TNO Defence, Security and Safety

Kampweg 5
P.O. Box 23
3769 ZG Soesterberg
The Netherlands

www.tno.nl

T +31 34 635 62 11
F +31 34 635 39 77
info-DenV@tno.nl

TNO report

TNO-DV 2009 B640

Motivated learning in students and young professionals

Date	May 2010
Author(s)	dr M.L. van Emmerik dr J.E. Korteling
Assignor	Prof. dr A.W. Bronkhorst
Project number	032.30172/01.01
Classification report	Ongerubriceerd
Title	Ongerubriceerd
Abstract	Ongerubriceerd
Report text	Ongerubriceerd
Number of pages	23

All rights reserved. No part of this report may be reproduced and/or published in any form by print, photoprint, microfilm or any other means without the previous written permission from TNO.

All information which is classified according to Dutch regulations shall be treated by the recipient in the same way as classified information of corresponding value in his own country. No part of this information will be disclosed to any third party.

In case this report was drafted on instructions, the rights and obligations of contracting parties are subject to either the Standard Conditions for Research Instructions given to TNO, or the relevant agreement concluded between the contracting parties. Submitting the report for inspection to parties who have a direct interest is permitted.

© 2010 TNO

Samenvatting

Doelstelling
Veel westerse landen hebben te maken met vergrijzing. Onder invloed van dalende geboortecijfers en verbeterde leefomstandigheden verandert de bevolkings-samenstelling. Hierdoor worden organisaties geconfronteerd met een gebrek aan jongeren om de groeiende proportie ouderen op den duur te vervangen. Voor de continuiteit en innovativiteit van een organisatie is het dan ook van levensbelang om voldoende jongere medewerkers binnen te krijgen. Motivatie op de werkvloer is hierbij een sleutelbegrip. Het huidige rapport onderzoekt of studenten en jonge werkenden dermate veel van oudere werkenden verschillen dat een andere aanpak om hen te motiveren gerechtvaardigd of zelfs noodzakelijk is.

Methode
Op basis van de beschikbare literatuur hebben we de eigenschappen die de huidige generatie (grofweg 18-30 jaar oud) worden toegedicht onderzocht. Deze generatie heeft onder meer namen als ‘de millennials’, ‘the digital natives’, en de Internet-generatie waarmee een voorkeur voor netwerken en online activiteiten wordt gesuggereerd.
Op basis van de bevindingen schetsen we vervolgens een benadering voor motivatie en richtlijnen om motivatie op de werkvloer vast te houden.

Resultaten
De literatuur blijkt echter weinig empirische ondersteuning te geven voor de harde claims over de millennials voorzover het gaat over hun hogere intelligentie, vaardigheid wat betreft kritisch denken, vloeiende beheersing van digitale taal, en een anders georganiseerd brein (vergeleken met eerdere generaties). Ongeacht in welke generatie mensen geplaatst worden lijkt motivatie toch vooral beïnvloed door; het gevoel controle over de omgeving te hebben; de gelegenheid om hun eigen gedrag te bepalen; en de aanwezigheid van een sociale omgeving waarin mensen zich goed voelen.

Conclusie
De digitale revolutie heeft noch de definitie van motivatie noch de eigenschappen van de mensheid veranderd. Verschillen tussen oudere en jongere werkers kunnen veeleer verklaard worden vanuit leeftijdsverschillen dan vanuit generationele eigenschappen. De nieuwe mogelijkheden die moderne technologie ons biedt kunnen wel gebruikt worden om motivatie te verhogen of te ondersteunen. Op een dergelijke manier kan een goed en transparant beleid opgezet worden, gericht op levenslange ontwikkeling van vaardigheden en ondersteund op sociaal-emotioneel onderwijskundig gebied.
Een dergelijk beleid richt zich niet specifiek op jongeren of ouderen maar benadrukt de interacties tussen de generaties.

Summary

Purpose
In many western countries the composition of the population is becoming top-heavy with elderly. Birth rates have dropped while at the same time older people live longer with higher quality of life. Organizations are confronted with an increasing proportion of middle-aged and older professionals and a diminishing number of younger ones to replace them. It will be of utmost importance for those organisations to guarantee the influx of sufficient numbers of young employees in order to maintain their current rates of innovation. Motivation on the workfloor is a key aspect in this effort.
The current report focuses on the question if students and younger employees differ in such a way from older workers that a different approach to their motivation is required.

Method
Through a study of the available literature we have investigated the characteristics attributed to the current generation of young people (roughly aged 18-30). Common names for this generation include 'the millennials', 'the digital natives' and 'Internet-generation' suggesting a liking for networking, and online activity.
Based on the findings we then sketch an approach to motivation and guidelines to secure motivation on the workfloor.

Results
The findings show that there is little empirical evidence directly supporting the strong claims about millennials as far as their higher intelligence, critical thinking skills, fluent digital language, and different brain structure (compared to previous generations) is concerned. Irrespective of generational membership, motivation seems to be affected by the experience of people to have control over their environment; the ability to determine their own behavior; and the availability of other individuals to care for and relate to.

Conclusions
The digital revolution has neither changed the definition of motivation nor the characteristics of humankind. The differences between older and younger workers can be related to differences in age rather than generations. New (internet based) technology provides new ways to achieve and support motivation. As such it can facilitate the development of an adequate and transparent policy aimed at life-long development of capabilities, accompanied by a sufficient degree of (social-emotional-educational) support. This is expected beneficial to increase motivation. Preferably such an approach should not treat older and younger employees seperately but stress the interaction between generations.

Contents

Samenvatting **2**

Summary **3**

1 Introduction **5**

2 The Millennials **6**
2.1 Higher intelligence 7
2.2 Critical thinkers 8
2.3 Fluent digital language 8
2.4 Different brain structure 10
2.5 Discussion 11

3 Motivation **13**
3.1 Motivational theory 13
3.2 Motivation at work 14
3.3 Wrap up 16

4 Discussion and conclusion **17**

5 References **19**

6 Signature **22**

1 Introduction

As a result of economical, technical, cultural, and societal changes the qualities that organizations demand of their employees change as well. People thus have to adapt to these needs by (continually) educating themselves. However, with an increasing speed of change, the educational system runs the risk of lagging behind and delivering employees that are only fit for yesterdays tasks. Such a situation is neither beneficial for organizations nor for its employees. Without the proper competences, people cannot function optimally and hence are likely to suffer from stress and motivational problems. Within the current report, we are especially concerned with the motivation of students and young professionals as they will become a 'scarce commodity' for many organizations in the coming decades: in many western countries the composition of the population is becoming top-heavy with elderly. Birth rates have dropped while at the same time older people live longer with higher quality of life. Paradoxically, the world is innovating at an unprecedented speed. Therefore, it seems logical to contend that any organization failing to attract sufficient numbers of young employees will not be able to maintain the current rate of innovation. It will therefore become more and more important for an organization to motivate its (young) employees to develop themselves. The definition of youth (or for that matter, of any age category) is always colored by individual and contextual factors. Moreover, aging is a gradual process that has physical, cognitive, and social-emotional aspects that not necessarily are at odds with each other. Therefore, the current report will not provide an authoritative, coherent definition of 'young' workers but instead uses a pragmatic categorization including those professionals up to approximately 30 years old. This still allows for considerable differentation between individuals but is likely to include those persons that are in their first working years as well as the group (or generation) that has been raised in a 'digital world'. A range of different authors has invented well-sounding names for them such as 'Millennials', 'Net generation', or 'Digital Natives'. In Chapter 2 the scientific basis for distinguishing this generation from its predecessors will be addressed. Chapter 3 describes –motivation in theory and in practice at work after which Chapter 4 follows with a discussion and concluding remarks for the defence organization.

2 The Millennials

Newcomers entering the labour market differ in many respects from those of the generation before. Probably the most noticeable change is that todays' starters grew up in a digital world. Under the influence of the Internet and new communication technologies, these young students and employees, allegedly, have developed different preferences, strategies, and methods of working compared to those raised without the Internet. Both from the perspective of an employer who needs to hire new personnel and from the educators who want to prepare their students optimally for their future jobs, it would be important to consider the implications of such changes for motivation.

The current chapter will start out investigating the evidence there is for these differences between the (Inter)net generation (Tapscott, 1998), digital natives (Prensky, 2001a), generation Y (Li, 2007), or millennials (Howe & Strauss, 2000) -as this generation is named by different researchers- and their predecessors: 'generation X', and the 'baby boomers' (see also Table 1).

Table 1 Different classifications of human age (generations categorized by their estimated start and end years of birth). Corresponding colors (roughly) signify comparable generations.

Li (2007)[1]		Prensky (2001)	Dede (2004)	Caspian Learning (2008)
			Neomillennials (?)	Post Millennial (1995- now)
Gen Y (1980-1988)	Youth (1985-1994)	Digital Natives (1980-1994)	Millennials (1982-??)	Generation Y (1977-1994)
Gen X (1966-1979)			[gen. in between][2] (1965-1981)	Generation X (1965-1976)
Young Boomers (1956-1965) Older Boomer (1945-1955)		Digital Immigrants (before 1980)	Baby Boomers (1946-1964)	Baby Boomers (1946-1964)
Senior (before 1945)				Swing generation (1933-1945) WWII generation (before 1933)

According to popular beliefs, the advent of Internet as an ubiquitous information source with all it's possibilities for communication, sharing information, gaming and simulation, has changed the learning preferences of the current generation alike and traditional ways of training are wasted on them. Regardless of this hypothesis being true or false, the possibilities created by the Internet are extending the current educational horizon for both younger and older employees. This renders us with the intriguing question if (and how) we can increase motivated learning per sé (and hopefully training efficiency as well) by means of modern technology.

[1] Li originally provided ages for each generation based on data collected in 2006 . For ease of comparison these have been transferred to matching years of birth.
[2] Dede does not provide an explicit label to this group.

The Internet generation is often opposed to the so called 'Baby Boomers'. Born in the post-war era (1946-1964) this latter group is characterized as being strongly shaped by television and as such they are described as passive observers or consumers (Dede, 2004). In a reaction on this 'verdict', a critical reader might start to wonder which generation invented the Internet in the first place.

The characteristics of the Millennials (born after 1982 and starting their professional careers after the year 2000) have been shaped by the Internet and computers imbuing them with many characteristics including:

- A higher intelligence than their predecessors (Tapscott, 1997; Howe & Strauss, 2000).
- Critical thinking skills, highly independent, (less subserviant to authority) compared to their parents, open, innovative and curious (Tapscott; 1997; Dede, 2004; Pallof & Pratt, 2003).
- Speaking a digital language (Prensky, 2001).
- Different brain structure, short span of attention (Prensky, 2001; Oblinger & Oblinger, 2005; Opaschowski, 1999).

As a result of this they would be at risk of becoming alienated from traditional education (which has been designed for the previous generation). Dede (2004) suggests a number of measures to be taken to prepare education for the learning styles of (neo) millennials. It seems logical to assume that millennial employees would have similar requirements for their working environment to prevent alienation thus extending these measures to our complete environment. These include large scale wireless networking possibilities (using mobile wireless devices), personalizable multi-purpose habitats (instead of specialized locations or labs), and virtual versions of physical environments or augmented realities. Such facilities should support co-design and co-instruction so that knowledge of individuals can easily be shared among others and adapted to personal learning style. By means of guided social constructivist and situated learning pedagogies, simulation and case-based training assessment beyond tests and papers should be facilitated in associational webs of peers (Dede, 2004). The evidence for the presented claims, however, seems to be mainly anecdotical as will be argumented below.

2.1 Higher intelligence

Tapscott (1997) as well as Howe & Strauss (2000) put forward claims about the high intelligence of the Net generation. What they base their claims on is not completely evident. It turns out that Tapscott used questionnaires (returned by 300 respondents) obtained from an Internetforum with 15000 readers. This raises questions about selectivity of the responses and, moreover, the representativeness of the forum readers in relation to a whole generation.
Howe and Strauss mainly present anecdotical evidence. For example, to illustrate some of their claims about millennials, they refer to successful persons (such as actors or athletes) who are barely representative of their average generation. With regard to the questionnaire data Howe and Strauss use, it appears that all data were gathered from a Washington DC suburb (Fairfax County). Hesel and May (2007) compared the key demographic measures of this suburb to the national average (based on US Census data) and found that the sample population consisted of households with incomes nearly twice the national average and included almost no African-American or Hispanic families. Another methodological flaw is concerned with the fact that the results are

reported as percentages of all responses other than 'don't know' or 'not sure'. This will cause an inflation of the response rate for the remaining (extreme) categories and is likely to introduce a bias when the person who administers the questionnaire is your classroom teacher (that might read your answers).
In short, the evidence for claims about intelligence is based on suspect questionnaire data and anecdotical material from non-representative samples, and thus cannot be confirmed by empirical data.

2.2 Critical thinkers

Under influence of modern technologies the members of the Net Generation should become active seekers of information that produce their opinion from different sources. They are supposed to be critical thinkers, and more independent (less subserviant to authority) compared to their parents, furthermore they are open, innovative and curious (Dede, 2004). As he acknowledges, however, this classification is a simplification as it can be stated that the differences among individuals are greater than the dissimilarities between groups (Dede, 2004).
Lorenzo & Dziuban (2006) observed that Internet usage of students is often characterized by shallowness, randomness, and passiveness. Students "*lack of critical thinking when using Internet based information sources implies that students aren't as net savvy* [or Internet smart] *as we might have assumed*" (p.2, text between square parentheses added). In Bennet, Maton & Kervin (2008), students searching on the Internet are qualified as being easily frustrated, adopting a 'snatch and grab philosophy', and as making 'hasty, random choices with little thought and evaluation'. As far as curiosity is concerned, Dutch research indicates that technology may have changed but students have not (Kanters et al. 2008). Students still regard homework as boring, only they use a computer with Internet to find an answer on Google instead of in a book. Often students only check the first three hits from their search and they rarely cross-check the results. One of their conclusions is that although students might be 'ICT savvy', they are not necessarily 'information savvy'.

A further interesting study relates to independence and obedience to authority. Burger (2009) did a partial replication of Milgram's (in)famous experiment (Milgram, 1963) in which he investigated the willengness of naive subjects to obey an authoritative experimenter instructing them to administer potentially dangerous electrical shocks to a third person. His findings suggests that "*average Americans react to this laboratory situation today much the way they did 45 years ago*" p.9. Even though the author did not address the behavior of one specific generation, he "*found no effect for education, age, or ethnicity on participants' behavior in the study*" p.10. Which adds up to the evidence contradicting the characterization of a whole generation with a single concept.

2.3 Fluent digital language

Prensky, (2001) differentiates between digital natives and digital immigrants. According to him, "*Digital Immigrant instructors […] speak an outdated language*". As a result of the arrival and rapid dissemination of digital technology, a big discontinuity (or even singularity) has taken place between those who grew up with all these devices and those who didn't. The digital immigrants had to learn to interact with this technology at older age and hence will always have an 'accent'. This should explain that Digital Natives often have problems understanding their teachers need a revolutionary change of the tedious, slow educational approaches that the immigrants

are used to. Prensky's ideas are strongly criticized for their lack of empirical underpinning and aggressive rhetorical content by different authors. Bennet, Maton & Kervin (2008) state that "*there is little evidence of the serious disaffection and alienation among students*." Schulmeister (2008) argues against the digital natives / immigrant dichotomy: "*Die Pioniere der Computer- und Medientechnologie, die mit der Entstehung des Computers aufgewachsen sind, die ihren Computer noch aufmachen mussten, um ihn mit Controllern, Grafikkarten und zusätslichen Prozessoren auszustatten, die kryptische DOS-befehle tippen und Programmiersprachen wie Assembler beherrschen mussten, diese >>digitalen Experten<< sind nicht mit Prenskys Attribut >>Digital Natives<< gemeint, obwohl sie mehr vom Digitalen verstehen als Prenskys Netzgeneration."* In other words; Who invented the computer and the Internet anyway? Not these so-called digital natives!
The latter are in fact mainly users of software for, email, chatting, browsing, text editing, downloading music or movies, etc… It seems therefore, that the digital language Prensky speaks about has not so much to do with 'digital knowledge' but with communication, leisure, and social networking.
Kennedy et al. (2008) conducted a survey with more than 2000 Australian university students about access to, use of, and preferences for established as well as emerging technologies and tools. Although they observed that students rely on mainstream technologies for fast communication and convenient acces to information and services, they found considerable variation between students. The authors warn for a 'one size fits all' approach to the integration of ICT into education. While they see many opportunities for integrating modern technology in education and work, the exact way in which this should happen is not clear.

Figure 1 Digital language.

2.4 Different brain structure

Another claim by Prensky (2001) holds that digital natives have a different brain structure when compared to digital immigrants. This is caused by their being surrounded by modern technology and their constant interaction with this ubiquitous technical environment.
Obviously, on a micro level, individuals differ in the amount and strength of synapses or connections between individual neurons. Synapses are strengthened or weakened during learning and practice so that experts are likely to have strongly interconnected neurons in particular areas of their brains compared to novices (e.g., Aydin et al., 2007; Cannonieri et al., 2007; Draganski et al., 2006; Gaser & Schlaug, 2003). It is unlikely, however, that the functional organization or biological structure of the brain would be changed under the influence of practice -other than for reasons of a serious trauma (Schulmeister, 2008). Bennet, Maton & Kervin (2008) even label the 'digital natives' debate as an academic form of a 'moral panic' whilst there is no empirical nor theoretical evidence supporting the claims made about the current generation.
Yet Prensky states that Digital Natives are excellent multitaskers who continually and efficiently divide their attention between their e-mail, instant messages, computer, mp3-player or other gadgets. They can't sustain their attention for a long period, that is: when "old ways of learning" are concerned. As soon as they encounter anything that actually interests them, they are able to work focussed for longer times (Prensky, 2001b). Of course such argumentation can easily lead to circular reasoning. As Prensky continues, the Digital Natives work best in a network style and prefer games to serious work. Their skills have developed as a result of practicing over 10,000 hours during their formative years. The Digital Immigrant on the other hand is operating slow and serially and cannot cope with (or understand) the Native's way of working.
Again these claims seem to be inspired by anecdotical evidence with little back-up from science. The alleged talent of millennials for multitasking is seriously questioned by research findings. Dux et al. (2006) found evidence for a physical limitation of our ability to multitask, -even in young professionals-. They performed three experiments with 27 subjects aged 19 to 32 using time-resolved functional magnetic resonance imaging (fMRI) to measure the (hemodynamic) activity in the brain. Having subjects perform two tasks that shared neither sensory nor output modalities, their results show that at least in one place in the brain (the posterior lateral prefrontal cortex; pLPFC) neural networks exist that act as a bottleneck of information processing. This implies that Prensky's definition of multitasking has to be (at least) redefined to task-switching. Task-switching is the alternating serial performance of multiple tasks (which is serial rather than parallel). Still, at least for alternations that are not self-paced (i.e. phone call, cell phone short-text message, or an instant message) Westwell (2007) found that interruptions on a primary task disrupted performance as much for older (35-39) as for younger (18-21) subjects.
Korteling and Van Emmerik, (2009) also point out that the differences between age groups that are found for multi-tasking performance generally stem from laboratory tasks whereas those effects become smaller, or even disappear, when performance is measured in tasks that were well-trained before in daily life or at work. It seems that the older people have more difficulties in those situations in which skills or routines *have to be modified* or when *new (multi-)task skills* have to be learned. As this difference between younger and older persons has been observed for years and years, it should be considered an age-effect rather than a generation- or cohort-effect.

2.5 Discussion

The picture emerging from these findings shows that there is little empirical evidence directly supporting the strong claims of Prensky and other researchers. The dichotomy between Digital Natives and -Immigrants creates an artificial boundary between generations that holds neither in literature nor in practice. As some of these authors acknowledge, indidual differences within groups are larger than the differences between groups. Moreover, many specific claims about the millennial generation can be refuted by actual data. The widespread adherance to the idea of an Internet generation can according Hesel and May (2007) be explained by the Forer effect: "*People are highly disposed to accept vague, generalized, positive personality descriptions as uniquely applicable to themselves (or, in this case, their children).*" p.21.

To account for the large individual differences between users of technology it might be more productive to consider them based on their participation (instead of their year of birth). Li (2007) for example distinguishes users by their level of participation in social computing behavior, and as a result comes up with six types of users[3]:
Creators, Critics, Collectors, Joiners, Spectators, Inactives. The Creators are the most active group, publishing blogs, maintain web pages or upload material to You Tube more than once a month. Critics are users that comment on blogs or post ratings on sites. Collectors create metadata by saving URLs on social bookmarking services. This way they play a vital role in structuring the amount of content being generated by the Creators and Critics. Joiners are those users that participate in social networks like Hyves, Facebook, or LinkedIn. The Spectators are those reading and watching the content generated by their peers. Most of them do not generate content (as collectors, critics or creators do). The last group consists of inactives. That is, these are online but do not participate in social computing activities.

Table 2 Differences in participation in online activities per generation. Table adapted from Li (2007).

	Percent of each generation in each Social Technographics category							
	Youth (12-17)	Youth (18-21)	Gen Y (18-26)	Gen X (27-40)	Young Boomers (41-50)	Older Boomers (51-61)	Seniors (62+)	Total
Creators	34%	37%	40%	19%	12%	7%	5%	13%
Critics	24%	37%	34%	25%	18%	15%	11%	19%
Collectors	11%	16%	18%	16%	15%	16%	11%	15%
Joiners	51%	70%	57%	29%	15%	8%	6%	19%
Spectators	49%	59%	54%	41%	31%	26%	19%	33%
Inactives	34%	17%	21%	42%	54%	61%	70%	52%

Source: Forrester Research, Inc 2006 as presented in Li, 2007.

[3] Data stem from two different surveys and were weighted by age, income, and broadband adoption to demographically represent the US population:
Youth (N=4556): Forrester's NACTAS Q4 2006 Youth Media & Marketing And Finance Online Survey.
Adults (N=4475): Forrester's NACTAS Q4 2006 Devices & Access Online Survey.
Further, note that youth categories differ in that different activities and frequency of use were used: i.e. at least once per week versus at least once per month in the adults.

Table 2 shows the diverse roles that are assumed while interacting with digital media. Note that the activities displayed by the generations as shown from Gen Y to Seniors suggest a gradual change rather than the revolution preached by Prensky (2001a). It can be seen that students and young professionals (18-26 years old) are strongly represented amongst the Creators. However, as the categories are not excluding each other, we also see for example many more Spectators. In short, digital media usage is far higher for the younger generations and those young users assume many different roles (which explains why the percentages add up to a figure over 100%).

Furthermore, it can be seen that still 1 out of 5 members of Generation Y (Millennials) belongs to the inactives whereas 54% is mainly consuming (and not producing). This clearly illustrates the lack of homogeneity in the population that leads Kennedy et al. (2008) to conclude that regarding the access to, and use of modern technologies a large scale adaptation of school curricula in itself cannot be justified. There might, however, be other reasons to change our schools and working environments in an attempt to maintain or improve motivation of learners and employees. "*Students will be best served if their individual talents, passions, convictions, and commitments are touched personally. A one-size-fits-all generational theory works against that goal.*" Hesel & May, 2007. p. 22.

3 Motivation

In the previous chapter we have seen that there is no empirical argument to label an entire generation as Millennials. The large differences between individuals within an age group argue against such a unitary approach. Furthermore, the differences that appear between generations -if any- at the most suggest a gradual change rather than a revolution. These observations however, do not mean that we cannot (or need not) improve our schools or working environments from a motivational point of view.
In fact, for an organization such as Defense it is essential to secure the influx of young people as well as retaining them. The ample possibilities for education and training have long been major arguments to join the armed forces. As the pool of potential recruits is becoming smaller Defense will suffer growing competition from civil educational organizations. As such, they should take special care to address the motivational and attractive components of their jobs.

3.1 Motivational theory

With regard to motivation, a common distinction is made between extrinsic and intrinsic motivation (Deci, 1972; Bandura, 1997; Deci & Ryan, 1985).
Where motivation -in general- refers to the driving force to engage in a certain activity, in extrinsic motivation this drive is generated from outside the individual, for example by rewards or punishment. Intrinsic motivation is associated with the initiation of an activity because it is considered as interesting and satisfying in itself. Similarly, Herzberg (Herzberg, Mausner & Snyderman, 1959), in his two-factor theory of motivation distinguishes between motivating factors and so called hygiene factors that move people. Hygiene factors inherently do not give satisfaction. Their absence, however, does give dissatisfaction. Therefore Herzberg also popularly called them KITA (Kick In The Arse) factors implying that you can ‘move’ anybody by sheer force but once you stop applying force ‘motion’ stops. Motivation factors on the other hand are those that are satisfying when present. These help a person to achieve and grow and should be provided by the task and the workplace itself. According to Herzberg, these include factors such as achievement, recognition, responsibility, growth and advancement. This also implies that training opportunities are important to keep people motivated over time and to retain them. Extrinsic motivators or hygiene factors might be useful in recruiting personnel but will not make them stay.

Edward Deci and Richard Ryan (Ryan & Deci; 2000, Deci & Ryan; 1985, 2002) have developed the Self-Determination Theory (SDT) of motivation. According to SDT, human behavior, or rather the motives according which people choose to engage in an activity can be seen on a continuum from being externally driven to being totally volitional or self-determined. Ryan and Deci claim that the process of internalizing external motives is affected by social context, basic human needs, and individual differences (Ryan & Deci, 2000). On the low-end of the continuum is *external regulation*, which implies the person does something only to achieve a reward or to avoid punishment. Once the individual starts seeing that performing a task in his own interest, Ryan and Deci talk about *introjected regulation* (partial internalization of extrinsic motives). The next level is *identified regulation*, which refers to doing an activity because the individual identifies with the values and accepts them as his own. From this stage on, behavior is autonomous and not merely controlled by external factors. Finally, *integrated regulation* refers to identification with the values and

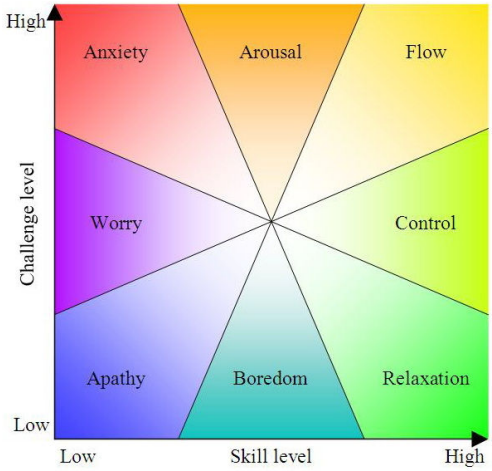
meanings of the activity in such a way that these become fully internalized and autonomous (Ryan & Deci, 2000).

3.2 Motivation at work

Employees in any organization need something to keep them satisfied. According to popular belief in the 19th century and early 20th century the salary of the employee should be enough to keep them working on the job (Taylor, 1911). Since then, many research has claimed otherwise. Mayo (1933, 1949) already stated that social contacts at the workplace are important for job satisfaction whereas boredom and repetitive work leads to reduced motivation. Acknowledgement of social needs and the feeling of being important along with responsibility and freedom to make their own decisions resulted in satisfied workers, regardless of other manipulations that the researchers administered. This has become known as the Hawthorne effect. Although Mayo has received many criticisms, his study at least showed that motivation can be influenced by many intervening variables such as expectations, change, and attention.
Another motivational theory was posed by Herzberg (1959). According to his two factor theory salary is mainly a dissatisfier when an employee is underpaid and it won't necessarily increase productivity when increased. Also according to Maslow's hierarchy of needs (1943), money is a motivator, though its effect tends to be ephemeral and therefore has a place in the lower levels of the hierarchy. At higher levels of the hierarchy, praise, respect, recognition, empowerment and a sense of belonging are far more powerful motivators than money. In addition to the nature of the work environment in relation to motivation, other researchers focused on individual characteristics of the workers who might have different orientations to their jobs.
For some employees, work is merely a means to an end. Goldthorpe et al. (1968) called these instrumentally oriented workers. They also defined bureaucratic workers who see their jobs a source of status, security and immediate reward. Finally solidaristic workers prioritise group loyalty. For each of these employees, different motivators could be used.
Since then, it has been recognized that cultural differences play a part in motivation, and further as individuals develop, their motivation will be triggered by different factors at different times. Deci and Ryan (2002) stress that for any organization, it is important to realize that employees will generally search for growth and development.
By stimulating three basic psychological needs: competence, autonomy, and relatedness, organizations can facilitate the process of internalization of external motivation. According to Deci and Ryan (2002) these three psychological needs motivate the self to initiate behavior and specify "nutriments" that are essential for psychological health and well-being of an individual.
To feel competent, employees should experience themselves as capable and competent in controlling their environments and they should be able to reliably predict outcomes. The feeling of autonomy (or self-determination) refers to the active participation in determining ones own behavior without being forced by external interferences. Relatedness has to do with social aspects. Everyone needs others to care for and feel related to others. Feeling valued increases motivation.

Flow
The observation that motivation changes over time can be explained by a concept strongly related to motivation: flow. Csíkszentmihályi (1975, 1998) describes this as a state of concentration where people are completely absorbed by the activity they are engaged in. It is one of the most enjoyable experiences, and people report feeling active,

alert, happy, strong, concentrated and creative during the experience (Csíkszentmihályi & LeFevre, 1989). As such, flow is an optimal state of intrinsic motivation. During a period of flow, a person typically ignores other needs such as the need for sleep, food, or affection to be able to contue a self selected activity.
Flow theory predicts that experience will be most positive when a person perceives that the environment both contains high enough opportunities for action (or challenges), and is matched with the person's own capacities to act (or skills). If a task does not contain enough challenge, apathy and boredom will occur rather than flow. A challenge level that is too high for a given skill level will result in anxiety. This framework can predict that people who develop their skills will not continue to be motivated by the same challenges forever.



(Csíkszentmihályi, M., Finding Flow, 1997.)

Goal setting
Motivation can also be related to goal setting (Locke, 2001). According to goal theory setting a clearly defined end state results in a drive to reach that state. Three properties determine the strength of a goal: proximity, difficulty and specificity. This is similar to the SMART criteria (Miller & Cunningham, 1981).
To increase the likelyhood that a goal can be reached, it should not be set too far away in de future. Furthermore, goals should be moderately difficult to complete. Either too low or too high difficulties will reduce motivation to reach the goal. Finally, the goal should be defined objectively, in clear and understandable terms. Once people cannot cleary identify their goals in terms of these properties, many will fail to attain them.

Self-efficacy
Motivation is also determined by several cognitions which can, as such, be used to predict attrition rates (Cigrang et al., 1998, 2000; Maddi et al.,1998). Important cognitive predictors are the positive expectations towards the results of putting in one's effort in a job or training. If these are paired with a sense of control, self-efficacy, and the intention to finish that job, people can be said to be motivated.
Self-efficacy refers to the extent to which a person expects to be able to face certain challenges. If a person feels unable to complete a certain task this will naturally be detrimental to his motivation (Longo et al.,1992; Cigrang et al., 1998). For a person with a high level of self-efficacy, asserting their own influence in the events that happen around them, attrition rates are lower (Kingston, 2008). If someone feels in control in a predictable environment, he or she will interpret daily activities as interesting and meaningful, whereas stressors provide possibilities for growth and development

(Vogt et al., 2008). Such an attitude wil reduce the risk of demotivation. By focusing interventions on cognitive aspects such as self-efficacy, the risk of attrition as a consequence of diminshed motivation can be reduced (Deci, 1995; Christle et al., 2007).

3.3 Wrap up

The appreciation of motivation has departed from the traditional stick and carrot model for quite some time. We have come to realize that real motivation (as required for job satisfaction) should originate from the individual instead of from external sources. Having reached this conclusion it is also seen that intrinsic motivation is the most difficult to influence- whether that be for younger or older employees. By providing optimal conditions for the individuals to grow and develop, an organization sets the scene for motivated employees. This means that employees should experience control over their environments, can determine their own behavior and should be surrounded by others to care for and to feel related to. This remains unchanged for current generations regardless of technological developments. If task and required skill level are in line, a person can get into a state of flow which means that performing the task in itself becomes motivating. Furthermore, if individual goals can be defined ‘smart’ or in terms of proximity (in time), difficulty and specificity, working towards those goals will increase motivation. By seeing their goals coming closer step by step, self-efficacy (the feeling one is capable of reaching his goals) makes it worthwile to persevere and attain them.

4 Discussion and conclusion

Some authors argue that a new generation emerges from the digital revolution: the advent of the Internet, the availability of mobile technology, the increase of computer power. Combined, these three aspects result in a ubiquitous availability of communication, education, and entertainment. According to these authors, today's youth, even have evolved physically as a consequence of their new ways of collecting and distributing information. Young students and professionals allegedly differ from their predecessors (the baby-boomers) on a number of aspects. They are supposed to have a different brain structure, a high intelligence, strong critical thinking skills althought they have a short span of attention when they are confronted with traditional learning tasks, they are highly independent, (less subserviant to authority compared to their parents), open, innovative and curious, and speak a digital language. However, the available data do not support the definition of a whole generation as 'millennials'. Their proponents present mainly claims supported by anecdotical evidence at most. Whereas many of the so called Internet generation only use the Internet for accessing their email and socializing through Hyves or Facebook, many of the technological developments the millennials are supposed to derive their identity from (including the Internet itself) have been developed by 'baby-boomers' or members from 'generation X'. The large differences between individuals within an age group argue against a unitary approach to learning, working, and social life. In fact, the differences that appear between generations -if any- at the most suggest a gradual change or evolution rather than a revolution.
As we are confident that age categories are gradual and should not be distinguished by a metaphorical gap, it would thus be odd then to draw that gap when speaking of motivation and learning for life. For that reason, some of the recommendations made by Korteling and Van Emmerik (2009) will hold for younger employees as well as they do for the older ones. Still, it can't be denied that there are differences between younger and older workers. In general, younger employees will be more flexible, more open to challenges, and less specialized than older workers, but in our opinion these differences are related to age rather than generation.

In addition to these observations, it has been noticed that in many western countries the composition of the population has shifted from a pyramid shape to a distribution that is becoming increasingly top-heavy with elderly and has a small base. This has been caused by a drop of birth rates combined with improved medical and working conditions. As a result people live longer with higher quality of life. The increased number of elderly, at the same time, places a heavy burden on the social system forcing people to continue working after the age of 65. To survive in a world that is innovating at an unprecedented speed, organisations should aim at the older workers as well as at the young ones.

With respect to the older employees a lot of negative stereotyping has to be overcome. Korteling and Van Emmerik (2009) argue that an adequate and transparent policy aimed at life-long development of capabilities, accompanied by a sufficient degree of (social-emotional-educational) support can be adequate to counteract the social, cognitive and motivational phenomena older workers are confronted with. Such an approach should not treat older and younger employees seperately but stress the interaction between generations.

We have seen that stereotypes for younger workers also exist, although they tend to be more positive. Nevertheless, any organisation willing to maintain their current rate of innovation should secure the influx of young employees by providing a stimulating, challenging, and secure work environment for its employees.
Where Korteling and Van Emmerik (2009) focus on the resilience of the individual (the activation of motivational resources to enhance one's adaptive capacities), resilience in the current context could apply to the organization. Companies too, have to adapt to the changes instigated by society, labour market, and technology to secure their continued existence.
This is not achieved by an approach on motivation aimed only at the current generation. Instead all employees should be allowed to work under optimal conditions to grow and develop. Such an environment is not necessarily based on technology but stems merely from three basic psychological needs: competence, autonomy, and relatedness.
These needs facilitate the process of internalization of external motivation. Motivating employees is one side of the story. Keeping them motivated is another. People who develop their skills will not continue to be motivated by the same challenges forever. This implies that in a dynamic world, with dynamic employees, organisations face quite a challenge.
Once employees experience control over their environments, feel trusted to determine their own behavior and are surrounded by others to care for and to feel related to the conditions for motivation at work are present. If these conditions persevere over an extended period of time employees can get into a state of flow which means that performing the task in itself becomes motivating for them.
By clearly defining the goals for individual employees and approaching these goals in a step by step manner, an organisation can stimulate self-efficacy (the feeling one is capable of reaching his goals) makes it worthwile to persevere and attain them.

5 References

Aydin, K., Ucar, A., Oguz, K.K., Okur, O.O. & Agayev, A., et al. (2007). Increased Gray Matter Density in the Parietal Cortex of Mathematicians: A Voxel-Based Morphometry Study. AJNR Am J Neuroradiol 28: 1859–1864.

Bandura, A. (1997), Self-efficacy: The exercise of control, New York: Freeman, p. 604.

Bennett, S., Maton, K. & Kervin, L.(2008). The 'digital natives' debate: A critical review of the evidence. British Journal of Educational Technology 39 (5), 775-786.

Burger, J.M. (2009). Replicating Milgram; Would People Still Obey Today? American Psychologist 64 (1), 1-11.

Cannonieri, G.C., Bonilha, L., Fernandes, P.T., Cendes, F. & Li, L.M. (2007). Practice and perfect: length of training and structural brain changes in experienced typists. Neuroreport 18: 1063–1066.

Christle, C.A., Jolivette, K. & Nelson, C.M. (2007). School Characteristics Related to High School Dropout Rates. Remedial and Special Education, vol28, nr 6, p. 325-339.

Cigrang, J.A., Carbone, E.G., Todd, S. L. & Fiedler, E. (1998). Mental Health Attrition in Air Force Basic Training. Military Medicine, vol. 163, p. 834-838.

Cigrang, J.A., Todd, S.L. & Carbone, E. G. (2000). Stress Management Training for Military Trainees Returned to Duty After a Mental Health Evaluation: Effect on Graduation Rates. Journal of Occupational Health Psychology, vol. 5, nr 1, p. 48-55.

Csíkszentmihályi, M. (1998). Finding Flow: The Psychology of Engagement With Everyday Life. Basic Books.

Csíkszentmihályi, M. (1975). Beyond Boredom and Anxiety. San Francisco, CA: Jossey-Bass.

Csíkszentmihályi, M. & LeFevre, J. (1989). Optimal experience in work and leisure, Journal of Personality and Social Psychology 56 (5), p. 815–822.

Deci, E. (1972). "Intrinsic Motivation, Extrinsic Reinforcement, and Inequity", Journal of Personality and Social Psychology 22 (1): 113–120.

Deci, E.L. & Ryan, R.M. (1985). Intrinsic motivation and self-determinaton in human behaviour. New York: Plenum.

Deci, E.L. (1995). Why we do what we do: Understanding self-motivation. New York: Penguin Books.

Deci, E. & Ryan, R. (Eds.) (2002). Handbook of self-determination research. Rochester, NY:University of Rochester Press.

Dede, C. (2005). Planning for Neomillennial Learning Styles: Implications for Investments in Technology and Faculty. In: Oblinger, D.G. & Oblinger, J.L. (Eds): Educating the Net Generation. Educause 2005. Available at: http://www.educause.edu/educatingthenetgen

Draganski, B., Gaser, C., Kempermann, G., Kuhn, H.G. & Winkler, J, et al. (2006). Temporal and spatial dynamics of brain structure changes during extensive learning. J Neurosc 26: 6314–6317.

Dux, P.E., Ivanoff, J., Asplund, C.L. & Marois, R. (2006). Isolation of a Central Bottleneck of Information Processing with Time-Resolved fMRI. Neuron 52, 1109–1120.

Gaser C. &. Schlaug, G. (2003) Brain structures differ between musicians and non-musicians. The J Neurosci 23: 9240–9245.

Goldthorpe, J.H., Lockwood, D., Bechhofer, F. & Platt, J. (1968). The Affluent Worker: Attitudes and Behaviour Cambridge: Cambridge University Press.

Herzberg, F., Mausner, B. & Snyderman, B.B. (1959). The Motivation to Work. John Wiley. New York.

Hesel, R.A. & May, S.B. (2007). Dispelling the Millennial Myth. CaseCurrents 33 (2), 16-22. Available at: www.casecurrents.org

Howe, N. & Strauss, W. (2000). Millennials Rising; the next great generation. Vintage books.

Kennedy, G.E., Judd, T.S., Churchward, A., Gray, K. & Krause, K. (2008). First year students' experiences with technology: Are they really digital natives? Australasian Journal of Educational Technology, 24 (1), 108-122.

Kingston, E. (2008). Emotional Competence and Drop-Out Rates in Higher Education. Education and Training, vol. 50, nr 2, p. 128-139.

Korteling, J.E. & Emmerik, M.L. van (2009). Learning for life in older professionals. TNO Report (in preparation) TNO Human Factors, Soesterberg, NL.

Locke, E.A. (2001). “Motivation by Goal Setting,” Handbook of Organizational Behavior, 2: 43-54.

Longo, D.A., Lent, R.W, & Brown, S.D. (1992). Social Cognitive Variables in the Prediction of Client Motivation and Attrition. Journal of Counseling Psychology 39, p. 447-452.

Lorenzo G. & Dziuban, C. (2006). Ensuring the Net Generation Is Net Savvy. Oblinger, D. (Ed.) ELI Paper. 2: Educause. September 2006.

Kanters, E., Vliet, H. van, Ringersma, D., Zwaan, M. & Kokkeler, B. (2008). Wat punt nul...? Web 2.0 en MBO leerlingen. Zoetermeer: Stichting Kennisnet.

Li, C. (2007). Social Technographics. Cambridge: Forrester Research.

Maddi, S.R., Kahn, S. & Maddi, K.L. (1998). The Effectiveness of Hardiness Training. Consulting Psychology Journal; Practice and Research, vol. 50, nr 2, p. 78-86.

Mayo, G.E.J. (1933). The human problems of an industrial civilization (New York: MacMillan).

Mayo, G.E.J. (1949). Hawthorne and the Western Electric Company, The Social Problems of an Industrial Civilisation, Routledge.

Maslow, A.H., (1943). A Theory of Human Motivation, Psychological Review 50(4): 370-396.

Milgram, S. (1963). Behavioral study of obedience. Journal of Abnormal and Social Psychology, 67, 371–378.

Miller, A.F. & Cunningham, J.A. (1981). How to avoid costly job mismatches. Management Review 70, (11).

Oblinger, D.G. & Oblinger, J.L. (2005). Is It Age or IT: First Steps Toward Understanding the Net Generation. In: Oblinger, D.G. & Oblinger, J.L. (Eds): Educating the Net Generation. Educause 2005. Available at: http://www.educause.edu/educatingthenetgen

Opaschowski, H.W. (1999). Generation @. Die medienrevolution entläßt ihre Kinder: Leben im Informationszeitalter. Hamburg/Ostfildern: Kurt Mair Verlag.

Palloff, R.M. & Pratt, K. (2003). Virtual Student. A Profile and Guide to Working with Online Learners. San Francisco: Jossey-Bass.

Prensky, M. (2001a). Digital Natives, Digital Immigrants. On the Horizon. NCB University Press, 9(5). Available at: http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20 Immigrants%20-%20Part1.pdf.

Prensky, M. (2001b). Digital Natives, Digital Immigrants, Part II: Do They Really Think Differently? On the Horizon. NCB University Press, 9(6). Available at http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part2.pdf.

Ryan, R.M., & Deci, E.L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, 55, 68-78.

Schulmeister, R. (2008). Gibt es eine >>Net Generation<<? Hamburg: Universitat Hamburg.

Taylor, F.W. (1911). The Principles of Scientific Management (New York: Harper Bros.). Available at: http://www.eldritchpress.org/fwt/taylor.html.

Tapscott, D. (1997). Growing Up Digital: The Rise of the Net Generation. McGraw-Hill: New York. Available at: http://www.growingupdigital.com/index.html.

Vogt, D.S., Rizvi, S.L., Shipherd, J.C. & Resick, P.A. (2008). Longitudinal Investigation of Reciprocal Relationship Between Stress Reactions and Hardiness. Personality and Social Psychology Bulletin, vol34, nr 1, p. 61-73.

Westwell, M. (2007). Disruptive communication and attentive productivity. Institute for the Future of the Mind, University of Oxford, Department of Pharmacology, Mansfield Road, Oxford OX1 3QT UK.

6 Signature

Soesterberg, May 2010

TNO Defence, Security and Safety

dr M.M. Hackmann, MSc
Head of department

dr M.L. van Emmerik
Author

Distribution list

The following agencies/people will receive a complete copy of the report.

1	DMO/SC-DR&D inclusief digitale versie bijgeleverd op cd-rom
2/3	DMO/DR&D/Kennistransfer
4/6	Bibliotheek KMA
7/8	TNO Defensie en Veiligheid, vestiging Soesterberg, (Archief)
9/12	TNO Defensie en Veiligheid, vestiging Soesterberg, Business Unit Human Factors, Prof. dr A. Bronkhorst dr M.L. van Emmerik dr M.M. Hackmann, MSc dr J.E. Korteling