

**Personalized Education to Increase Interest**

Rolf Reber

University of Oslo

Elizabeth A. Canning

Indiana University

Judith M. Harackiewicz

University of Wisconsin

*(Current Directions in Psychological Science, in press)*

Address Correspondence to: Rolf Reber, University of Oslo, Department of Psychology,

Postboks 1094 Blindern. E-mail: [rolf.reber@psykologi.uio.no](mailto:rolf.reber@psykologi.uio.no)

J. M. Harackiewicz was supported by National Institutes of Health Grant R01GM102703

### **Abstract**

A long-standing ideal of school education has been to connect instruction to a student's life outside school in order to render subject matter interesting. New technologies enable instructors to personalize learning materials to increase situational interest. After distinguishing three main methods to personalize education – context personalization, choice, and active personalization – we review recent intervention studies to increase situational interest which is necessary for the emergence of individual interest. Across all three kinds of interventions, some studies point to the possibility to increase interest for students low in initial interest. Despite progress in developing personalized interventions for school practice, research on the theoretical mechanisms behind the success of the interventions has just begun.

Keywords:

Personalized Education; Interest; Context Personalization; Choice; Utility Value Intervention

Recently, personalized medicine has emerged as a new “form of medicine that uses information about a person’s genes, proteins, and environment to prevent, diagnose, and treat disease” (National Cancer Institute, 2015). In analogy to personalized medicine, we propose personalized interventions in education that use a student’s individual interests, values, and preferences to increase interest in school subjects. The basic idea to connect a child’s experiences outside school with the learning materials in school goes back to Dewey (1975/1913). Although it is possible to increase interest in the classroom with an intervention that fits all, for example through teacher enthusiasm (Keller, Woolfolk Hoy, Goetz, & Frenzel, 2016), the ideal would be to customize learning materials to students’ personal interests. The greatest obstacle to this ideal has been the classroom model where a teacher provides instruction for 20 students or more. Such settings limit the opportunities to personalize the learning experience. However, new developments in multimedia learning have made it possible to provide more customized learning materials and practice tasks.

Akin to the personalized medicine model, we focus on personalized education to increase interest (for reviews of effects of educational interventions on learning outcomes, see Harackiewicz & Priniski, 2018 and Walkington & Bernacki, 2018). The studies reviewed here range from middle school to undergraduate studies, focusing on interventions that increase interest in science and math.

### **Individual and Situational Interest**

Fostering students’ interest in school is essential because interest has positive effects on persistence and learning (Ainley, Hidi, & Berndorff, 2002) and determines academic and vocational choices (Henriksen, Dillon, & Ryder, 2015). It is therefore alarming that interest—especially in science and math—declines from elementary to high school (Frenzel, Goetz, Pekrun, & Watt, 2010; see Frenzel, Pekrun, Dicke, & Goetz, 2012, for qualitative shifts in

mathematics interest). Motivating the students of the 21<sup>st</sup> century is one of the major challenges in education (Hidi and Harackiewicz, 2000).

Interest develops over time and in phases from situational interest to individual interest. Hidi and Renninger's (2006; Renninger & Hidi, 2016) four-phase model of interest development assumes that in the first phase, it is necessary that the materials attract a student's attention and lead to momentary enjoyment; this is triggered situational interest (TSI). In the second phase—maintained situational interest—external factors sustain a learner's attention. Factor-analytical approaches identified two kinds of maintained situational interest, one related to feelings such as enjoyment (MSI-F), the other to the experience of value (MSI-V; Linnenbrinck-Garcia et al., 2010). The last two phases include emerging individual interest (Phase 3) and well-developed individual interest (Phase 4). Individual interest is defined as an enduring predisposition to willingly reengage in a particular activity that leads to enjoyment or has intrinsic value.

In order to increase individual interest, Hidi and Renninger's (2006) model predicts that educators have to first increase situational interest before a more stable disposition to reengage in the learning materials can emerge. Interventions therefore aim at increasing triggered and maintained situation interest (Phase 1 and 2) in order to facilitate the emergence of individual interest (Phase 3). As learners come from diverse backgrounds and have differing out-of-school interests and preferences, this model predicts that the development of interest is an individual process. Therefore, we propose that personalizing education to the interests, values, and preferences of the individual student is more likely to increase situational interest compared to one-size-fits-all approaches.

Personalized education has been implemented through three kinds of interventions (see Table 1, for an overview of interventions and studies): 1) context personalization; 2)

providing students with learning choices; and 3) encouraging students to actively generate personalized connections.

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Insert Table 1 here  
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### **Context Personalization**

In context personalization, learning contents and tasks are customized to the individual student. Such customization often includes personal details in the text, such as the student's name or birthdate or preferences like favorite drinks and clothing brands. In an early study, Lopez and Sullivan (1992) compared a group that learned mathematics materials from individualized contents (individual personalization) to a group whose texts included the most popular but not the learner's individual details and preferences (group personalization). A control group received the generic materials as used in textbooks. Students in the individual personalization group were more interested in solving additional math tasks than the control group, with the group personalization condition in between. A later study by Ku, Harter, Liu, Thompson, and Cheng (2007) showed that learners in an individual personalization condition, compared to non-personalized computer-based instruction, liked the program more and were more willing to reengage in it; however, learners did not find the program more interesting. As these early studies measured interest with single items, it was difficult to distinguish between the different facets of situational interest.

Later studies used measures based on Linnenbrinck-Garcia's et al. (2010) analysis of the different facets of situational interest. Høgheim and Reber (2015) implemented context personalization by customizing learning materials based on individuals' self-reported interests (e.g., sports or movies). Compared to a control group that received generic learning materials,

students in the context personalization condition experienced higher situational interest – TSI, MSI-F, and MSI-V – especially when pre-intervention individual interest was low.

Using the same learning materials and tasks, Høgheim and Reber (2017) used preferences pertaining to objects (e.g., favorite beverage) instead of interests pertaining to sustained engagement in activities (e.g., doing or watching sports), to implement context personalization. For preference-based context personalization, compared to a control group, MSI-V increased for learners with low perceived competence but decreased for those with high perceived competence. These results suggest that interest-based context personalization, as used in Høgheim and Reber (2015), may provide deeper connections of materials with the learner (see Walkington & Bernacki, 2014) and are therefore more effective than preference-based personalization.

Bernacki and Walkington (2018) showed that context personalization had positive effects not only on situational interest but also on individual interest and performance in high-school students. Their study is the first that tested context personalization in a longitudinal design, applying the intervention at different time points in school instruction. This enabled the authors to test and support the assumptions of the interest development model by Hidi and Renninger (2006) that posits that situational interest is a necessary component in the emergence of enduring individual interest. In sum, context personalization, compared to generic materials, is an effective tool to increase interest.

### **Choice**

It has long been known that choice increases interest and related motivational states. In their meta-analysis, Patall, Cooper, and Robinson (2008) documented positive effects on interest when students were given the choice of activities, versions of the same task (e.g., different puzzles), procedures, such as self-paced timing, and rewards. Interestingly, the

strongest effects stemmed from instructionally irrelevant choices, such as the choice of names of characters in a computer game (Cordova & Lepper, 1996), or the choice between two text packages with unknown content (Flowerday, Schraw, and Stevens, 2004). Such findings suggest that mere choice, or just the experience of making a choice, is enough to increase interest, presumably through increasing autonomy support (see Deci & Ryan, 1985).

These choice paradigms increase situational interest by providing superficial choices, rather than connecting materials to personal interests, as implemented in context personalization, and as proposed by Dewey (1975/1913). However, an approach called example choice does exactly this. When learners have to study a principle, such as confirmation bias in psychology or probability calculus, they are given a choice among different examples to work with (Høgheim & Reber, 2015; 2017; Reber, Hetland, Chen, Norman, & Kobbeltvedt, 2009). After selecting the example or topic that students are most interested in, an online system provided conceptually or mathematically identical learning materials embedded in the chosen example. Reber et al. (2009) found that first-year psychology students were more interested in learning about the confirmation bias if the learning materials were embedded in the chosen topic (choice group) rather than a given topic (given example group), suggesting that personally meaningful choices were effective in promoting interest.

More recently, Høgheim and Reber (2015) extended this finding, using measures that assessed the facets of situational interest with more sophisticated scales than earlier studies on choice. Norwegian middle school students could choose among twelve examples from six popular topics, like sports, music, or gaming. After selecting one example, they received instruction on probability calculus, embedded in the chosen example. Again, the choice group showed higher ratings on TSI and MSI-F than the control group, with the given example group in between. Consistent with the personalization condition in Høgheim and Reber (2015),

increases in interest were high for students low in pretest individual interest. Unlike the personalization condition, example choice did not result in increased MSI-V (see Table 1, for a summary of results).

Høgheim and Reber (2017) further extended the findings on example choice by providing middle school students with choices among the most popular topics and examples. Although the topics were already highly popular, example choice increased TSI even further. In contrast to the example choice condition in Høgheim and Reber (2015), pre-intervention individual interest did not moderate the effects in the new study.

In conclusion, there seem to be different mechanisms underlying choice. While some forms of choice, such as choice of details that are instructionally irrelevant, may provide autonomy support, example choice aims at connecting learning materials to everyday interests and preferences. Although more research is needed, instructionally irrelevant choices may trigger interest, but it might take more personalized types of choices, such as those offered in example choice, to promote maintained situational interest.

### **Active Personalization**

In active personalization, students contribute to the connection between the learning materials and their interests, preferences, or future career aspirations. A well-tested intervention is the utility-value intervention that exists both in non-personalized and personalized form. In the non-personalized form, all students passively receive the same information about the utility-value of the learning materials for everyday life or future career opportunities. In its personalized form, students have to write an essay about the potential utility-value of the learning content for their life or future career. So far, only one study has compared active personalized and passive non-personalized conditions in the same experimental design. Canning and Harackiewicz (2015) found that the personalized version

tended to enhance task interest for learners low in confidence whereas the non-personalized, passive version enhanced interest for high-confidence learners. Another experiment within the same study revealed that an intervention that combined both personalized and non-personalized utility value had the greatest effect on interest for learners low in confidence.

The effectiveness of the personalized version of this intervention, especially for students with low confidence or low performance, is well documented for college students (Hulleman, Godes, Hendricks, & Harackiewicz, 2010; Hulleman, Kosovich, Barron & Daniel, 2017), high school students (Hulleman & Harackiewicz, 2009), and middle school students (Gaspard et al, 2015). Hulleman et al. (2010) found that the intervention increased self-reported situational and maintained interest for learners with low levels of initial performance. Extending these findings to groups of students that traditionally underperform, Harackiewicz, Canning, Tibbetts, Priniski and Hyde (2016) found an effect of the intervention on behavioral engagement with the writing assignment (measured by essay length) in addition to performance, suggesting that that the intervention supported situational interest. Moreover, personalized utility value interventions have begun to show long-term effects on interest by increasing reengagement and retention within the field (Canning, Harackiewicz, Priniski, Hecht, Tibbetts & Hyde, 2018), pointing to the potential of the intervention to move learners from situational interest to emerging individual interest.

Other ways of active personalization that have become popular in mathematics and science education include question asking (Rothstein & Santana, 2011), digital storytelling (Sadik, 2008), and problem posing (Brown & Walter, 2005; Kapur, 2015). In these interventions, students can ask questions, tell stories or pose problems that match their personal interests, values, or preferences. In a study that explored problem posing, Walkington and Bernacki (2015) found that both affective and utility value components of interest in mathematics increased from before to after the intervention. As the main objective

of this study with 24 students was to explore difficulties of problem posing in algebra tasks, there was no control group. Future research should examine how these promising and popular techniques affect interest by using the same experimental designs as the other studies on context personalization, choice, and utility value interventions.

### **Discussion and Outlook**

Recent experimental studies observed that personalized education increases situational interest in the short term, which is essential to promote individual interest in the long term. Indeed, the findings of the longitudinal study by Bernacki & Walkington (2018) suggest that Hidi and Renninger's (2006) model of interest development is a useful framework to explore interventions to increase interest in the classroom.

Studies using each type of personalized education – context personalization, choice, and active personalization – found that the interventions increased interest in those learners who had low initial interest or low performance expectations. Although not every study obtained this result, finding this pattern across different interventions is important because often the most academically advantaged students benefit from interventions to improve psychological outcomes while the poorest do not (the so-called Matthew-effect; Bakermans-Kranenburg, van IJzendoorn, & Bradley, 2005). These experimental studies fuel hopes that interventions to increase interest may reverse the Matthew effect and that the academically disadvantaged students might benefit most, in terms of interest, from personalized education.

There are at least three ways in which personalized education could be extended. First, research may examine dependent variables related to interest, such as effects of personalized teaching on well-being in the classroom, social belonging, or subjective meaning of school education (for the latter, see Reber, 2018). Moreover, it is important to assess effects of personalization on learning, transfer, and performance. Second, research may explore new

interventions that help customize learning materials. Much propagated but untested interventions use question asking or storytelling as methods to purportedly increase interest. Finally, there is little research about the processes underlying personalized teaching to increase interest. Walkington and Bernacki (2014) introduced a useful classification of dimensions for personalization by asking how deep the connection of learning materials with the learner goes, whether learning materials are customized to individuals or groups, and the degree of ownership – does the teacher or the learner create the connection. Such models are a first step toward a firm foundation for evidence-based practice and offer a way to explore the processes underlying the positive effects of personalized education on student interest.

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**Recommended Reading:**

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Table 1

*Main findings of studies on context personalization, example choice, and active personalization.*

Intervention Study	School Level	Main Findings for Effects of Personalization on Interest
<b>Context Personalization</b>		
Høgheim & Reber (2015)	Middle school	Low initial interest: TSI+, MSI-F+, MSI-V+
Høgheim & Reber (2017)	Middle school	Low perceived performance: MSI-V+; else MSI-V-
Lopez & Sullivan (1992)	7 <sup>th</sup> -grade	Task interest+
Ku et al. (2007)	Middle school	Liking+; Reengagement+
Bernacki & Walkington (2018)	9 <sup>th</sup> -grade	Situational interest+; Individual interest+
<b>Example Choice</b>		
Høgheim & Reber (2015)	Middle school	Low initial interest: TSI+, MSI-F+
Høgheim & Reber (2017)	Middle school	TSI+
Reber et al. (2009)	First-year university	Task interest+
<b>Active Personalization</b>		
Canning & Harackiewicz (2015)	College	Low confidence: Task interest+; else task interest-
Canning et al. (2018)	First-year university	Reengagement+; Retention within the field+
Gaspard et al. (2015)	Middle school	Utility value+
Harackiewicz et al. (2016)	College	Low initial interest: Behavioral engagement with the writing assignment+
Hulleman & Harackiewicz (2009)	High school	Situational interest+
Hulleman et al. (2010)	College	Low initial performance: Situational interest+; maintained interest+
Hulleman et al. (2017)	College	Low initial performance: Situational interest+

Note: TSI = Triggered Situational Interest; MSI-F = Maintained Situational Interest – Feeling; MSI-V = Maintained Situational Interest – Value; + = Increase compared to control group; - = Decrease compared to control group