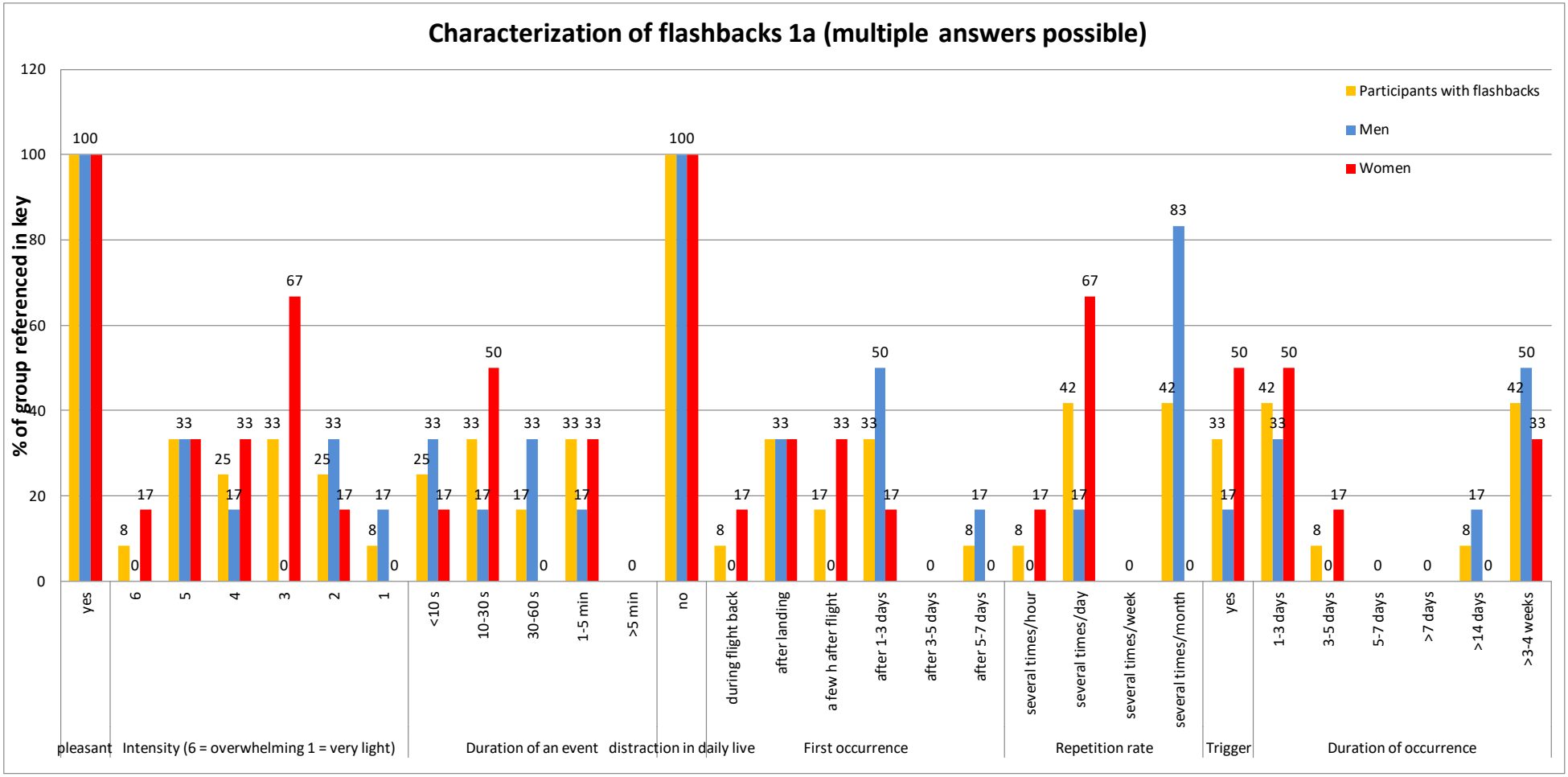

Figure 4-4: Characteristic of flashbacks, related to overall number of participants with flashbacks and gender distribution

Note: For possible triggers see section 2.1.

What sticks out most in Figure 4-4 is that all participants of the study rated the flashbacks as pleasant and no one was adversely affected by them in daily life.

Most participants experience flashbacks of a medium intensity, especially the women. The higher the rating number, the higher is the perceived intensity, but of course it has to be considered that the rating is a subjective judgment of the experience.

Flashbacks normally don't last longer than a few minutes; the duration range extends from < 10 s for up to 5 minutes, the durations being evenly distributed throughout the participants.

The most frequent time for first occurrence of flashbacks is in the time after the landing for normally up to 3 days after the flight, and with several events during the day. Rarely they are experienced much later, with women having a higher repetition rate (columns „first occurrence“ and „repetition rate“).

The most likely scenario is that flashbacks occur without any external trigger, especially in the male participants of the study. For women this is evenly distributed (the main reported triggers were viewing of zero-g videos and a relaxed atmosphere).

What really surprises is that the majority of the participants either experiences flashbacks for up to 3 days after the flight or weeks later, with no one reporting any events for time spans in between those two.

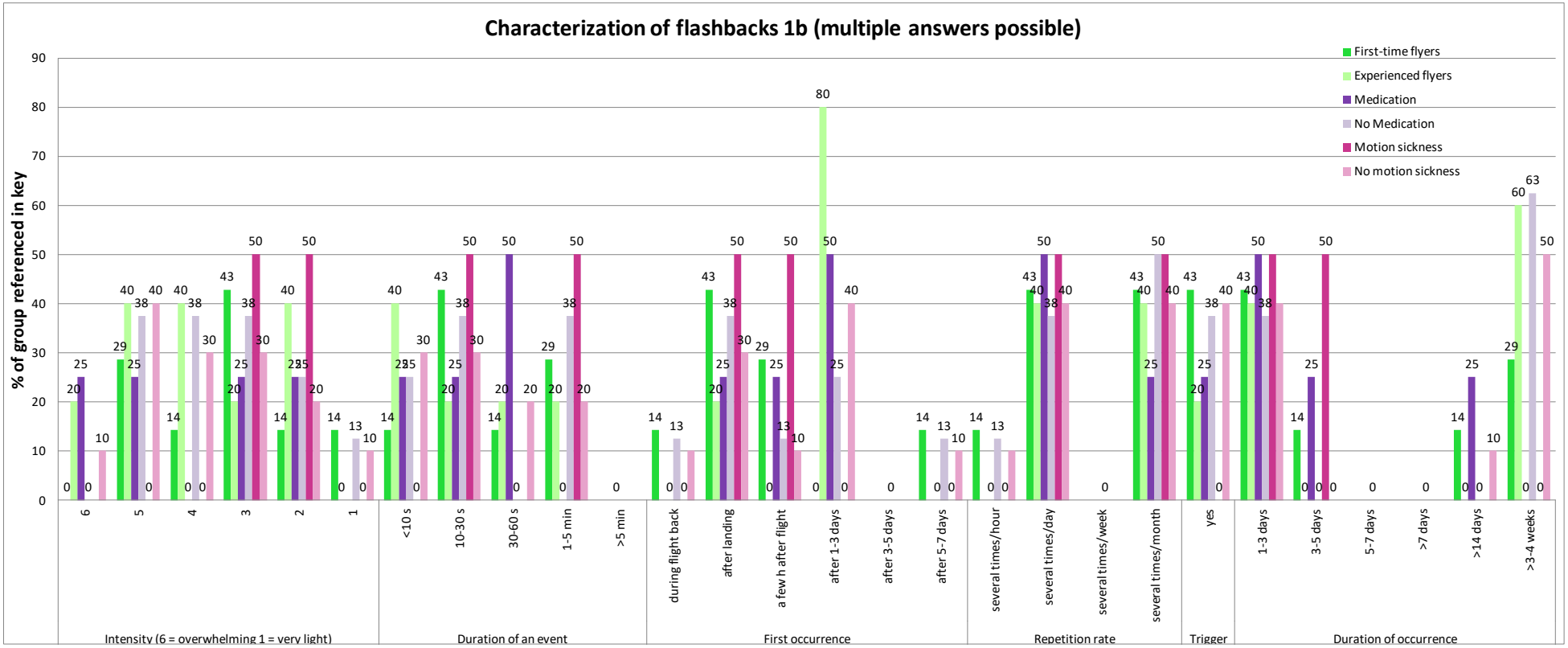

Figure 4-5: Characteristic of flashbacks, related to first-time flyers, motion sickness and medication

Generally for Figure 4-5 the same can be said as for the previous diagram, the distribution is similar. But the data are quite thin because only a few participants who took medication or suffered from airsickness reported any flashbacks. Generally noticeable is that for people experiencing motion sickness and flashbacks, those are usually weaker than for people with no problems of this kind.

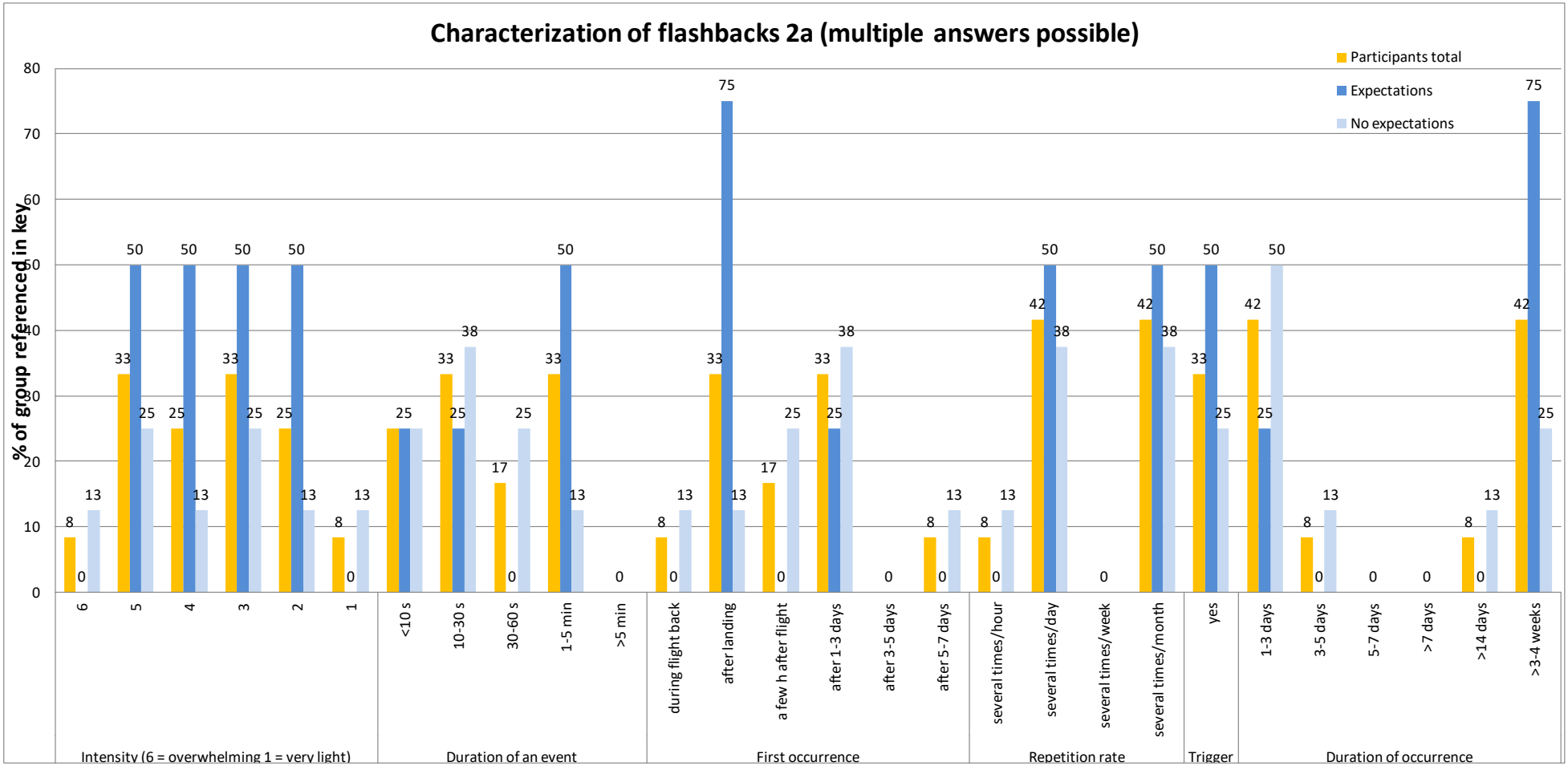

Figure 4-6: Characteristic of flashbacks, related to overall number of participants with flashbacks and expectations of participants

Although participants with expectations experience less flashbacks than participants without, if they do the duration of a flashback event tends to be longer (column "Duration of an event"). Furthermore they tend to start more often after landing, whereas for participants without expectations the onset is rather after a few days. Participants with expectations also report more often that there are trigger events for flashbacks and a remarkably frequent long duration of occurrence (75% >3-4 weeks, column "Duration of occurrence").

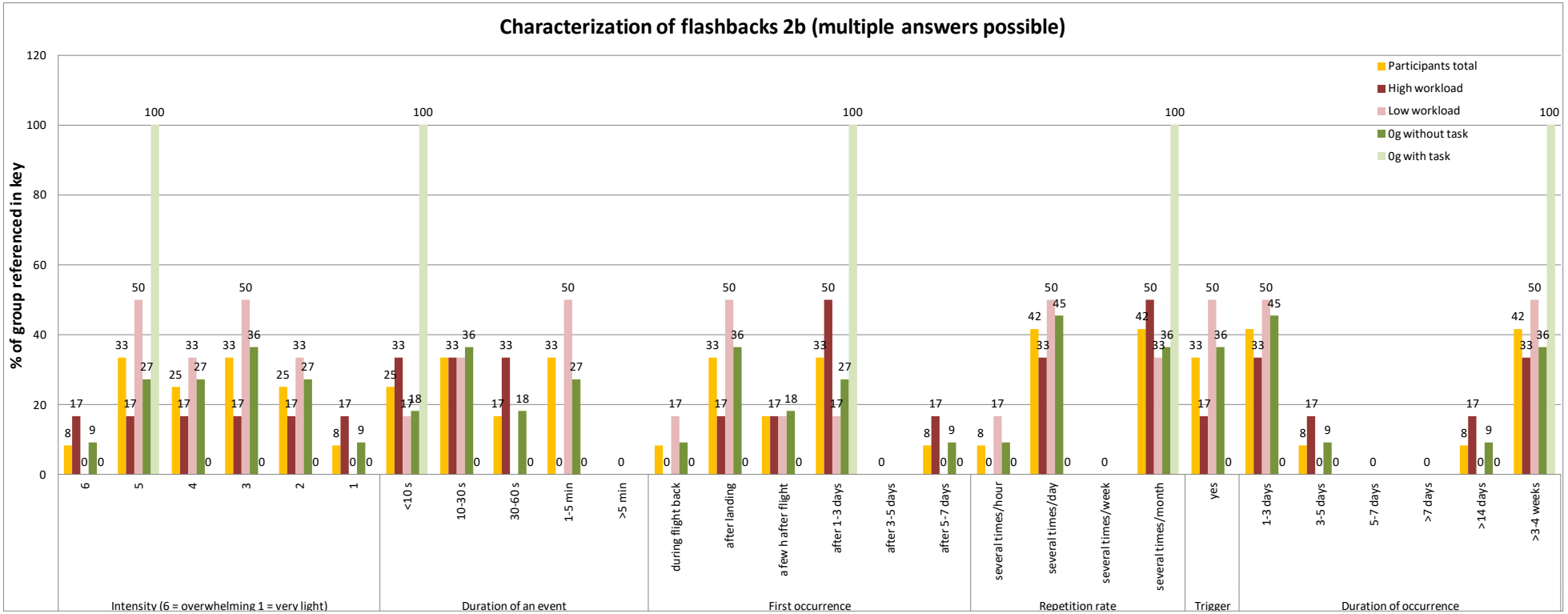

Figure 4-7: Characteristic of flashbacks, related to the workload of participants during their flight

According relations concerning workload, the participants who didn't have a chance to enjoy weightlessness without a task, if they experience flashbacks, may enjoy more intense events. But there was only one participant, therefore this needs further verification.

Apart from that the same relations concerning event durations and occurrence can be observed, independent from how busy the affected persons were on their flight. Generally it can be said that it is of advantage for the experience of flashbacks to be not too busy. The cause is presumably that a low workload (no matter of which sort) leads to a more conscious and intense perception of weightlessness.

5. Conclusions

It seems that this is a complete re-living of the weightless experience, where the body believes to be in weightlessness again. This is also where the EEG measurements of Cmdr. Nader point to. The assumption is that this causes different perceptions which can be felt more or less intense.

Also possible is that the body develops a different mode of perception for equilibrium signals when in weightlessness, here called „zero-g mode“. Contrary to that, the „1 g mode“ is the perception mode under normal gravity conditions. There is an assumption that the body switches into “zero-g mode” during (spontaneous or on purpose) occurrence of flashbacks and that then the normal equilibrium sensations are ignored. A self-experiment of the author points to that, where through triggering of a flashback a feeling of dizziness could be eliminated (the dizziness was most likely caused through tension in the neck and therefore disturbed equilibrium). This would also explain the spatial illusions and partly also the altered perception of the body, which are sometimes occurring together with the flashbacks.

But this seems to be different from the feelings after a sea voyage, when the floor seems to move for up to several days after the stay on the ship, at least concerning the author. The aftereffects of a sea voyage could never be recalled after they vanish and never triggered further flashbacks of sea legs. Sadly no reports are known to the author who could be compared with her experiences.

5.1. Spontaneous experience

The activity performed during the onset of a flashback is not necessarily related to the parabolic flight; according to the current data the occurrence of flashbacks is possible in every situation of daily life. One of the questioned persons reported that there were no apparent triggers, but that the flashbacks only happened during a relaxed position similar to what the body would adopt in weightlessness.

5.2. Triggered experience

This can happen on purpose or without intent. A triggering without intent could happen in all situations that activate a spontaneous recall of the weightless situation.

A triggering on purpose could most easily be achieved in a relaxed laying down position, with closed eyes, to experiment with the symptoms described in sections 3.1 to 3.3. It could be stated that, when being familiar with the situation, the flashbacks were suitable to get into a relaxed state and even help with falling asleep (experiments of the author).

5.3. Long-term occurrence

Based on the statements of the interviewed people it seems very likely that flashbacks most likely are experienced the more impressed the affected persons are by their weightless experience, and the less they were distracted from the experience by tasks during their flight.

It is imaginable that the previous movement experience plays a role: Among the interviewees are a dancer and a gymnast, and both experience symptoms to the present date, which can also be triggered on will.

Repeated experience of even very short-time weightless situations can also facilitate easy triggering.

During self-experiments of the author it has been proven that a conditioning could happen if a conscious triggering is combined with a stay in the water. This leads to situations where solely the stay in the water can provoke flashbacks.

Therefore it can be assumed that the recall of weightless memories can be learned.

6. About the author

The author works as test engineer in the aerospace industry, is a member and the vice president of the Mars Society Germany (Mars Society Deutschland e.V.) and also a member in the Association for promotion of space travel (Verein zur Förderung der Raumfahrt e.V.). She took part in several parabolic flights and organizes the parabolic flight tests for the Mars balloon project MIRIAM-2 (**M**ain **I**nflated **R**eentry **I**nto the **A**tmosphere **M**ission test 2) of the Mars Society Germany.

She has a major interest for weightlessness and especially the psychological effects on humans.

Contact of the author:

Dipl.-Ing. (FH) Tanja Lehmann
Kaspar-Kerll-Str. 19
81245 München
zero_g@gmx.de
www.zerog2002.de

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Appendix A
Flashback questionnaire version 2016

(5 pages)

Appendix B
Possible flashback experience after acrobatic glider flight

(1 page)