Think!First:
Inducing Behavioural Change Through Gamification, Persuasive Design Principles and Machine Learning

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Abstract: The importance of online trading is steadily increasing both nationally and internationally and will reach a market volume of 354 billion euros in 2020 for clothing alone. This rapid increase in parcel volume, but also the high number of returned goods - which account for up to 60% of deliveries - pose new challenges in the light of climate change, air pollution and traffic management (EHI Retail Institute 2015; Kristensen K. et al. 2013). Previous initiatives aim at the electrification of delivery cars or at the provision of central collection points, but do not use the biggest lever: human behaviour. What is needed are innovative approaches that broaden the scope of action for customers highlighting a more sustainable shopping experience. Within the Think!First project, a modular framework in terms of “level-up” for web shops was designed, developed and evaluated. With the help of gamification strategies, persuasive design principles and machine learning algorithms, users of our test shop were encouraged to behave in a more targeted and environmentally conscious manner while purchasing online goods. In order to measure the impact of our framework, we conducted a nationwide field test which showed that there are significant quantitative changes in interest and knowledge concerning sustainable shopping choices as well as a reduction of returned parcels in the test shop. Qualitative expert interviews showed that online retailers may implement customer-centric Think!First strategies in their own shops taking into account the increasing competition and ever demanding efforts to satisfy customers. In retrospect our framework can be seen as crucial first step in improving the e-commerce sector on an ecological, a technological and a behavioural level.

Keywords: behavioural change, gamification, persuasive design, machine learning, e-commerce

1. Introduction

E-commerce is showing steady national and international growth rates (Handelsverband 2015, RetailMeNot 2015). Currently, 10% of retail sales in Austria are handled via e-commerce. This share will rise sharply in the future (WKO & bmwfw 2014), which will have serious consequences for freight traffic. Looking at this development from an ecological point of view, the increasing volume of parcels results in more delivery trips, more transport vehicles and more customer stops. In addition, this problem is exacerbated by the mostly free return of parcels, which are an inherent part of online trading. Online trading can only show a better eco-balance than local shops under optimal conditions, which include group orders, personal presence at home at the time of delivery, the reduction of returns and the renunciation of "same day" deliveries which have become en vogue. The goods should be delivered directly to the end customer, and additional shopping channels are to be eliminated.

This is where the "Think!First" project comes in. In contrast to conventional logistic solutions[1], which are currently being researched and tested in various studies, this project intervenes in the ordering process to induce a behavioural change in customers. Online shoppers are voluntarily nudged to inform themselves about size charts and product properties, to write reviews, to accept longer delivery times and to avoid returns. This highly customer-centred and preventive approach starts even before any freight traffic is created.

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[1] E.g. optimization of processes, increase of capacity utilization and efficiency through optimization of routing algorithms and bundling of goods in delivery/collection boxes, use of actively and alternatively driven means of transport

This positive change in awareness and behaviour should be achieved through the application of a gamification framework, persuasive design principles and machine learning. The project benefits from the current trend towards a more careful use of resources and increased awareness of climate protection among the population. Thanks to the support of the partner company “Gruene Erde” (Green Earth), a nationwide field test across Austria has taken place that specifically examines and validates the effectiveness of these strategies to effect a behavioural change towards a more environmentally friendly future in eCommerce. Thus, this paper delivers a descriptive report on customer-centric intervention strategies.

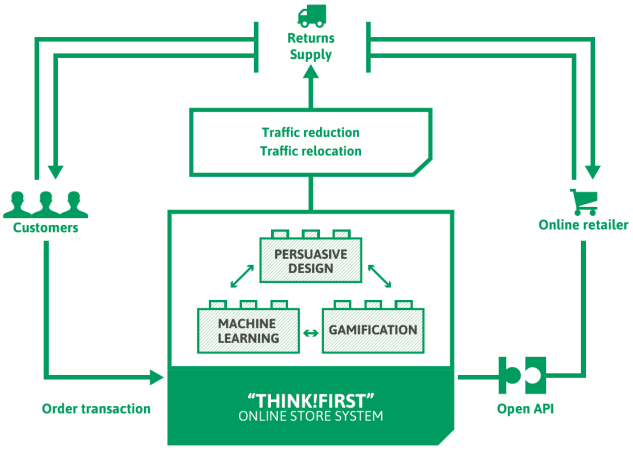

Figure 1: Framework

2. Theoretical Framework

As part of the "Think!First" project, a modular online ordering system has been designed, developed and tested with the aim of sensitizing and directing customers to more sustainable shopping behaviour through innovative intervention strategies. Figure 1 shows the intersection of the topics of freight mobility and e-commerce as well as the three intervention strategies used: gamification, persuasive design and machine learning. The theoretical framework is based on behavioural change theories with a focus on gamification as well as persuasive design. In a further step, machine learning strategies were integrated in this modified model.

2.1. Gamification

The gamification movement deals with the application of game elements in non-game application areas. Elements such as points, badges, level-ups, items or rankings, which are known from digital games, are used to satisfy the needs of the players, to increase the experience factor and to motivate users to make more intensive use of the respective offer (Deterding 2011). The reference to behavioural theories such as operant conditioning (Skinner, 1984), the theory of self-efficacy (Bandura 1977) and social determination theory (Ryan & Deci, 2000) is immediately recognizable and can already be found in 19th century customer loyalty programmes (Zichermann 2011). Building on the success of the games sector, gamification is now being widely applied globally in almost all sectors from e-commerce and personal mobility to the education sector.

However, the quantitative impact of gamification has hardly ever been empirically evaluated so far with the exception of a meta analysis by Hamari et al- (2014). In mobility research, positive effects of gamification strategies in the sense of greater environmental awareness in the choice of means of transport were found in (Kazhamiakin 2015). In general, with regard to the implementation of gamification in various settings, a low to medium impact of gamified systems on motivational, cognitive and behavioural levels can be assumed according to (Klumpp 2016) and Wouters et al. 2013).

2.2 Persuasive Design

Persuasive design uses the conscious design of virtual services (Kim & Fesenmaier 2008) or real goods (Marcuse 1991) to bring about targeted behavioural changes (Fogg 2009) or to influence decision making (Redström 2006). Strategies range from reward systems, contextual information, social comparisons to competitive elements (Herber 2013; Torning & Oinas-Kukkonen 2009). A close relationship to gamification and nudging is therefore strongly evident. The motivational-psychological perspective is particularly relevant here. There are two essential prerequisites for the success of behavioural triggers: On the one hand, the initial

motivation must be sufficiently high - on the other hand, the actual ability to execute the desired behaviour is a prerequisite (Fogg 2009). This is where persuasive design strategies come into play. Onboarding must be as easy as possible, and the interface should be informative, efficient and at the same time appealing in terms of high usability (Kim & Fesenmaier 2008).
Within the scope of e-commerce, persuasive design strategies are often used to maximise the user-friendliness of the ordering system and the desired behaviour in terms of sustainable goods delivery (=compliance) by means of a strong visual character and prominently placed context information. The interactive component (e.g. reward systems, social shopping experiences) is covered by the combination with gamification frameworks.

2.3 Machine Learning

Machine learning is a subfield of Artificial Intelligence, which since 1959 has had the goal of developing algorithms that learn. Machine learning and especially the currently popular research area deep learning are used in many areas to replicate complex human behaviour. Examples where these concepts are applied are the Japanese board game "Go" (Silver et al. 2016) or autonomous cars (Levinson et al. 2011). The current challenge is the processing of big data. This involves large, fast-changing, complex or weakly structured data. For decades, many aspects that are of importance for addressing this challenge have been among the active research areas of machine learning, such as the scaling of computational complex learning algorithms (Seewald & Kleedorfer 2007), the direct processing of complex structured data (Seewald 2008), the determination of the required amount of training examples to achieve accuracy and to enable the decision quality of such systems in realistic deployment scenarios (Seewald 2012). This is particularly important for deep learning concepts, as training data in the billions is sometimes required. To achieve this, data may be extended by transformations, which can have a negative impact on performance in the real world if these are not sufficiently representative. Deep learning systems can benefit disproportionately from the availability of large amounts of data. For this reason, however, they are also unable to react quickly to rapidly changing data, which is why they cannot always hold their own against older, simpler methods. One recently noted disadvantage of deep learning methods is their susceptibility to minor changes in input data and their propensity to learn discriminative models which can be easily fooled (see adversarial learning).

2.4 Research Questions

Based on these three intervention types, a research design involving two main research questions was created which will be presented as follows. The first research question refers to the motivational as well as the behavioural impact of the test shop which implements gamification, persuasive design principles and machine learning:

> *Does the gamified test shop lead to an increased interest in sustainable e-commerce as well as an increased awareness and knowledge of sustainable shopping choices?*
>
> H_1: The test shop leads to significant changes in awareness and knowledge of sustainable shopping choices as well as an increased interest in eco-friendly e-commerce.
>
> Based on a meta-analysis of the impact of gamification on motivation, interest and behaviour (Wouters et al. 2013), a medium, significant influence on awareness and ordering behaviour ($p<.05$; low to medium effect strengths) is expected.

The second research question refers to the return quota:

> *Do optimized sizing tables derived from machine learning algorithms as well as highlighted options as use case for persuasive design principles lead to a significant reduction of returns?*
>
> H_1: Persuasive design principles lead to a reduction in returns.
>
> H_1: Automatically created sizing tables lead to a significant reduction in returns.
>
> The field of persuasive design strategies is still in its infancy and is therefore unexplored (Torning & Oinas-Kukkonen 2009). Based on findings from related studies on gamification such as the Wiener Linien campaign and Booking.Com, it is assumed that returns will be reduced by at least 10%.
>
> With regard to the implementation of machine learning systems, there are no empirical data on the effect size available in the proposed form. A related, non-automated system based on extensive user feedback, “TrueFit”, has reduced returns by 30% (Kirstensen et al. 2013).

3. Method

3.1 Research Design

A pre-post single-group design was used which, among other things, provides information on the effect of our online ordering system. Changes in external factors must be taken into account, as the resulting changes in purchasing and ordering behaviour are hardly detectable and therefore causal relationships cannot be investigated reliably. It is therefore crucial to pay attention to whether fundamental framework conditions (e.g. rising article prices, new offers, changed supplier and return conditions, advertising and awareness campaigns for sustainable ordering), which demonstrably influence the purchasing and ordering behaviour of the target group, have changed during the test period. In this respect, it can be mentioned that none of the events mentioned occurred and therefore a good data quality can be assumed.

In order to be able to make statements about the effect of the strategies implemented in the test shop and thus about the behavioural changes achieved by the test subjects, customers were asked the same questions before and after the participation in the test shop about the grade of interest, awareness and information. The survey design of the first questionnaire also included questions on socio demography, actual shopping behaviour and attitudes towards sustainable shopping. The final questionnaire included questions on the test shop and its usability.

Table 1: Survey Design

Dependent Variables	Pre-Test	Post-Test
Socio demography	✔	
Shopping behaviour & attitude towards eco-friendly e-commerce	✔	
Consciousness regarding consequences of personal actions	✔	✔
Interest, awareness and information about sustainable shopping behaviour	✔	✔
Usability		✔
Likes, Dislikes & Suggestions for Improvement		✔

3.2 Sample

Different recruitment channels like newsletters, the “Gruene Erde” magazine as well as social media channels were used to recruit users for the field test A total of 118 customers completed the first online questionnaire and 77 of them completed the second online questionnaire. This corresponds to a response rate of about 65%. It can be assumed that this high response rate is due, among other things, to the ongoing communication between the research team and the customers, the incentive strategies and the high interest of the customers in the research project. For the impact analysis these participants were excluded, since in this case no comparison before and after was possible. For other questions, however, the answers of these persons were also taken into account. Next to the survey, expert interviews with 8 store managers and KEP providers were conducted. Returns were tracked for 300 users of the test shop during the field test as well as the number of interactions with the sizing table, product information, the gamified comment function, delivery options as well as a banner linking to KEP apps (for re-routing of parcels).

3.3 Research Material

Figure 2: "Virtual Forest" as gamified progress system & incentives

From August to December 2018 a test shop was implemented for the field phase of the project. In total 8 different interventions with regards to machine learning, gamification as well as persuasive design were evaluated within the test shop. In order to take part, participants had to opt in and were then automatically routed into the test environment after logging in. Within the three phases we tested the following interventions.

a) Phase I included machine learning strategies for optimized size information (based on size tables from production) and improved product information in the form of qualitative size features (such as figure skimming, figure emphasizing, straight or casual).
b) Phase II included all strategies from Phase I and additional interventions from persuasive design, such as colour and layout emphasis of size tables and product information, as well as the provision of sustainable delivery options.
c) Phase III included all strategies from the previous phases and interventions from gamification, such as rewards for sustainable buying behaviour (see figure 2), the evaluation of comments, a personal level system, and banner information on delivery options.

4. Results

4.1 Qualitative Results

The rapid increase in parcel volume - but also the high number of returned goods (returns) - pose new challenges for online retailers. Innovative solutions are needed to make the delivery of goods to customers more efficient and climate-friendly on the one hand, and to reduce cost-intensive and climate-damaging returns on the other. We asked eight renowned online retailers how they assess the current situation in the apparel sector and which innovative delivery strategies are finding their way into their industry.

Corporate Social Responsibility is a top priority for all online retailers interviewed, especially in the areas of purchasing, production and workplace design. By contrast, a climate- and resource-friendly supply of goods still plays a subordinate role. In contrast to international studies which show a return rate of 55 percent in the clothing sector, the surveyed online retailers report a much lower average value for returns of about 20 percent. There is a strong correlation with the size of the company. In particular, larger companies are struggling with a higher return rate. However even for small and medium-sized companies, returns a large issue

from a sustainable and economic point of view. Some of the surveyed retailers are considering the idea of introducing fees for returns in the future although this method could lead to a loss of customers.

With regard to the company-specific relevance of our innovative strategies "gamification", "persuasive design" and "machine learning" researched in the course of "Think!First", we found that although these methods had been previously used only rudimentarily in their own online shops, almost all surveyed retailers see great potential in these innovative strategies, both to sensitize customers for sustainability and to create economic corporate advantage. Above all, improved product information (e.g. size information for clothing) and motivating incentives (e.g. rewards in the form of discounts, playful visualizations and comparisons with other buyers) are considered to have high potential to positively influence the return behaviour of customers. What is needed are innovative approaches that broaden the scope of action for - as well as increase the knowledge of - customers with regard to sustainable transportation of their clothing, e.g. a choice of sustainable means of transport, longer delivery times in favour of a higher utilization of supply vehicles, or the selection of precise delivery times - which are still limited. They key learning is that most online retailers can imagine implementing customer-centric strategies based on motivational as well as behavioural theories in their own online shops.

4.2 Quantitative Results

In order to assess the effects of our field test, a customer survey was created and used before and after the field test. In the first questionnaire, socio-demographic data was collected and purchasing behaviour was assessed. The second questionnaire included questions on the usability of the web shop and suggestions for improvement. Both questionnaires included questions on the interest in, the awareness of and the information about sustainable online ordering in order to assess the impact.

Most of the questioned customers buy in web shops once a month. The ratio between online shopping and visits to local shops is roughly balanced (50/50). Particularly important for customers are detailed product descriptions and different payment channels. Interestingly, the expressed desire for resource-saving delivery methods such as train or freight bikes for the last mile was high - however, such options are currently seldom offered. For customers of “Gruene Erde”, it seems to be particularly important that their bought products are produced in a sustainable way. On the other hand, their generally positive view of free returns contradicts this.

In total approximately 19.000 interactions (in terms of compliant behaviour) were registered. About 300 active users conducted on average 66 actions per day. The historical data analysis was applied to a dataset containing several million samples, 312 different features and was conducted in eleven loops until a satisfactory model was found. For the impact on a subjective level 112 cases were analysed using inferential statistics after exporting the data from the online survey. Usability was overall rated as very good (M=1.23 on a 5 point likert scale).

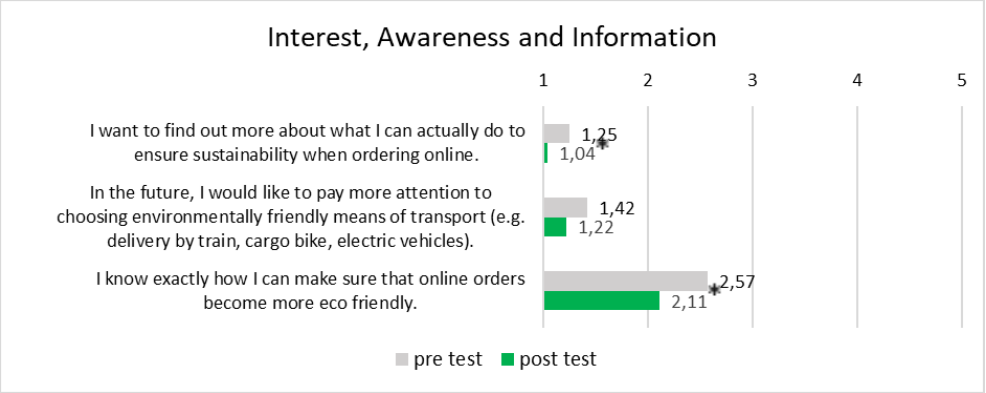

Figure 3: Impact on interest, awareness and information (N=77)

The comparison between the pre-test and post-test showed that the impact on the interest for ecologically friendly shopping as well as on the information about sustainable shopping choices could be enhanced in course of the field test (N=77). The means for interest (M_{pre}=1.25, M_{post}=1.04; F=3.00; p<.05) as well as

information (M_{pre}=2.57, M_{post}=2.11; F=3.23; p<.05) are significantly higher after the interventions were triggered.
With regards to attitudes and shopping behaviour significant results can be reported for the preference of total delivery (M_{pre}=1.43, M_{post}=1.08; F=3.02; p<.05) as well as the wish for sustainable modes of transport for parcel delivery (M_{pre}=1.52, M_{post}=1.27; F=2.47; p<.05).

Next to inferential statistics, a historical data analysis was also done. From the data warehouse of our project partner we received a set of a few million samples from a time period of several years, containing detailed information on customers, orders, products, deliveries and returns during this time period. In total there were 312 features – 202 numeric features and 110 nominal features with up to 10 values (avg. 2.75) per feature. Overall returns over all products (including clothing) within this time period were within the ranges reported in the literature. One trivial way to reduce returns would be to delist products or ban customers which are responsible for a large proportion of returns. To achieve a 10% reduction in returns, for this dataset, we would need to ban 0.17% of customers at the cost of selling 4.31% less products overall; or delist 1.13% of products at the cost of selling 13.46% less products overall. Both alternatives were deemed unsatisfactory by our project partner.

As next step, we decided to visualize all relevant parameters in a single graph (see figure 4). We binned returns rate in percent into 100 bins at the X axis. For each bin we computed both the number of products sold and the number of returns. Absolute number of products returned (linear scale) and sold (log scale) are shown on the left and right Y axis. Figure 4 shows the results. Here, we computed returns rate on products level (i.e. each product was assigned its average returns rate over all its sales). The bimodal distribution of returns indicates that returns are driven by two approximate normal distributions: a smaller peak of products which sell high numbers at low relative returns rate - which still translates to high absolute returns - and a larger peak of products which sell lower numbers at higher relative returns rate. The latter group contributes about six times the absolute number of returns of the former.

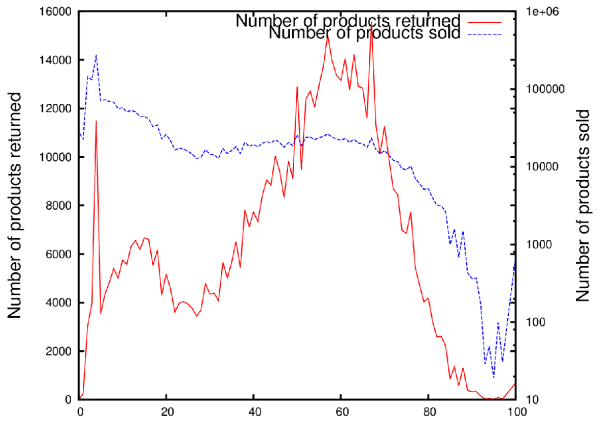

Figure 4: Bimodal distribution of returns

Finally, we evaluated the returns from phase I, II and II of the field test. Since the returns rate varies greatly over time, we compared the average returns rate across all participants in the field test with the same value for all other customers within the same time period. Each phase corresponded to a defined time period. Phases I and II were about two months long, phase III three weeks. Christmas fell in the middle of phase III, a factor that might explain the lower returns rate in the control group for this phase as few people will return gifts.

Table 2: Return rates in course of the three project phases

Type	Phase	avg(retQ)	std(retQ)	count(*)
Field test	I	45.00000000	47.16990566	20
Control	I	41.27287499	40.63307904	5422
Field test	II	36.11111333	41.74067664	30
Control	II	40.31230389	41.07013451	9026
Field test	III	30.00000000	40.00000000	5
Control	III	34.91857530	41.34140747	1927

One can clearly see that the return rate of the control group is already highly variable and ranges from 36% to 41%, a range of about one tenth of the total value. In phase I, the control group is slightly better, but the difference is quite small and not significant due to the high variability. In phases II and III, the field test has a lower return rate by about 6%. Within the group participating in the field test, the return rate could be reduced from approx. 45% in phase I to approx. 30% in phase III.

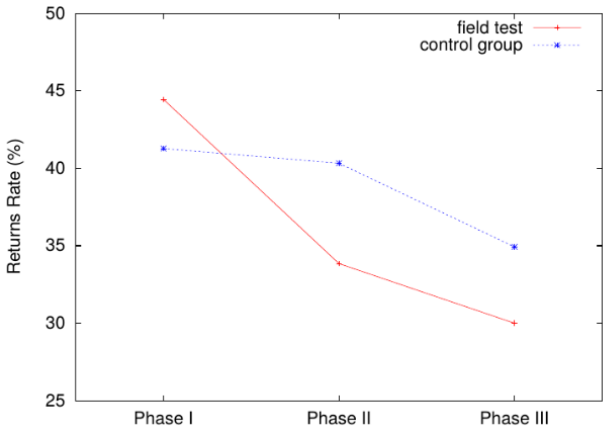

Figure 5: Return rate in course of the project phases

5. Conclusion

The usability of the test shop was rated very well, the user friendly navigation was especially highlighted. The virtual forest as a central dashboard for sustainable purchasing decisions was considered a top feature. Ideas for more sustainable online orders included collective orders with pickup from the local shop, an option for longer waiting times if an item is not immediately available, and a direct selection of parcel boxes as destinations.

With regard to the impact of our test shop, a positive change could be identified. About 50% of the respondents stated that their opinion on sustainable purchasing behaviour had improved, almost 60% stated that awareness of sustainable decisions had increased. There has been a significant improvement in the level of interest in environmentally friendly online shopping from the pre-test to the post-test: customers are now better informed about how to behave more environmentally friendly. The specification of an exact size table with dimensions in cm instead of the usual inaccurate size specifications (e.g. S, M, L) was a relatively simple measure to reduce returns. In related literature, improvements ranging from 9% to 46% are measured. In our test shop returns could be reduced by roughly 15%. Two of our main research hypotheses could thus be confirmed, however there are some limitations with regard to the generalizability of the results. Small sample sizes for returns hindered us from calculating inferential statistics in some cases. Also, some results are statistically relevant but still not high in terms of the effect size. There is clearly room for improvement. Further research should be done on the subjective needs of customers which still include free returns although there is a strong wish for sustainable transport systems. This is clearly an indication of cognitive dissonance between the attitude and respective (shopping) desires.

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References

Bandura, A. (1977) Self-efficacy: Toward a unifying theory of behavioural change. Psychological Review, Vol 84, No. 2, pp. 191-215.
bevh - Bundesverband e-commerce und Versandhandel (2016) Weißbuch „Nachhaltigkeit im Interaktiven Handel". Retrieved from: https://www.bevh.org/fileadmin/downloads/bevh_Weissbuch_10072016_final_Druck.pdf
BMVIT (2015) eComTraf - Auswirkungen von e-commerce auf das Gesamtverkehrssystem. Studie gefördert im Rahmen des Programms „Mobilität der Zukunft" durch das Bundesministerium für Verkehr, Innovation und Technologie.
Bunchball (2010) Gamification: An Introduction to the Use of Game Dynamics to Influence Behaviour. White Paper, retrieved from: www.bunchball.com/sites/default/files/downloads/gamification101.pdf
DCTI – Deutsches CleanTech Institut (2015) Klimafreundlich einkaufen – eine vergleichende Betrachtung von Onlinehandel und stationärem Einzelhandel. Retrieved from: http://www.ottogroup.com/media/docs/de/studien/Studie_Klimafreundlich_Einkaufen.pdf
Digital Affairs (2013) Retrieved from: http://www.slideshare.net/digitalaffairs/campaigning-mit-gamification
EHI Retail Institute (2015) E-commerce- Markt Österreich/Schweiz 2015. Retrieved from: https://www.ehi.org/de/studien/e-commerce-markt-oesterreichschweiz-2015/
Fogg, B. J. (2009) A behaviour model for persuasive design. Proceedings of the 4th international Conference on Persuasive Technology. ACM.
Hamari, J., Koivisto, J., & Sarsa, H. (2014) Does Gamification Work? – A Literature Review of Empirical Studies on Gamification. In proceedings of the 47th Hawaii International Conference on System Sciences, Hawaii, USA.
Handelsverband (2015) retail - Magazin für den Österreichischen Handel. Offizielles Medium des Handelsverbandes. Retrieved from: https://www.handelsverband.at/fileadmin/content/images_publikationen/retail/Retail_2015_04.pdf
Heindl, A., Seewald, A., Thalhammer, T., Bises G., Schepelmann, M., Uhrova, H., Dekan S., Mesteri, I., Rogojanu, R., Ellinger, I. (2013) Automated Recognition of tissue-associated erythrocytes (ARETE)—a new tool in tissue cytometry. Cytometry A. Volume 83A, Issue 4, pp. 363–374.
Herber, E. (2013) Designing the Persuasive Learning Experience. Behringer and Sinclair.
Kazhamiakin, R., Marconi, A., Perillo, M., Pistore, M., Valetto, G., Piras, L., & Perri, N. (2015) Using gamification to incentivize sustainable urban mobility. In Smart Cities Conference (ISC2), 2015 IEEE First International (pp. 1-6). IEEE.
Kim, C., Galliers, R. D., Shin, N., Ryoo, J. H., & Kim, J. (2012) Factors influencing Internet shopping value and customer repurchase intention. Electronic Commerce Research and Applications, 11(4), pp. 374-387.
Kim, H., & Fesenmaier, D. R. (2008) Persuasive design of destination web sites: An analysis of first impression. Journal of Travel research.
Klumpp, M., Neukirchen, T., & Jäger, S. (2016) Logistikqualifikation und Gamification: Der wissenschaftliche und fachpraktische Ansatz des Projektes MARTINA (No. 51). ild Schriftenreihe Logistikforschung.
Kristensen K., Borum N., Christensen LG, et al. (2013) Towards a Next Generation Universally Accessible 'Online Shopping-for-Apparel' System. In Human-Computer Interfaction. Users and Contexts of Use. Volume 8006 of the series Lecture Notes in Computer Science pp. 418-427.
Levinson, Jesse, et al. (2016) Towards Fully Autonomous Driving: Systems and Algorithms. Retrieved from: http://www.cs.cmu.edu/~zkolter/pubs/levinson-iv2011.pdf
Marcuse, H. (1991) One-Dimensional Man: Studies in the Ideology of Advanced Industrial Society. Routledge
Morganti, E.; Seidel, S.; Blanquart, C.; Dablanc, L.; Lenz, B. (2014) The impact of e-commerce on final deliveries: alternative parcel delivery services in France and Germany. Transportation Research Procedia 4 (2014) 178 – 190, Elsevier.
Redström, J. (2006) Persuasive design: Fringes and foundations. In International Conference on Persuasive Technology, pp. 112-122. Springer Berlin Heidelberg.
RetailMeNot & Centre for Retail Research (2015) Internationale e-commerce-Studie 2015. Retrieved from: http://www.retailmenot.de/studien/e-commerce-studie-2015
Ryan, R. M., & Deci, E. L. (2000) Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American psychologist, 55 (1), 68.
Seewald, A., Kleedorfer, F. (2007) An Approximation of the String Subsequence Kernel for Practical SVM Classification and Redundancy Clustering. Journal for Advances in Data Analysis and Classification, Vol. 1, Number 3 / December 2007, pp. 221-239, DOI: 10.1007/s11634-007-0012-1.
Seewald, A. (2008) Towards Automating Malware Classification and Characterization. In Konferenzband der 4. Jahrestagung des Fachbereichs Sicherheit der Gesellschaft für Informatik, Saarbrücken, pp. 291-302.
Seewald, A. (2012) On the Brittleness of Handwritten Digit Recognition Models, ISRN Machine Vision, Vol. 2012.
Seewald, A. (2007) Improving the Effectiveness of Mailings by Building a Response Model for Inactive Customers. Technical Report, Seewald Solutions, Wien.
Seewald, A. (2002) How to Make Stacking Better and Faster While Also Taking Care of an Unknown Weakness. In Proceedings of the Nineteenth International Conference on Machine Learning (ICML-2002). Sydney, Australia. Morgan Kaufmann Publishers, San Francisco.

Seewald, A., Fürnkranz, J. (2001) An Evaluation of Grading Classifiers. In Advances in Intelligent Data Analysis: Proceedings of the 4th International Symposium (IDA-01). Lisbon, Portugal. Springer-Verlag.
Silver D., Huang A., Maddison, CJ. (2016) Mastering the game of Go with deep neural networks and tree search. Nature 529, pp. 484–489.
Skinner, B. F. (1984) The evolution of behaviour. Journal of the experimental analysis of behaviour, 41 (2), pp. 217-221.
Torning, K., & Oinas-Kukkonen, H. (2009) Persuasive system design: state of the art and future directions. In Proceedings of the 4th international conference on persuasive technology, 30. ACM.
VCÖ (2014) Online-Handel und seine Auswirkungen auf den Verkehr, Wien.
WKO & bmwfw (2014) Internet-Einzelhandel.
Wouters, P., van Nimwegen, C., van Oostendorp, H., & van der Spek, E. D. (2013) A Meta-Analysis of the Cognitive and Motivational Effects of Serious Games. Journal of Educational Psychology. Advance online publication.
Zichermann, G., & Cunningham, C. (2011) Gamification by Design: Implementing Game Mechanics in Web and Mobile Apps. Sebastopol: O'Reilly.