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Flow State: The Equilibrium and Disequilibrium Associated with the Autoletic and Optimal Experience

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Abstract

Flow is an optimal experience where people become totally immersed in an activity and enjoy it immensely and intensely which is a desirable state with positive effects for employee well-being and innovation at work. The concept of Flow implies a balance of perceived challenges and skills in understanding optimal experience. Both the perceived challenges and skills must be at a moderate to high level so that the challenges stretch but do not surpass existing skills. Some predictors of Flow includes social support, support for innovative practices at work, having clear rules and norms at work, having clear goals. Skill variety, autonomy, job/task clarity, meaningfulness of job, job feedback, task identity and task significance. Since the Flow state is rewarding and appetitive, humans thrive to experience it more often and are more likely to engage in flow-eliciting activities. That is why highly flow-conductive activities carry at the same time a high risk for addiction. Examples are playing video games or internet surfing. Flow has been linked to online Gaming Addiction and Internet Addiction. The “optimal experience” of flow does not necessarily mean that the consequences of flow are always positive. While experiencing flow, individuals can become addicted to the euphoric feelings associated with flow, underestimate the personal risk of being led astray, derailing from other tasks and activities, willing to hurt or even kill other people. Typical Internet activities are general web browsing, e-mailing, news websites, telnet, and blogging. Reported researches have supported the flow-addiction link: the stronger the participants experience of flow, the higher the problematic Internet use. The term “optimal” refers to the inner state of sound physical and mental functioning, but not to the desirability of its outcome. Flow experience is not just a hedonic feeling that enhances an individual’s quality of life; it is also an optimal functional state that can lead to peak performance. One risk factor for addiction disorders seems to be hypodopaminergic functioning of the brain reward system so that dopamine-enhancing substances or activities are used to counterbalance the lack of dopamine in the system. A significant positive correlation between cortisol and flow-experience was observed in a complex video game. Elevated cortisol was also found in participants playing an optimally challenging level of the video game. The dark sides of flow needs theoretical, empirical, and practical attention as well as intervention by significant others. The challenge entails learning to distinguish the useful and the harmful forms of flow, and then making the most of the former while placing limits on the latter.

Keywords: Flow, Autoletic and optimal experience, online gaming and internet addiction

Introduction

In 1946, the World Health Organization defined health as, more than the mere absence of disease, it refers to a state of physical, mental, and social well-being. The focus in occupational health psychology which was primarily on stress and ill health, has shifted of late, towards increasing interest in the positive aspects of well-being through the development of positive psychology (Byree & Haworth, 2002; Tumer, Barling & Zacharatos, 2002) [5, 62]. Positive psychology has a strong focus on quality of life and the opportunities for personal growth and optimal functioning. Flow refers to a state of consciousness where people become totally immersed in an activity and enjoy it intensely which has been identified as a desirable state with positive effects for employee well-being and innovation at work. Flow theory has received considerable attention over the past decade (Bakker, 2005; Demerouti, 2006) [30]. Flow research supports the view that work provides various opportunities for experiencing a state

of positive well-being (Henry, 2004) [40]. The concept of flow has a close kinship with occupational health psychology; so as “to develop maintain and promote the health of employees”. Flow has been described as “a particular kind of experience that is so engrossing that it becomes autotelic, that is, worth doing for its own sake even though it may have no consequence outside itself ” (Csikszentmihalyi, 1999) [22]. Bryce and Haworth (2002) [5], have found associations between flow and job satisfaction, enthusiasm, and contentment. To promote well-being, it has been claimed that work should be organized so as to facilitate the experience of flow (Csikszentmihalyi, 1999; Csikszentmihalyi, 2003) [22, 23].

The Concept of Flow

Flow refers to an optimal and positive state of mind during which individuals are highly motivated and engrossed in an enjoyable activity. There optimal experiences have been reported in a wide variety of domains, including leisure

(Csikszentmihalyi and Csikszentmihalyi, 1988) ^[11], sports (Jakson & Marsh, 1996), and work activities (Demerouti, 2006) ^[30]. The initial phenomenological concept of flow, implied a balance of perceived challenges and skills in understanding optimal experience (Csikszentmihalyi, 1975) ^[9]. To elucidate, the perceived challenges, inherent in the task or activity must interact with, and match with the perceived skills of the person performing the task (Nakamura & Csikszentmihalyi, 2002) ^[47]. Likewise both challenges and skills must be at a moderate to high level so that the challenges “stretch but do not surpass existing skills” (Nakamura & Csikszentmihalyi, 2009) ^[49].

Flow and Performance

Since the beginning of flow research, a close relationship between flow experiences and performance has been postulated. This association has two plausible reasons. First of all, flow is characterized by high concentration and a sense of control, which are facilitators of performance (Eklund, 1996) ^[34].

Second, flow could be seen as a motivating force for excellence (Engeser and Rheinberg, 2008) ^[35]. When individuals develop the skills necessary to perform an activity, they also begin to master the challenges inherent in the activity. As new skills are acquired, new challenges have to be identified so that the balance between challenges and capabilities can be maintained. This cycle increases motivation, enhances competence, fosters growth, and extends the individual’s capacities (Csikszentmihalyi, 2008). Research on flow at work has shown that flow is positively related to performance in activities that have high intrinsic motivational potential (that is high in autonomy, meaningfulness, feedback, and challenge) (Demerouti 2006 ^[30]; Eisenberger, Jones, Stinglhamber, Shanock, & Randall, 2005) ^[33]. Based on a review of literature, Bakker (2005) ^[1] and Demerouti (2006) ^[30] identified three core elements of flow:

- i). Absorption, which refer to the absolute concentration and involvement in the activity.
- ii). Enjoyment, which refers to the experience of enjoying the activities, and
- iii). Intrinsic motivation, which refers to the need to perform a certain activity because of the fascination of the activity.

Predictors of Flow at Work

Flow has been found to be more prevalent at work than in leisure (Csikszentmihalyi & Lefevre, 1989) ^[14]. Some predictors of Flow at work includes social support, support for innovative practices at work, having clear rules and norms at work, and having clear goals (Salanova, Bakker, & Llorens, 2006) ^[56]. Furthermore, skill variety, some degree of autonomy in the job, job/task clarity, job feedback, task identity and task significance of the Job Characteristics Model (JCM) (Hackman & Oldham, 1975, 1980) ^[38] were also found to be of immense significance as the other predictors.

Components of Flow

Csikszentmihalyi (1975) ^[9] described six components of the flow experience.

- i). **Merging of Action and Awareness:** A person is aware of his/her actions but not of the awareness itself which is inseparable “from what one is doing”.
- ii). **Centering of Attention** on a limited stimulus field: high degree of concentration.

- iii). **Loss of Self-consciousness:** consideration about self-become irrelevant: this could be described as “the loss of ego,” “self-forgetfulness,” “transcendence of individuality,” or “fusion with the world” “One is in an ecstatic state to such a point that one feels as though one almost does not exist...”
- iv). **The Feeling of Control** of one’s action and the feeling of control over the demands of the environment:
- v). **Coherent, Non-contradictory Demands** for action, clear & unambiguous feedback, goals and means are logically ordered; action and reaction are automatic;
- vi). **Autoletic Nature:** No need for external goals or rewards; “The act of writing justifies poetry. The purpose of the flow is to keep on flowing...”

Nakamura and Csikszentmihalyi (2005) ^[24]; Csikszentmihalyi and Csikszentmihalyi (1988 a, 1988 b) ^[12, 13] additionally listed the characteristic of “distortion of temporal experience of time.” which typically means the feeling of time passing faster than normal.

Flow as a Multifaceted Experience

Conceptual and empirical evidence showed that the components of flow are highly correlated. Csikszentmihalyi (1997) ^[21] speculated that the merging of action and awareness is the clearest sign of the experience, and immersion might, in fact, represent a more central aspect than the other components. As Csikszentmihalyi put it. Flow is the “holistic sensation that people feel when they act with total engagement” (1975), and this holistic sensation is comprised of various components.

Flow as a Subjective Experience

Some of the listed components are sometimes regarded as conditions rather than components of flow. The component “feeling of control,” has become especially important in flow research (Nakamura and Csikszentmihalyi, 2005) ^[24]. The same holds true with the component of coherent, non-contradictory demands. The activity which promotes flow provides a clear goal and immediate feedback. Flow activities such a climbing or playing chess have such clear rules and goals. They also provide immediate feedback, which makes the experience of flow more likely. It is important to see the coherence and non-contradictory nature of the demands as a subjective experience that is part of the flow experience rather than a condition.

Flow as an Autoletic Experience

The “autotelic nature” of flow is sometimes regarded as the component of flow. Flow is experienced as being highly rewarding, and individuals strive to attain this state over and over again. The incentive lies in the engagement of an activity (Schuler and Engeser, 2009) ^[58], and in this respect, it is an autotelic or intrinsically rewarding experience.

Flow as an Optimal Experience

Csikszentmihalyi and LeFevre (1989) ^[14] called flow the “optimal experience” in the sense that “Flow is defined as a psychological state in which the person feels simultaneously cognitively efficient, motivated, and happy” (Csikszentmihalyi 1996) ^[19]. Flow is a positively valenced experience and is associated with feelings of enjoyment. As a highly functional state, flow correlates with performance enhancement in creative activities, learning, and sports (Csikszentmihalyi *et al*, 2005., Engeser and Rheinberg 2008)

[24, 35]. Flow also provides the incentives for developing skills and personal growth. Flow fosters the engagement in challenging activities, and in order to maintain flow, a person has to set higher standards as skill progress. In this respect, Csikszentmihalyi assumed flow to be the key to a rich, productive life and to cultural evolution (Massimini *et al*, 1988) [46].

Flow and Happiness

Flow is a rewarding experience, and loosely speaking, rewarding experiences make us happy, as punishing experiences make us unhappy. However, flow is not the experience of happiness itself. Empirical data confirm that flow and happiness are not experienced at the same time. Correlational data from an experience sampling method (ESM) Rheinberg *et al*, (2007) [55]; Rheinberg, 2008) [54] also showed that flow and happiness were not highly correlated.

Well-Being and Creativity

Csikszentmihalyi (1975) [9] explored the implications relating to “big questions” of human happiness, well-being, and creativity. What does it take to live a happy, meaningful, and creative life? Flow is a rewarding experience, as it has been reiterated through a large volume of researches. Moreover, flow can be experienced in a wide variety of activities. The rewarding nature of flow has a further implication, which Csikszentmihalyi emphasizes in relation to what makes a happy and meaningful life (Csikszentmihalyi 1996, 1997) [19, 21]. Flow provides the means, a help to a person to live up to one’s individual potential. A person actively searching for challenging situations that stretch his or her skills will increasingly develop more skills. In general, this means that a society should provide opportunities for actions that allow individuals to enjoy these activities, experience flow, and live up to their potential (Rheinberg and Engeser, 2010). Modern societies should make culturally valued activities prone to enjoyment in order to ensure the motivational basis for excellence in these areas. The implications drawn from Csikszentmihalyi for a better life are inspiring and of great value. “Flow is a powerful motivator, but it does not guarantee virtue” and that “a culture that enhances flow is not necessarily ‘good’ in any moral sense” (Csikszentmihalyi and Csikszentmihalyi 1988 a, b) [12, 13].

The Autotelic Experience

Csikszentmihalyi (1990) [15] described the flow experience in the following words: “The state in which people are so intensely involved in an activity that nothing else seems to matter; the experience itself is so enjoyable that people will do it even at great cost, for the sheer sake of doing it”. The desire to engage in an activity for its own sake typically is referred to as intrinsic motivation (Deci 1975; Rheinberg 2008) [26, 54].

Positive Affect and Life Satisfaction

It is plausible to assume that an experience that is so enjoyable as the flow experience should lead to positive affect and happiness. Csikszentmihalyi (1999) [22] concluded that his studies “have suggested that happiness depends on whether a person is liable to derive flow “the bottom line of existence because without it there would be little purpose in living” (Csikszentmihalyi, 1982) [10].

Subjective Well-Being

Subjective well-being comprises an affective as well as a

cognitive component. Whereas pleasant and unpleasant affective states constitute the affective component, the cognitive component is life satisfaction (Pavot and Diener, 1993) [50]. Life satisfaction refers to a cognitive judgmental process and can be defined as “a global assessment of a person’s quality of life according to his chosen criteria” (Shin and Johnson, 1978) [60]. Flow theory states that flow has an indirect effect on subjective well-being by fostering the motivation to face and master increasingly difficult tasks, thus promoting lifelong organismic growth. In particular, flow theory states the frequency and intensity of flow in everyday life pinpoint the extent to which a person achieves sustained happiness through deliberate striving, and ultimately fulfils his or her growth potential.

The Hitherto Neglected Dark Side of Flow

Flow is conceptualized as an optimal motivational state characterized by a positive quality of experience and is associated with high performance (Csikszentmihalyi, 1990) [15]. Empirical analysis of flow have mainly focused on the bright sides of flow, revealing flow to be a predictor of performance in the workplace (Eisenberger *et al*, 2005) [33], in academic learning settings (Engeser *et al*, 2005), and in sports (Jackson *et al*, 2001) [41]. Flow has also been shown to predict persistence in activities (Csikszentmihalyi, 1993) [17] & creativity (Perry, 1999) [51]. Hardly any studies have addressed Csikszentmihalyi’s claim that “Flow experience, like everything else, is not good in an absolute sense” (Csikszentmihalyi, 1990) [15]. Csikszentmihalyi and Rathunde (1993) [17] have answered their rhetorical question whether flow is always a good thing with the clear statement that “like other forms of energy, from fire to nuclear fission, it [flow] can be used for both positive and destructive ends.” Csikszentmihalyi has thereby suggested that the bright side of flow is accompanied by a dark side. From a critical look at the extended definition of flow as a state “in which people are so involved in an activity that nothing else seems to matter; the experience itself is so enjoyable that people will do it even at great cost, for the sheer sake of doing it” (Csikszentmihalyi, 1990) [15] has implications for a dark side of Flow. In other words, Flow has a cost. It has the potential to be dark & shady if not harnessed and put to use righteously.

The Characteristics of Flow and their Potential to be Good or Bad

Flow is a multifaceted phenomenon which is mainly characterized by “a subjective state that people report when they are completely involved in something to the point of forgetting time, fatigue, and everything else but the activity itself” (Csikszentmihalyi and Rathunde, 1993) [17]. The deep involvement in a task is usually described as a positive feeling. However, it is also associated with a loss of self-awareness, which means not thinking about the compatibility between one’s current activity and one’s future goals and personal values. For example, spending long hours playing computer games might cause time conflicts with one’s future educational goals in order to pass an exam and one’s personal goals (fostering social relationships) and might be incompatible with engaging in cultural activities and being an active person. Flow might produce short-term and long-term psychological conflicts. Other characteristics of flow can also be interpreted in a less “bright” way. Thus, the strong concentration on the task at hand means a narrowed focus of attention that makes it impossible to process information which is unrelated to the task, but nevertheless important. For

example, individuals who spend night after night playing computer games might neglect social obligation and other responsibilities and would be unaware and unbothered about the inappropriateness of their behaviour. During flow, individuals often report a distortion of time, time often seems to pass quickly. This can be interpreted as the absence of boredom (in which time seems to stand still), but could also have negative effects on activities which require a precise sense of time. In addition, flow can wreak havoc on useful time schedules (being home from work timely, finishing a project on time in order to allocate resources and time to other tasks) sums up the potential dark sides of flow.

Flow and Addiction

The International Classification of Diseases (ICD 10, World Health Organization 1994) defines addiction as a cluster of phenomena in which “the use of a substance takes on a much higher priority for a given individual than other behaviours that once had greater value.”

Table 1: The Dark sides of Flow characteristics

Flow characteristics	The Dark sides of flow characteristics
Loss of self-reflection	Neglecting further goals and values (of others)
Exclusive concentration on the task at hand	Narrowed focus of attention excluding additional information
High control, absence of anxiety	Overestimation of one’s abilities, unrealistic optimism
Distortion of time	Neglecting temporal information

Although these criteria were developed for psychoactive substance use and describe the symptoms of mentally ill persons, some criteria are also applicable to the experience of flow (Grant *et al.*, 2010) [37]. Individuals report a strong desire to experience flow again (Rathunde, 1993) [16] and prioritize it at the cost of other behaviors. The experience of flow is more likely a balance between the challenge of a task and the skills of a person and task and hand (Nakamura, 2002) [47], the situational challenges have to be continuously adapted to the improvement of the skills of a person.

Flow vs. Online Gaming Addiction and Internet Addiction

Recent studies show that flow can be experienced not only in natural environments but also in online environments (Chen, 2006) [7]. The World Wide Web is characterized by features such as controllability, immediate feedback, and ease of use, which make the experience of flow highly probable. Furthermore, flow has been found to be related to positive affect, exploratory behaviour, and attitudes toward web sites has been successfully used to explain online shopping behaviour and web use (Webster *et al.*, 1993) [63]. Besides the positive consequences of flow for Internet use, there are also negative consequences. The association between flow and problematic or even addictive behaviour has been analyzed empirically for the domains of Online Gaming and Internet use. Thatcher *et al.*, (2008) [61] have posited that the flow experience and problematic Internet use are correlated positively which was based on their study of more than one thousand Internet users. Problematic Internet use refers to the excessive use of the Internet that creates psychological, social, emotional dysfunctions and leads to maladaptation and maladjustments to the environment. The personal and professional life of an individual (in various domains such as School/College/Institutes etc. gets impaired and derailed.

(Beard and Wolf, 2001) [3]. Problematic Internet Addiction and Online Gaming includes symptoms such as needing to spend more and more time online, loss of control regarding the time spent online, and withdrawal symptoms. Typical Internet activities are general web browsing, e-mailing, news websites, telnet, and blogging. Thatcher *et al.*, (2008) [61] reported results which support the flow-addiction link: the stronger the participants experience of flow, the higher their problematic Internet use.

This is supported by the findings of Kim and Davis (2009) [42] and (Caplan, 2002) [6], who found a positive association between flow, as measured using Webster *et al.*'s (1993) [63] flow in human computer interaction scale (“When using the Internet, I am totally absorbed in what I am doing”), and problematic Internet use, which assessed items such as “I’ve tried and failed to cut down the amount of time spent online” and “My job performance and/or productivity suffers because of the Internet”. In addition, Kim and Davis (2009) [42] identified the participants’ perceived importance of Internet activity as being a mediator of this relationship. Researchers into the phenomenon of Online and Cyber-game addiction have argued that cyberspace behaviour is associated with flow because while in the flow state, the individual experiences a sense of happiness, an exploratory desire, and the absence of time pressure. In accordance with the above-mentioned findings which link flow to addiction, Chou and Ting (2003) [8] have found that the positives of flow tends to be addictive that promotes the tendency to repeat the activity of Cyber-gaming, which in turn can lead to addictive behaviour.

One dark side of flow is that it includes the possibility of making individuals addicted to certain activities. In dealing with addiction, clinical psychologists have established different principles and therapeutic techniques to deal with the problem, such as behaviour therapy (operant conditioning) and cognitive behaviour therapy (self-control techniques), which might also work in the treatment of flow addiction. However, in contrast to other forms of addiction, which need a specific substance (alcohol, cocaine), flow can be experienced through nearly any activity (Csikszentmihalyi, 1990) [15]. In order to prevent individuals from becoming addicted to a certain flow-producing and health-endangering activity (big wave surfing despite injuries), the experience of flow can be spread over a broader range of more moderate sporting activities (starting a new sport) and/or intellectual activities (learning a foreign language). However, the question remains whether the sum of several low-intensity flow activities will be able to balance an extraordinary, high level flow experience.

Possible Contributions of the Neurotransmitter Dopamine to the Flow State

As suggested by Marr (2001) [45], there might be a correlation of dopamine and flow-experience. Flow is a highly intrinsically rewarding state, and dopamine is considered to be an essential element in the brain reward system. The mesolimbic dopamine system belongs to the so-called pleasure centers of the brain. When an electrode was implanted into the septum of a rat’s brain, the rat could stimulate itself by pressing a button. The self-stimulation was so rewarding that the rat did not continue regardless of hunger or thirst. The mesolimbic dopamine system leads to regulation of the reward-related motivational, emotional, and cognitive processes (Davis *et al.*, 2009) [25]. Engagement in rewarding activities creates positive memories, and, therefore, these activities gain salience for a subject. This process can be seen

as an upward spiral of positive reinforcement that increases a subject's motivation toward the rewarding activity. Using a PET scan method (IIC-labeled raclopride), Koeppe *et al.*, (1998) [43] investigated human participants playing a rewarding game. They found an endogenous dopamine increase particularly in the (ventral) striatum that was positively correlated with the performance level.

Other indicators supporting a relation of dopamine and flow-experience are the effect of dopamine agonists, such as cocaine, that strongly resembles some attributes of the flow-experience: a rewarding feeling of high energy and alertness, accompanied by an improvement of concentration (and therefore performance), a carefree trust in one's own abilities with a feeling of perfect control over the activity, while forgetting about basic human needs such as hunger or sleep. Since the flow state is rewarding and appetitive, humans thrive to experience it more often and are more likely to engage in flow-eliciting activities. That is why highly flow-conducive activities carry at the same time a high risk for addiction. Examples are playing video games or internet surfing. Therefore, the relation of flow and addiction has recently occupied the central focus of research. One risk factor for addiction disorders seems to be hypodopaminergic functioning of the brain reward system so that dopamine-enhancing substances or activities are used to counterbalance the lack of dopamine in the system (Davis *et al.*, 2009) [25]. Given that flow leads to a dopamine increase, low basal dopaminergic activity would contribute to an autotelic personality, which implies action seeking and mastering of difficulties in order to experience the rewarding state of flow.

Possible Contributions of Cortisol to the Flow State

The close relationship between flow and stress, suggests a connection of the stress-hormone cortisol to be related to the flow-experience. Cortisol is a hormone belonging to the group of glucocorticoids and is secreted by the adrenal glands as an end product of the hypothalamus-pituitary-adrenal (HPA) axis. Cortisol is involved in general bodily functions like in metabolism and the immune system. Whereas every cell in the organism contains cortisol receptors, some brain areas are particularly rich of these receptors, e.g., the hippocampus, the hypothalamus, or the Pre-Frontal Cortex (PFC). Cortisol is involved in the regulation of stress-related processes as it is increasingly secreted in stressful situations, and, therefore, cortisol is often called "the *stress-hormone*".

Existing studies suggest that cortisol is involved in the coping process by mediating the stress response (Oitzl *et al.*, 2010; Putman and Roelofs, 2011) [52]. Baumann and Scheffer, (2010) [2], hypothesized that flow results from seeing difficulty and mastering difficulty. Therefore, seeing difficulties results in a cortisol increase preparing the individual for the stressful situation and providing additional resources for coping with the situation. Since cortisol acts as an energy supplier by providing glucose to the body, it can help to maintain mental effort. Putman and Roelofs (2011) [52] argue that cortisol facilitates approach-related behaviour and shields task performance from irrelevant emotions. Cortisol increase selective attention to stress-relevant stimuli, so that individuals use given information more efficiently and watch the important detail rather than the complete picture. A significant positive correlation of $r = 0.40$ between cortisol and flow-experience was observed in a complex video game. Elevated cortisol was also found in participants playing an optimally challenging level of the video game. (Putman and Roelofs, 2011) [52].

Discussion and Conclusion

The studies reported above suggests that the "optimal experience" of flow does not necessarily mean that the consequences of flow are always positive. While experiencing flow, individuals can become addicted to the euphoric feelings associated with flow, underestimate their personal risk of being led astray, derailing from other tasks and activities, willing to hurt or even kill other people. Thus, the term "optimal" refers to the inner state of sound physical and mental functioning, but not to the desirability of its outcome. Flow experience is not just a hedonic feeling that enhances an individual's quality of life; it is also an optimal functional state that can lead to peak performance as flow has a high adaptive value. This would be in agreement with Deci and Ryan (1985, 2000) [28, 29] self-determination theory (SDT). SDT assumes that intrinsic motivation is evolution-based and that performing activities just for the pleasure of doing them is associated with subjective well-being and personal growth. SDT assumes that intrinsically rewarding activities are in principle not directed against other persons, but are performed in harmony with the interests of other people or even for the benefit of others. Flow theory does not explicitly exclude the possibility that the positive experience of flow can be associated with "negative" (antisocial) behaviours. According to flow theory, not even basic need-satisfying environments (environments providing feelings of autonomy) are needed in order to experience flow, as long as some basic conditions (challenge-skill balance, clear goals, immediate feedback) are fulfilled. Flow can even be experienced in dangerous and need frustrating situations such as in combat (Harari, 2008) [39] and in concentration camps (Csikszentmihalyi 1990) [15]. "Even an experience involving extreme levels of deprivation, discomfort, and danger tends to become highly attractive once people enter flow" (Harari 2008) [39]. Flow is a universal competence-enhancing and sometimes even life-saving experience with a high adaptive value in evolution. The negative consequences of flow assumes a new dimension on the practical interventions which aim to facilitate flow. On the one hand, flow-enhancing strategies contribute to the cognitive and physical efficiency, motivation, and happiness of individuals. On the other hand, flow-enhancing strategies can yield negative outcomes. There is a necessity for Flow-enhancing interventions to match with the characteristics of specific populations or situations.

According to the reward mechanism, this should lead to long-term adherence to the desired activity and a progress in performance. In contrast, individuals who are already experiencing flow while performing an activity, such as elite big wave surfers, passionate kayakers, and experienced computer programmers, do not need flow-enhancing strategies but might benefit from the knowledge of strategies to reduce the experience of flow which they can apply in situations that endanger their psychological well-being or health. The former group of people need to lose themselves in an activity, whereas the latter group need self-reflection in order to separate themselves from the distracting activity at the right moment.

Suggestions for Future Research

The findings on the negative consequences of flow are based on a very small number of studies. Moreover, these studies are limited in their study designs. Thus, the understanding of the negative consequences of flow is mainly based on qualitative interviews and correlative field studies. Experiments, which are the ideal way to analyze the

dependence of consequences on certain conditions, might reveal more precise or even different insights in the relationship between flow and its outcomes. Further research is needed to overcome methodological problems and components of flow that are associated more with positive rather than with negative consequences. Furthermore, it would be interesting to know whether certain personality traits, such as openness to experience, action orientation (Kuhl and Beckmann 1994) [44], and sensation seeking (Zuckerman, 2006) [65], boost the negative effects of flow, whereas other variables such as state orientation (Kuhl and Beckmann, 1994) [44] or self-control competencies can buffer its negative effects.

Furthermore, most research into the consequences of flow is based on participants' self-reports of flow. Identifying and using physiological and neuropsychological, correlates of flow could help to objectivize the measurement of flow and one of the most important aims of future research is to figure out how to control flow in terms of evoking it when it is useful and abandoning it when it is harmful. Only few researchers have examined flow from a physiological perspective. Particularly for brain processes, mainly theoretical approaches exist; empirical studies are lacking. Electrophysiological (EEG) or imaging techniques (fMRI, PET scan) should be used to shed more light on the hypofrontality hypothesis (Dietrich, 2004; Dietrich and Stoll 2010) [31, 32]. Furthermore, neural correlates of self, time, and space seems to be promising variables in the investigation of the Flow-experience. In addition, the role of dopamine and cortisol in the experience of Flow and its propensity towards the dark side namely Online Gaming and Internet Addiction needs to be investigated by way of empirical and longitudinal studies. Pharmacological studies can be of relevance to clarify the role of dopamine to reach and sustain Flow. Further, results on facial Electromyography (EMG) measures to investigate Flow indicating emotional arousal are still inconsistent and need future clarification. Another difficulty is the huge variability of possible flow-inducing activities that require different activation levels for "optimal functioning," depending on the certain demands of the activity. There is a strong potential in the psychophysiological investigation of flow-experience, and further studies in research would marshal the relevant facts and postulate the cause and effect relationship both from empirical and longitudinal studies. Future research on the relation of flow and dopamine are needed to throw light on this aspect. Pharmacological studies, such as the administrations of L-dopa in an experimental setting can be a potential area of correlational research on the area. Further, imaginable is the use of neuroimaging methods, fMRI or PET scan with C-labeled raclopride RAC to measure changes in extracellular dopamine levels during flow-experience (Koepp *et al*, 1998) [43] can be subject areas of further research.

The dark sides of flow also need theoretical, empirical, and practical attention and intervention by significant others. Csikszentmihalyi's (1990) [15] statement that the challenge entails "learning to distinguish the useful and the harmful" forms of flow, and then making the most of the former while placing limits on the latter."

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