Assessing motivational differences between young and older adults when playing an exergame

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ABSTRACT

Currently, exergames are used by different age groups for both recreational and training/rehabilitation purposes. However, little is known about how to design exergames so that they are motivating for specific age groups and health outcomes.

Objective: In this paper, we compare motivational factors between healthy young and older adults by analyzing their assessments of the same balance training exergame.

Materials and Method: We performed a laboratory-based assessment of a custom-made balance training exergame with twelve healthy young and ten healthy older adults. Their answers to a semi-structured text input questionnaire were analyzed qualitatively.

Results: Both age groups were motivated by a combination of intrinsic and extrinsic motivational factors. We found that the young adults tended to be motivated by the game challenge and the in-game reward system (scores). In contrast, the older adults were more motivated by the perceived health effects (both physical and cognitive) and the joy of playing, with less regard for the in-game rewards.

Conclusion: The differences in motivational factors that were identified between young and older adults have several design implications. For older adults less effort can be put on designing the in-game reward system, and more on showing the player the potential health effects of their play. Furthermore, the competition aspect can be downplayed, and more focus placed on simply making the gaming experience itself as joyful as possible.

KEYWORDS

Balance training; Body-based interaction; Design; Exergames; Weight-shift; Young adults; Older adults; Motivation.

INTRODUCTION

Although the health benefits of regular physical exercise have been established by studies time and again, physical inactivity remains a major global health concern as it increases the risk of heart disease, high blood pressure, stroke, type 2 diabetes, some forms of cancer, and falls among older adults.[1-3] With the gradual enhancement of traditional physical exercise by innovative technology, exergames are increasingly seen as tools that can motivate physical activity.[4-6] Larsen et al.[7] define exergames as "digital gaming systems with an interface that requires physical exertion to play the game" (ibid, p. 1). Synonyms include exertion games, exertainment, active-play videogames, and game-based technology-mediated physical activity. Popular exergaming platforms are Nintendo Wii and Microsoft Kinect.

Exergames are being used to facilitate physical exercise, balance training and rehabilitation in different settings.[8-10] There is a growing body of research on the health effects of exergames, including rehabilitation of motor impairments, fighting obesity, stroke rehabilitation, and balance training.[11-14] Chang et al.[15] tested the validity and reliability of WiiFit Balance board for the assessment of balance among young and older adults, and found the Wii balance board to have good reliability for older adults. Further, Graves et al.[16] compared the cardiorespiratory and enjoyment measurements among adolescents, young and older adults during inactive videogaming, Wii fit, and treadmill exercises. The study found Wiifit to be an enjoyable exergame for adolescents and adults, stimulating light-to-moderate intensity activity through the modification of typically sedentary behavior. Previous studies performed on both young and older age groups have focused largely on the validity of the technology and the physiological effects, rather than on the game design itself. Despite having a body of research focusing on the use of exergames and health effects,[8, 17, 18] there is still a need to gain more insight into how to design exergames for specific age groups. From a game design perspective, this raises the question as to what extent such games need to be designed for specific age groups. To answer this question, it is necessary to know what motivates different age groups to play exergames. To our knowledge, no studies have identified the underlying differences in motivational factors for young versus older age groups.

Assessing the motivational differences between young and older adults concerning exergames raises the need for a theoretical understanding of the term *motivation.* The term *motivation* originates from the Latin word *movere*, which means "to move". It generally refers to the forces that act on or within an individual and which cause the arousal, direction and persistence of goal-directed, voluntary effort. Most theories on motivation tend to consider motivation predominantly as a one-dimensional phenomenon, which means that the motivation to perform a certain activity can range from none or little to a considerable amount. Self-Determination Theory (SDT) [19] expanded this traditional view of motivation by also taking into account the orientation (or type) of motivation. In particular, SDT differentiates between reasons that give rise to an action. *Intrinsic motivation* refers to actions that are perceived as inherently interesting or enjoyable. *Extrinsic motivation*, on the other hand, refers to actions which are performed due to some external resource or reward. With respect to motivation for physical activity in general, Molanorouzi et al.[20] found that motivation for participation in physical activity among young and middle-aged adults differed across type of activity, age and gender. They reported that young adults had higher affiliation, mastery and enjoyment associated with participation in physical activities than middle-aged adults who considered psychological conditions and other expectations more important for participation. Furthermore, Kilpatrick et al.[21] found that among college students, motivation for sports participation was more related to intrinsic factors such as enjoyment and challenge, compared to more extrinsic motivation related to appearance and weight management for exercise behavior as such.

In this paper we compare motivational factors that influence healthy young and healthy older adults playing an exergame, by analyzing their assessments of the same game. Our research adds to the limited knowledge of designing goal-directed, interactive exergames for specific user groups. The main objective of the conducted study was to evaluate a balance training weight-shift exergame by these two age groups. The working hypothesis is that there are significant differences between the considered age groups, and that these differences have implications for designing motivating exergames. Both user groups played a balance training weight-shift exergame and filled out a questionnaire after playing the game. The results presented in this paper are based on a qualitative analysis of the participants' answers to the semi-structured text input questionnaire.

METHODS

Participants

The participants in this study consisted of 12 young adults between 23 to 28 years of age (25.3 ±1.6, 50% female), and 10 older adults between 65 to 85 years of age (74.5 ± 5.4, 80% female). The sample size was chosen to fit the aim of the study, i.e. to do an in-depth user experience assessment of the game. The participants were all healthy individuals and no additional medical information or medical data was collected for the study. The young adults were recruited from the University campus, and the older participants from senior groups. The overall inclusion criterion was to have overall good health for their age. Furthermore, older adults had to live independently and be able to stand and walk for at least 30 minutes. The exclusion criteria were any form of motor and/or cognitive impairment. The younger adults were regularly physically active for at least 60 minutes weekly. Three of the younger adults had previously played exergames, and seven of them indicated that they played videogames at least once a week. The older adults regularly performed some form of physical activity every week for at least 30 minutes. Two of the older adults indicated that they had previous exergame experience, and one indicated that she plays videogames daily.

Location and Equipment

The study was conducted in the University's usability laboratory equipped with roof-mounted, remotely controlled cameras (Sony EVI-D70) for video recording. For playing the game, we set up a PC with a Microsoft Kinect v2 connected to a wall-mounted 32" high definition LCD-TV with external speakers. The Kinect v2 motion recognition sensor was used as motion input device to play the game, not for data collection. Based on the sensor limit of the Kinect (1.2-3.5 meters), an appropriate physical gaming area (1.5 x 1.5 meters) was marked using colored tape.

The Exergame

The Celestial Shower is an age-neutral balance training exergame that was developed by the authors and used in the study. The game was designed within the Unity 3D game engine[1] using Microsoft Kinect.

Figure 1: Screenshot of the Celestial shower exergame

Figure 1 shows a screenshot of the gaming environment. The gaming environment consisted of a main avatar, that mimicked the player's physical movements. The avatar was positioned within a dynamic environment that consisted of several approaching stars and asteroids. The main task of the players was to stretch out their arms and shift their weight from side to side to catch approaching stars and gain points. At the same time, the players were to avoid the impact of oncoming asteroids by similarly shifting their weight and leaning sideways. The players got one point for every star caught. At the start of the game, the players were provided with a 100 % full health bar and lost ten percent of health each time the avatar was hit by an asteroid. The game was designed to elicit

[1] www.Unity3D.com

simple weight-shifting movements as in general balance training exercise. Furthermore, the game was designed to be very simple with minimal game objects and multi-sensory feedback systems, such as audio and graphical visual feedback.

Study Procedure

The study was ethically approved by the Regional Committees for Medical and Health Research Ethics (REK) and carried out in accordance with the Norwegian Centre for Research Data (NSD) and the Helsinki Declaration.

The participants were given basic information about the goal of the game and its control mechanism. All the participants filled out a simple questionnaire with background-specific information about their age, gender, gaming experience, exercise routine and a consent form before starting the experiment. All the participants were filmed from behind during the experimental session.

The participants initially played a two minutes' demo to get acquainted with the game and learn about the basic game dynamics. Following the demo, the participants played the game for 20 minutes. After the gaming session, participants filled out a questionnaire asking specific questions about the participants' perception and acceptance of the exergame, as well as their individual feedback and preferences. The entire session lasted between 45-60 minutes, depending on the individual participants.

Data Collection and Analysis

The qualitative data consisted of answers to a semi-structured text input questionnaire, consisting of several questions about pros, cons and suggestions for improvements of the game without explicitly asking about motivation. Gender differences were not addressed in this study due to the limited sample size. The answers from both the young and older adults were segmented into meaningful expressions. An open coding approach was followed on the two sets of data (young and older adults). Corbin and Strauss [22] describe open coding as follows: "*In open coding, events/actions/interactions are compared with others for similarities and differences. They are also given conceptual labels. In this way, conceptually similar events/actions/interactions are grouped together to form categories and subcategories*" (ibid, p. 13). Open coding is an iterative data analysis process where categories are added until inductive thematic saturation[23] is established, and all data have been categorized.

For each of the two user groups, expressions relating to similar topics were clustered together through an open coding process, leading to one set of topics (categories) for each age group.

RESULTS

In the coding process, inductive thematic saturation was established for both age groups, leading to five topics (categories) for young adults and seven topics (categories) for older adults.

Feedback from young adults

Figure 2 shows a young study participant playing the game. The feedback from the young participants obtained through the questionnaire were related to five distinct topics: *Challenge, Complex gaming environment, Graphics and music, Enhanced reward system,* and *Personalization.*

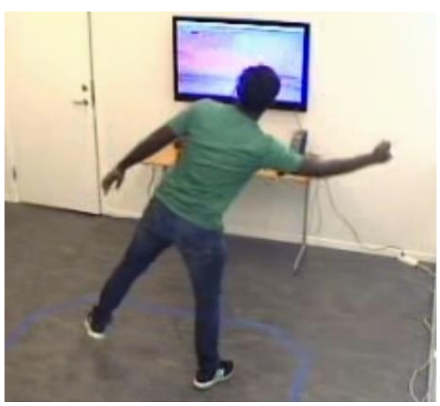

Figure 2: A young participant playing the game

Challenge: Many of the younger participants stated that they liked challenging themselves. The younger participants preferred being challenged both at a physical and a cognitive level while playing the game.

Py04 (Male; 28yrs): "Challenging yet doable"
Py10 (Male; 25yrs): "The difficulty level gradually increased, which kept me engaged and focused"
Py07 (Male; 26yrs): "I liked it when I had to move quickly and do more things at the same time"
Py11 (Male; 23yrs): "I would like it to be more challenging"

Complex gaming environment: One participant indicated that he preferred a more complex gaming environment as compared to a simple environment.

Py07 (Male; 26yrs): "Add multiple elements within the game"

Graphics and music: Five of the young participants indicated that they liked the background and graphics in the game, including the visual feedback and the gaming environment.

Py12 (Female; 24yrs): "The graphics and music were pleasant"
Py11 (Male; 23yrs): "I liked both background and character graphics"
Py10 (Male; 25yrs): "The background music helped to be more active"
Py09 (Male; 23yrs): "I like the music"
Py01 (Male; 26yrs): "I like the background and game environment"

Enhanced reward system: Three of the young participants suggested improvements for the in-game reward system.

Py11 (Male; 23yrs): "Include a better reward system"
Py10 (Male; 25yrs): "Include different booster points"
Py05 (Female; 26yrs): "There should be ways to earn extra points"

Personalization: Two of the young adults wanted to personalize the game with respect to parameters such as the theme, music, avatar, etc.

Py12 (Female; 24yrs): "option for different background"
Py11 (Male; 23yrs): "change in graphics"

In sum, the young participants expressed their interest and ideas about having a challenging and rewarding game environment. They further emphasized visual and interaction design parameters such as graphics, music, and personalization.

Feedback from older adults

Figure 3 shows an older participant playing the game. The feedback from the older participants obtained through the questionnaire were related to seven distinct topics: *Physical and Cognitive training, Having fun, Prompt feedback, Negative feedback, Movement Variation, Technology,* and *Increased Training Time.*

Figure 3: An older participant during the study

Physical and Cognitive training: The older participants expressed that they felt good about practicing their balance and training their mind at the same time. Given below is the corresponding feedback:

Po03 (Female; 76yrs): "It would be nice to have more challenging foot balancing tasks"
Po04 (Female; 76yrs): "I liked having to concentrate and move my body the whole time."
Po05 (Female; 71yrs): "I liked training my concentration and performing the simple movements."
Po06 (Female; 75yrs): "I like using my head and my body simultaneously"
Po07 (Female; 76yrs): "I like that it was engaging and required my concentration"
Po10 (Female; 65yrs): "I like that I am training my reflexes"

Having fun: Several participants expressed that they had fun playing the game, and that it was engaging. The participants had different reasons for why they found it to be fun. Some participants did not mention why they found the experience to be fun, whereas other participants (e.g. Po05 and Po08) mentioned why they found playing the game to be fun.

Po01 (Female; 71yrs): "It was fun"
Po04 (Female; 76yrs): "It was very fun and a good training"
Po05 (Female; 71yrs): "It was more fun than being alone, knitting, or watching the TV"
Po08 (Female; 70yrs): "I liked concentrating on my movements, so I don't get killed by the asteroids. For this reason, I found it to be fun."

Prompt feedback: One participant particularly acknowledged the timely feedback provided in the game.

Po03 (Female; 76yrs): "I like the fast feedback."

Negative feedback: One participant suggested providing more negative feedback.

Po04 (Female; 76yrs): "It would be nice if the game could provide more negative feedback for undesired movements such as stepping outside the gaming area"

Movement Variation: Two of the older participants expressed that they preferred more variation in physical movements while playing the game.

Po01 (Female; 71yrs): "I would like more movement variations"
Po02 (Male; 85yrs): "Would like more variation"

Technology: The older participants often needed to be reminded to position themselves in the center of the playing area. Another observation with respect to the sensor technology was that almost all the older participants initially reached forward to catch the stars instead of sideways. Four of the older participants commented on the motion recognition system as follows:

Po07 (Female; 76yrs): "The avatar wasn't responding precisely"
Po09 (Male; 72yrs): "The reaction of the avatar was slow"
Po03 (Female; 76yrs): "I felt having little control over the avatar"
Po01 (Female; 71yrs): "I did not like the slight lag between my movement and the avatar's movement"

Increased Training Time: It was observed that after the two minutes of demo, not all the older participants were sufficiently accustomed to the game. This sometimes resulted in participants repeating the demo or trying to learn the game during the actual gaming session as well. The need for increased demo time was both an observation and feedback that was received from one of the older participants.

Po08 (Female; 70yrs): "I like the second half better, because by then I understood the game better"

In sum, the older adults expressed their appreciation of the gaming experience in terms of having fun and for training their physical and cognitive skills. In addition, it was observed that this user group experienced slight difficulties with the technology and required more time to learn the game.

DISCUSSION

The purpose of the study was to compare motivational factors between healthy young and older adults by analyzing their assessments of the same balance training exergame. Results from a qualitative analysis of their answers to a semi-structured text input questionnaire indicate that when designing for older adults, in addition to making the games joyful to play, it is beneficial to give feedback on specific health effects and focus less on in-game rewards.

Relating to the Self-Determination Theory of motivation, both age groups show a combination of intrinsic and extrinsic motivation:

- ***The younger adults are intrinsically motivated by the game challenge, while the older adults are intrinsically motivated by the joy of playing.***
- ***The younger adults are externally motivated by the in-game rewards, while the older adults are externally motivated by the perceived health effects of playing.***

Although clear areas of concern emerged from the two different age groups, we do not claim that all younger adults are not motivated by health effects, nor that all older adults are not motivated by in-game rewards. We are only pointing to trends in motivational factors that should be considered when designing exergames for different age groups. A potential explanation for these differences could be that with age comes more self-reflection and less focus on competition. Another explanation could be that the perceived health effects of exergames were of more value to the older adults compared to the young adults, due to age-related decline in function and increased health problems, making it likely for older adults to be more aware of their health. However, this is generally not the case for healthy younger adults who might be less concerned about age-related functional decline. Furthermore, although the young and older participants framed their responses differently, certain responses conveyed similar meaning. For e.g. Py07 (Male; 26yrs): "I liked it when I had to move quickly and do more things at the same time" and Po06 (Female; 75yrs): "I like using my head and my body simultaneously". Both the participants conveyed that they enjoyed the challenge, although for older adults this seemed to be related to potential positive health effects. This is further supported by the responses provided by participants Po03, Po04, and Po05 with respect to physical and cognitive training, where they conveyed that they preferred and enjoyed the challenges for reasons of a positive health effect. However, as there are also older adults who participate in physical activities for competitive aspects, games should provide users with a choice for the amount of in-game rewards that they prefer to receive.

Although the sample of older adults (65 to 85 years of age) had a larger age spread than the younger adults, there were no differences between the youngest and oldest participants within the older adult group. Furthermore, as 80% of the older adults were females, this could have resulted in a gender bias. Though there were few males in the older adult group, their feedback was similar to that of the females within the group, which further supports the observed generational difference. An earlier study by Molanorouzi et al.[20] found that men were more motivated by mastery and competition, while females are more motivated by appearance and physical conditions. However, in this paper we only assessed the motivational differences between young and older adults, without assessing other factors such as gender. The women were spread evenly within the older adult sample, without clustering at either end of the age range.

The study provides specific feedback on aspects of the game that could be improved to better suit the different age groups, for example a more advanced reward system for the young participant and increased training time for the older users. This is of value as input to specific guidelines for designers of future exergames. What we found interesting in the results, however, are the implicit motivations behind the different areas of concern (topics) emerging from their answers. We did not ask the participants explicitly about what motivated them to play exergames, but it seems reasonable to assume that when a user answers "I like X", then X motivates him/her.

Following this line of reasoning, the motivational factors for the two age groups can be summarized as follows.

The young adults were motivated by:

- Exergames that allowed them to challenge themselves, both physically and cognitively.
- A complex gaming environment with visually appealing graphics and music that fits the game.
- An advanced reward system.
- The ability to personalize the game.

The older adults were motivated by:

- Exergames that can lead to positive physical and cognitive health effects on the player.
- Exergames that are fun to play (enjoyment).
- Feedback that help them do the desired movements.

Therefore, the implications of the above differences in motivational factors between young and older adults are that for older adults less effort can be put on designing the in-game reward system, and more on showing the player the potential health effects of their play. Furthermore, the competition aspect can be downplayed, and more focus placed on making the gaming experience itself as joyful as possible.

LIMITATIONS

As previously mentioned, we acknowledge several limitations in the current study. The limited number of participants precluded use of quantitative analysis and statistics. Furthermore, the group of older adults consisted of 80% women, which might have resulted in a gender bias. Despite these limitations, we believe that the results point to a real difference in motivational factors, especially given that we did not explicitly ask about motivation.

CONCLUSION

The current paper presents the evaluation of an age-neutral balance training exergame by healthy young and older adults, to assess differences in motivational factors between the two age groups. We found that the young adults tended to be intrinsically motivated by the game challenge and extrinsically motivated by the in-game reward system (scores). In contrast, the older adults were more intrinsically motivated by the joy of playing and extrinsically motivated by the perceived health effects (physical and cognitive), with less regard for the in-game rewards.

We conclude from this that when designing exergames for older adults, in addition to making the games joyful to play, it is beneficial to give feedback on specific health effects and focus less on in-game rewards and competition. While designing for specific user groups it is crucial to consider design preferences and influencing factors to achieve maximal adherence levels. We believe that the current results and insights could be of potential use for future design processes involving similar user groups. Further research is required to investigate the specific effects of age, gender and health status on motivation.

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AUTHOR DISCLOSURE STATEMENT

No competing financial interests exist

REFERENCES

1. Alves AJ, Viana JL, Cavalcante SL, et al., *Physical activity in primary and secondary prevention of cardiovascular disease: overview updated.* World Journal of Cardiology, 2016; 8: 575-583.
2. Warburton DER, Nicol CW, and Bredin SSD, *Health benefits of physical activity: the evidence.* Canadian Medical Association Journal, 2006; 174: 801-809.
3. Gillespie LD, Robertson MC, Gillespie WJ, et al., *Interventions for preventing falls in older people living in the community.* Cochrane Database Syst Rev 2012;CD007146., 2012; 12:
4. Barenbrock A, Herrlich M, and Malaka R. *Design lessons from mainstream motion-based games for exergames for older adults.* in *2014 IEEE Games, Media, Entertainment (GEM) Conference, 22-24 Oct. 2014.* 2014. Piscataway, NJ, USA: IEEE.
5. Adam C and Senner V. *Which Motives are Predictors for Long-term Use of Exergames?* in *11th conference of the International Sports Engineering Association, ISEA 2016, July 11, 2016 - July 14, 2016.* 2016. Delft, Netherlands: Elsevier Ltd.
6. Ijaz K, Yifan W, Ahmadpour N, et al. *Physical activity enjoyment on an immersive VR exergaming platform.* in *2017 IEEE Life Sciences Conference (LSC), 13-15 Dec. 2017.* 2017. Piscataway, NJ, USA: IEEE.
7. Larsen LH, Schou L, Lund HH, et al., *The physical effect of exergames in healthy elderly—a systematic review.* Games for health journal, 2013; 2: 205-212.
8. Tanaka K, Parker JR, Baradoy G, et al., *A Comparison of Exergaming Interfaces for Use in Rehabilitation Programs and Research.* Canadian Game Studies Association, 2012; 6: 69-81.
9. Hausdorff J, Rios D, and Edelberg H, *Gait variability and fall risk in community-living older adults: a 1-year prospective study.* Arch Phys Med Rehabil, 2001; 82: 1050-1056.
10. Ellmers TJ, Young WR, and Paraskevopoulos IT. *Integratingfall-risk assessments within a simple balance exergame.* in *2017 9th International Conference on Virtual Worlds and Games for Serious Applications (VS-Games), 6-8 Sept. 2017.* 2017. Piscataway, NJ, USA: IEEE.
11. Feltz DL, Irwin B, and Kerr N, *Two-player partnered exergame for obesity prevention: using discrepancy in players' abilities as a strategy to motivate physical activity.* J Diabetes Sci Technol, 2012; 6: 820-827.
12. Ho SS, Lwin MO, Sng JRH, et al., *Escaping through exergames: Presence, enjoyment, and mood experience in predicting children's attitude toward exergames.* Computers in Human Behavior, 2017; 72: 381-390.
13. Baranyi R, Reisecker F, Lederer N, et al. *WristDroid - a serious game to support and motivate patients throughout their wrist rehabilitation.* in *2014 IEEE Conference on Biomedical Engineering and Sciences (IECBES), 8-10 Dec. 2014.* 2014. Piscataway, NJ, USA: IEEE.
14. Schwenk M, Grewal GS, Honarvar B, et al., *Interactive balance training integrating sensor-based visual feedback of movement performance: a pilot study in older adults.* Journal of NeuroEngineering and Rehabilitation, 2014; 11: 164 -177.
15. Chang W, Chang W, Lee C, et al., *Validity and reliability of Wii fit Balance board for the assessment of balance of healthy young and the elderly.* J Phys. Ther. Sci, 2013; 25: 1251-1252.
16. Graves L, Ridgers N, Williams K, et al., *The physiological cost and enjoyment of Wii fit in adolescents, young adults and older adults.* Journal of physical activity and health, 2010; 7: 393-401.
17. Thomas S, Fazakarley L, Thomas PW, et al., *Testing the feasibility and acceptability of using the Nintendo Wii in the home to increase activity levels, vitality and well-being in people with multiple sclerosis(Mii-vitaliSe): protocol.* BMJ Open, 2014; 4: 1-11.
18. Hanley CA, Arciero PJ, Brickman AM, et al., *Exergaming and Older Adults Cognition: A Cluster Randomized Clinical Trial.* American Journal of Preventive Medicine, 2012; 42: 109-119.
19. Deci EL and Ryan RM, *Self-determination theory: A macrotheory of human motivation, development, and health.* 2008; 49: 182-185.
20. Molanorouzi KK, Selina; Morris, Tony;, *Motives for adult participation in physical activity: type of activity, age, and gender.* BMC Public Health, 2015; 15:
21. Kilpatrick M, Hebert E, and Bartholomew J, *College Students' Motivation for PhysicalActivity: Differentiating Men's and Women'sMotives for Sport Participation and Exercise.* Journal of American College Health, 2003; 54: 87-94.
22. Corbin JM and Strauss A, *Grounded theory research: Procedures, canons, and evaluative criteria.* 1990; 13: 3-21.

23. Saunders BS, Julius; Kingstone, Tom; Baker, Shula; Waterfield, Jackie; Bartlam, Bernadette; Burroughs, Heather; Jinks, Clare;, *Saturation in qualitative research: exploring its conceptualization and operationalization.* Qual Quant, 2017; 52: 1893-1907.