



**Háskólinn
á Akureyri**
University
of Akureyri

Misconceptions and behavior analysis

University students' misconceptions about behavior
analysis

Þóra Margrét Karlsdóttir

Sálfræðideild
Hug- og félagsvísindasvið
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12 eininga lokaverkefni
sem er hluti af
Baccalaureus Artium-prófi í sálfræði

Leiðbeinandi
Kristín Guðmundsdóttir

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Útdráttur

Ýmsar rannsóknir hafa sýnt fram á að almennt hafi fólk fjölmargar ranghugmyndir um atferlisfræði. Þær algengustu eru til dæmis að atferlisfræðingar einblíni aðeins á sjáanlega hegðun og hunsu hugsanir, tilfinningar og erfðir. Það er mikilvægt að vera meðvitaður og bera kennsl á ranghugmyndirnar til að laga þær. Fyrri rannsókn gaf til kynna að sálfræðinemendur sýndu mestu ranghugmyndirnar ásamt nemendum sem höfðu ekki tekið sálfræðiáfangu. Þessi rannsókn miðar að því að rannsaka hvort að okkar niðurstöður styðji fyrri rannsókn. Hér sýnum við fram á að sálfræðinemendur sýna ekki mestu ranghugmyndirnar. 134 nemendur við háskóla á Íslandi svöruðu spurningakönnun á netinu. Spurningalistinn innihélt atriði um algengar ranghugmyndir um atferlisfræði og aðferðir atferlisfræðinga. Niðurstöður sýndu að allir nemendur sýndu einhverjar ranghugmyndir. Sálfræðinemendur sýndu rétt undir meðallagi mikið af ranghugmyndum miðað við aðra nemendahópa, og þeir sýndu minnstu ranghugmyndirnar í flokknum Hagnýting. Nemendur í grunnnámi í kennarafræðum sýndu mestu ranghugmyndirnar, á meðan nemendur í heilbrigðisgeiranum sýndu minnstu ranghugmyndirnar. Framtíðarrannsóknir ættu að einblína á fyrri takmarkanir við gerð spurningalista til fyrirlagningar við mat á ranghugmyndum.

Lykilorð: ranghugmyndir, atferlisfræði, háskólanemar.

Abstract

Various studies have suggested that people generally hold numerous misconceptions about behavior analysis. The most common misconceptions are for an example that behavior analysts focus only on the observable behavior and ignore thoughts, feelings and genetics. It is important to be aware of and identify the misconceptions in order to repair them. Previous study suggested that Psychology students showed the most misconceptions out of students, along with naïve students. The present study aims to see if it would support the former finding. Here we show that Psychology students don't show the most misconceptions about behavior analysis. 134 students at Universities in Iceland completed a questionnaire online. The questionnaire contained items regarding common misconceptions about behavior analysis and the procedures of behavior analysts. The results showed that all education groups showed some misconceptions. Psychology students exhibited just under average amount of misconceptions out of all education groups, and they showed the least number of misconceptions in the category Application. Undergraduate students in Education science showed the most misconceptions while the Health sector showed the least misconceptions. Future studies should focus on the previous limitations of the construct of misconception questionnaire.

Keywords: misconceptions, behavior analysis, university students.

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This research paper is my BA thesis from the University of Akureyri. I want to thank my supervisor, Kristín Guðmundsdóttir, for good guidance and help in the writing of this paper. Furthermore, I want to thank students for participating in the questionnaire. Special thanks to Patrekur Örn Gestsson.

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Introduction

Applied behavior analysis is, in brief, the science of human behavior, how it works and how it can be improved, as Cooper et al. (2020) describe. The authors describe that applied behavior analysis focuses on behavior of great social importance and that will make a difference to the person. All strategies and tactics that are used are based on scientific methods to show in a reliable way the relations between the interventions and the improvement of the individual's behavior (Cooper et al., 2020). Critchfield and Kollins (2001) describe that those who practice behavior analysis assume that past consequences determine behavior. This assumption is then tested in a laboratory and tools such as operant procedures are used, which produces reinforcers and punishments on the behavior (Critchfield and Kollins, 2001). Applied behavior analysis can be used in various situations and across fields, and it focuses largely on children and adults with autism spectrum disorder and associated learning difficulties (Gharbieh and Isabella, 2021) and children with intellectual disabilities (Foran et al., 2015). When applied behavior analysis is used for children with autism, it is helpful to build a complex behavior through behavior treatment, and it can suppress aggression, self-stimulatory behavior, and more pathological behavior (Fielding et al., 1013). Behavior analysis has evolved to be used for things such as in consumer behavior analysis, where the behavior principles are used to interpret human economic consumption (Foxall, 2001) The field of behavior analysis is in fact free to choose among many fascinating topics that have not reached the attention of behavior analysts yet, and some within this field have in fact expressed concerns that the field is not addressing a wide enough range of problems that hold great socially importance (Critchfield and Kollings, 2001). Behavior analysis grew substantially in the 1950s and the 1960s and during that time it started to split into different branches, applied behavior analysis, behaviorism, and experimental analysis (Morris et al., 1990). Today, behavior analysis is a scientific field, a discipline, and a practice (Morris et al., 2013). Morris et al. (2013) describe that the first publication in the discipline's basic science can be traced to Skinner's dissertation in the early 1930s, but there are earlier works of applied research and behavior applications, such as Mary C. Jone's (1924) work on eliminating fear in a young boy. The first documented work done with an individual with autism was conducted in the early 1960s, and today a great part of applied behavior analysis is helping people with autism and children with other developmental disabilities (Morris et al., 2013).

Fielding et al. (2013) describe that despite overwhelming evidence that supports the benefits derived from using behavior analysis, educators often indicate many misconceptions in this field that seem to be common. According to the authors, it is important to be aware of those misconceptions in the field of behavior analysis since these misconceptions contribute to a reluctance from educators to use the strategies of behavior principles. Furthermore, these misconceptions can impede educator's effectiveness and the progress of the students (Fielding et al., 2013). Wyatt (2001) agrees with the notion that it is important to be aware of misconceptions in behavior analysis since behavior analysts use effective and empirically based therapies that are drug free. The discipline will advance, and society will be more and more accepting towards it, but there are powerful economies that will continue to push for medically based treatment. Poling (2010) describes that behavior analysis has the potential to grow in the future. According to the author, there has been an increase in memberships in the *Association for Behavior Analysis International* and there has been a growth in service aimed at people in the autism spectrum. But that can be a two-edged sword, as Poling (2010) describes that perhaps the field is focusing too much on treatments for people on the autism spectrum and that is slightly worrying, since applied behavior analysis can be useful in treatments for people with a wide range of diagnoses and even people who have no diagnosis as well (Poling, 2010). Grey et al. (2005) describe that there is a great potential in teachers implementing behavior interventions. Their research supports the notion that teachers can effectively conduct functional assessment, design, and implement behavior supports plan in interventions for the students. The fact that teachers can conduct a behavior assessment instead of consultant behavior analyst has a great implication for the future of education (Grey et al., 2005). Additionally, Miller et al. (2019) describe that behavior analysts practice increasingly within settings that are characterized by cultural diversity, and the number of culturally and linguistically diverse children is expected to increase in the future in the Western world. Furthermore, behavior analysts are increasingly becoming part of the conversation of increased cross-cultural interaction and social justice. The authors describe that the discipline of behavior analysis has roots that can both encourage and resist efforts regarding culture and social justice. It is important to be aware of those elements in the future of behavior analysis research and practice, since much of the research in the field is dedicated to improving lives of protected populations (Miller et al., 2019). As mentioned before, it has been reported that misconceptions in the field of behavior analysis are common. Fielding et

al. (2013) and Wyatt (2001) describe that being aware of misconceptions regarding the field is important.

Taylor and Kowalski (2004) describe that misconceptions can be defined as beliefs that are held contrary to known evidence. Studies on misconceptions often focus on physical science, such as physics instead of psychology or social science, where misconceptions are often held (Taylor and Kowalski, 2004). The field of psychology holds some prevalent misconceptions as well, and students tend to be susceptible towards psychological misconceptions (Taylor and Kowalski, 2004; Bensley and Lilienfeld, 2015). Taylor and Kowalski (2004) describe that these misconceptions are especially widespread in misconceptions regarding human behavior. If students enter their introductory psychology class with misconceptions that are strongly held, then it is likely going to be difficult to teach more accurate findings. (Taylor and Kowalski, 2004). Taylor and Kowalski (2012) describe that Undergraduate Psychology students tend to start their psychological courses with beliefs that they hold strongly but are in contrast with scientific evidence. They will freely leave their course, still holding those beliefs if there is not strong intervention that will challenge their false beliefs. According to the authors, students will have to recognise that what they believe to be true does not match the scientific evidence, and they must be presented with the right alternative in a way they can understand (Taylor and Kowalski, 2012).

Studying misconceptions is important because, as Taylor and Kowalski (2004) describe, it is difficult to change strongly held, but incorrect beliefs. The authors describe that after a misconception becomes fixed in a person's mind and knowledge base, then new information that is learned is often distorted or even ignored, resulting in the inaccurate belief being strengthened or retained. Michael (2002) describes that only when the possible existence of misconceptions is known, it is possible to look for it and identify them. After that it is possible to help the students repair their faulty mental models, according to Michael (2002).

Wyatt (2001) describes that there are some common misconceptions regarding behavior analysis and how behavior analysts conduct their studies. These misconceptions are not only in the general discussion, but in the counselling literature and mass media as well (Myers and Thyer, 1994) and even in textbooks for psychology studies and among members of the psychology faculty (Lamal, 1995). Those misconceptions concern the methods of behavior counselling and the foundation of the learning theory (Myers and Thyer, 1994).

The misconceptions that are common, as Wyatt describes above, are for example that the field of behavior analysis ignores thoughts, cognitions and feelings and is only interested in observable behavior (Wyatt, 2001; Myers and Thyer, 1994). Additionally, it is a common misconception that behavior analysts ignore genetic influence and its role in behavior and instead believe that all behavior is learned (Wyatt, 2001; Myers and Thyer, 1994). Those misconceptions can be debunked, since the truth is that behavior analysts understand and consider the genetic role in behavior. Behavior analysts both understand that people have unique genetic structures and that is what makes individuals unique (Wyatt, 2001; Myers and Thyer, 1994). Even Skinner and other behavior analysts have long known the importance of genetics and natural selection processes (Wyatt, 2001; Myers and Thyer, 1994). Hineline (1980) describes that behavior analysts look at the behavior of a person as a function of three variables that are interacting. The variables are genetics, past experiences, and the conditions of current environment (Hineline, 1980). Cooper et al. (2020) describe that as neither genetic preposition nor past experiences cannot be manipulated, then the manipulating of the current environmental condition becomes the best way to modify behavior. Wyatt (2001) describes that furthermore, behavior analysts understand that thoughts and feelings play an important role, but they are in fact behaviors so they can be subjected to reinforcement. Wyatt (2001) describes that even though positive reinforcement is recommended instead of punishment, there is a commonly held misconception that behavior analysts overuse punishment procedure. The Ethics Code for Behavior Analysts recommend that punishment be used only when the desired behavior results cannot be obtained using less intrusive means. In addition, it can be used when the risk to the client is considered to be greater than the risk associated with the behavior-change intervention (Behavior Analyst Certification Board, 2020). Furthermore, Cooper et al. (2020) describe that punishment is poorly understood and often misapplied and the application of punishment is controversial. The authors describe that the general population thinks of punishment as the application of adverse consequences, such as physical or psychological pain. These notions of punishment have little, or nothing, to do with punishment as a principle of behavior. Cooper et al. (2020) describe punishment as punishing the behavior, not the person. There is a response from the person, and that response has a consequence, which is not directed at the person itself but only at the behavior (Cooper et al., 2020). Fielding et al. (2013) describe that other common misconceptions are that applied behavior analysis is used exclusively for children that have autism. The authors describe that it is important that the public views behavior analysis as a science, but not merely as a therapy

for autism. Fielding et al. (2013) describe that another common misconception is that the use of applied behavior analysis requires a 1:1 ratio of student to teacher. The authors describe that there does not need to be a 1:1 ratio, a teacher can implement behavior approach for the classroom. That can be response cards during group discussion or a tutoring behavior, such as presenting material, prompting, and then praising and using corrective feedback (Fielding et al., 2013). Furthermore, the authors also describe that the behavior analysis terminology often invokes a negative feeling, especially words such as “punishment” (Fielding et al., 2013).

DeBell and Harless (1992) described that people generally held misconceptions about Skinner’s work and the views he held. The authors describe that those misconceptions are that Skinner discounted the role of both psychology and genetics in behavior and that Skinner believed that all behavior can be conditioned. More misconceptions regarding Skinner are that he ignored the uniqueness of the individual, that he preferred punishment as a method of behavior control and that he denied that internal states exist (DeBell and Harless, 1992).

DeBell and Harless (1992) conducted a study on students of all levels of psychology training and put forward a questionnaire that inspected misconceptions about Skinner’s work. The subjects were Undergraduate Psychology students with no experience with psychology, advanced Undergraduate Psychology students, beginning Graduate students, advanced graduate students and lastly, faculty in the psychology department. DeBell and Harless (1992) constructed a 14-item true/false questionnaire, with 7 items that were related to common misconceptions about Skinner’s work, as described above, and 7 items that were general information about Skinner’s ideas, which were not related to the misconceptions. According to DeBell and Harless (1992), students who were not educated in psychology showed misconceptions about Skinner and his ideas, but even students who had more education in psychology showed some misconceptions about the topic, even though they were more informed than the other students. All education levels, that is both Undergraduate and Graduate Psychology students, showed more misconceptions regarding the myths than the general items (DeBell and Harless, 1992). The authors found no significant difference between the beginning graduate students and the advanced graduate students and the psychology faculty.

Surprisingly, Lamal (1995), found that advanced undergraduate students held few misconceptions about the field when he partially replicated DeBell and Harless’s study from 1992. He conducted a study where the students answered a 13-item true or false questionnaire, with 12 items taken from DeBell and Harless’s (1992) questionnaire. He decided to not refer

to Skinner in his items, like DeBell and Harless (1992) did, but rather refer to behavior analysis and behavior analysts. That was to counteract that Skinner was the only one who founded the basis of behavior analysis and wrote about it. Lamal (1995) only found three misconceptions were widely held, but those three misconceptions were resistant to change. Even after taking an introductory course in behavior modification, taught by Lamal himself, there were no significant changes in the misconceptions held by the students. The misconceptions were mostly towards the behavior analysts' view of the importance of genetics, the importance of behavior analysis on American society and the species limits on conditioning (Lamal, 1995). Lamal's (1995) findings relating to the misconceptions regarding genetics and conditioning are consistent with DeBell and Harless's (1992) findings. Lamal changed the wording of a couple of items in his study and referred to behavior analysts or behavior analysis rather than to Skinner, like DeBell and Harless (1992) did, but that did not seem to make much difference. Still, Lamal wanted to use that wording, to avoid future misconceptions (Lamal, 1995).

Arntzen et al. (2010) replicated Lamal's (1995) study with few additional statements and included students who had no formal psychology training. Arntzen et al.'s (2010) study focused on misconceptions about behavior analysis held by students from different educational studies, such as psychology, bioengineering and social education. The participants in their research study were Undergraduate students studying various studies, Graduate students in behavior analysis, university teachers and students who had no formal psychology training. Arntzen et al.'s (2010) findings showed that all participants held some misconceptions. The Graduate students showed the fewest misconceptions, as expected, but surprisingly the Undergraduate students in Psychology showed the most misconceptions regarding behavior analysis, along with the naïve participants (which was expected). Previous studies have shown that teachers hold as many misconceptions as students, but Arntzen et al. (2010) suggested that they do not. Results from Arntzen et al.'s (2010) study showed that the teachers showed significantly less misconceptions than Undergraduate students, but more than Graduate students in behavior analysis (Arntzen et al., 2010). The authors describe that the results might arise, at least to some extent, from the ambiguity of the true-false questions, which can be explained by the fact that the items used in such misconception tests are drawn from different textbooks. Arntzen et al. (2010) describe that not only are the questions ambiguous, but it is also quite difficult to compose simple statements, since psychology is so complex. Another explanation for the results might be that no option for *don't know* was

included. This could result in the fact that it may not be possible to differentiate misconceptions held by the students from students guessing. This can be the problem of true-false questionnaires (Arntzen et al., 2010).

The main purpose of this study is to replicate Arntzen et al.'s (2010) study on misconceptions regarding behavior analysis. The current study is conducted with university students in Iceland as participants, and students who are studying police science were included as well. Moreover, this study includes one additional question that was added to the Arntzen et al. (2010) questionnaire. That question is about whether behavior analysts can explain how we learn language. Instead question 22 was removed from the Arntzen et al. (2010) questionnaire, as it did not fit the purpose of the current study. The current study aims to answer whether findings from students at Icelandic universities will support Arntzen et al.'s (2010) findings. Will psychology students show the most misconceptions about behavior analysis?

Method

Participants

The participants in this study were university students both from the University of Akureyri and the University of Iceland. There was a total of 136 participants from nine different studies (112 women and 22 men), recruited with purposive sampling. The first group consisted of Master's students in Health Science (n=3), the second group consisted of nursing students (n=9), the third group was made up of students studying occupational therapy (n=10). The fourth group consisted of Undergraduate Education (n=16) and the fifth group was made up of Master's students in Education (n=14), that is student teachers. The sixth group comprised students in police science (n=2) and the seventh group comprised students of biotechnology and fishery science (n=2). The final group was made up of Undergraduate Psychology students (n=73) who were taking a introductory course in behavior analysis. All the education groups, except Psychology, consisted of students from the University of Akureyri. Students in Psychology were from the University of Akureyri and the University of Iceland, almost divided equally.

Procedure

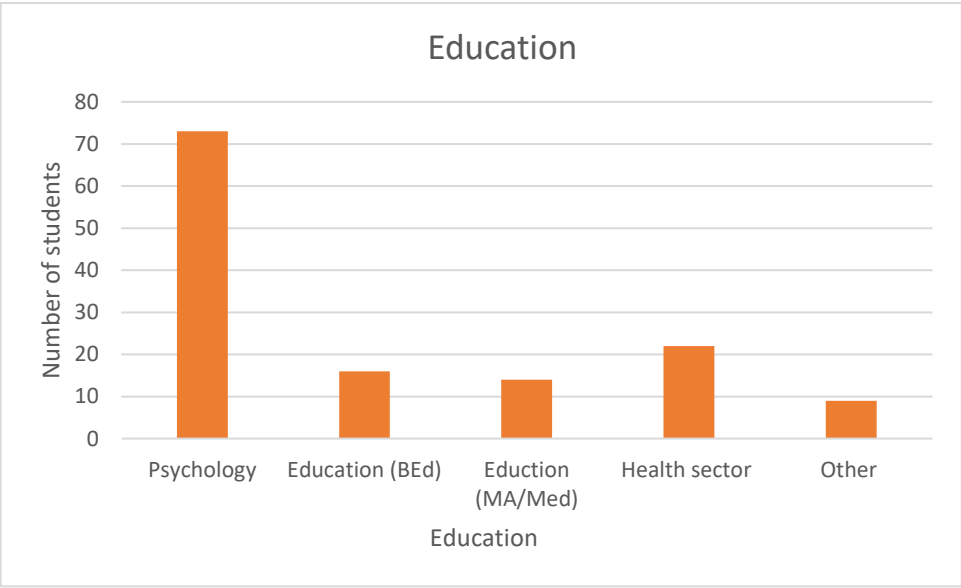
A 22-item true-false questionnaire was used. 21 item was taken directly from Arntzen et al. (2010) and translated directly to Icelandic, see Table A1 in Appendix. See Table A2 in Appendix for the English version. Question 22, "Behavior analysis includes description that in other parts of psychology have been referred to as "the self" or "sense of self"", was removed. One new item was added, "Behavior analysts can explain how we learn and use language". The questions were regarding application, belief, theory, and knowledge. Seven items were coded "True" and 15 item were coded "False". The participants in the sample were recruited by inviting all students in each course that was included in the study (as described in Participants) to participate. An online questionnaire was accessible from a weblink provided to the students via their course Learning Management System. The student completed the online questionnaire on their own computers in their own time. A permission to submit the survey to students was obtained from the course supervisor for each course.

Statistical analysis

The groups were combined from nine to five (see Figure 1). Master's students in health science, Nursing students and students in occupational therapy were combined into one group,

which was named “*health sector*”. Students in police science and biotechnology and fishery science were combined with others who did not belong to any of the nine original groups, called “*other*”. The items on the questionnaire were divided into different categories, depending on the question’s content.

Figure 1
The Five Education Groups



Note. Education groups after being combined.

The categorization was according to Arntzen et al.’s (2010) categorization. The new question (question 22) in the current study was placed in *application*. The categories, which are presented in Table 1, were four in total: *knowledge* (items 7, 13 and 18), *beliefs* (items 2, 3, 4, 5, 6, 15, 17), *theory* (items 14, 16, 19, 20 and 21) and *application* (items 1, 8, 9, 10, 11, 12, 22). One-way ANOVA was conducted to get a statistically significant test. ANOVA was used to get means with 95% confidence for each group in each subcategory and for each group in Overall Knowledge.

Table 1

Categorization of Questions From the Questionnaire

Knowledge	7. Behavior analysts have shown that principles of learning apply more to animals than to humans 13. Behavior analysis is a popular viewpoint in Iceland 18. Very few effective modern treatment methods have been based on behavior analysis
Beliefs	2. Behavior analysts believe that any behavior can be conditioned 3. Behavior analysts believe that theories that attempt to explain psychological constructs are useful to psychology 4. Behavior analysts believe that genes play an important role in shaping behavior 5. Behavior analysts use rigorous statistical analyses in examining data from their studies 6. Behavior analysts recognize the uniqueness of individuals 15. Behavior analysts compare humans with machines when explaining behavior 17. Behavior analysts argue that almost every behavior is elicited by preceding stimuli
Theory	14. Behavior analysis denies private events 16. Behavior analysts treat humans as infinitely changeable organisms 19. Behavior analysis has no place for thinking and feeling, as thinking and feeling cannot be observed by anyone other than the behaving organism 20. Behavior analysis cannot explain creative achievements, such as art 21. Behavior analysis can explain phenomena that are usually described as cognitive, such as problem solving and remembering
Application	1. According to behavior analysis, negative reinforcement is another form of punishment 8. Behavior analysts support the use of physical punishment in controlling human behavior 9. Behavior analysts have demonstrated that shaping has minimal impact in teaching new behavior 10. In general, behavior analysts believe that positive reinforcement is more effective than punishment 11. Behavior analysts focus on behavior that is observable and measurable 12. Behavior analysts discuss secondary reinforcers; one example of this is money 22. Behavior analysts can explain how we learn and use language

Note. The item number is presented before the question.

Results

One-way ANOVA revealed statistically significant overall effects of group for the main measure of the Overall Knowledge, and for all subcategories except one. The Belief category was not statistically significant. Analysis of variance is presented in Table 2.

Table 2

Analysis of Variance for Overall Knowledge and Subcategories

Scales	SS	df	MS	F	p
Overall knowledge					
Between groups	2627,91	4	656,98	5,42	.001
Withing Groups	15636,6	129	121,21		
Total	18264,5	133			
Beliefs					
Between groups	1550,5	4	387,63	1,36	.251
Withing Groups	36727	129	284,71		
Total	38277,5	133			
Knowledge					
Between groups	8755,57	4	2188,89	4,66	0.002
Withing Groups	60572,8	129	469,56		
Total	69328,4	133			
Theory					
Between groups	7944,26	4	1986,06	5,23	.002
Withing Groups	48990,1	129	379,77		
Total	56934,3	133			
Applications					
Between groups	6057,9	4	1514,48	6,58	.002
Withing Groups	29697,5	129	230,21		
Total	35755,4	133			

Note. In the first row the labels of the scales are presented. In the second to seventh column, variance sources, Sums of Squares (SS), degrees of freedom (df), Mean Sums of Squares (MS), F values, and p values are listed.

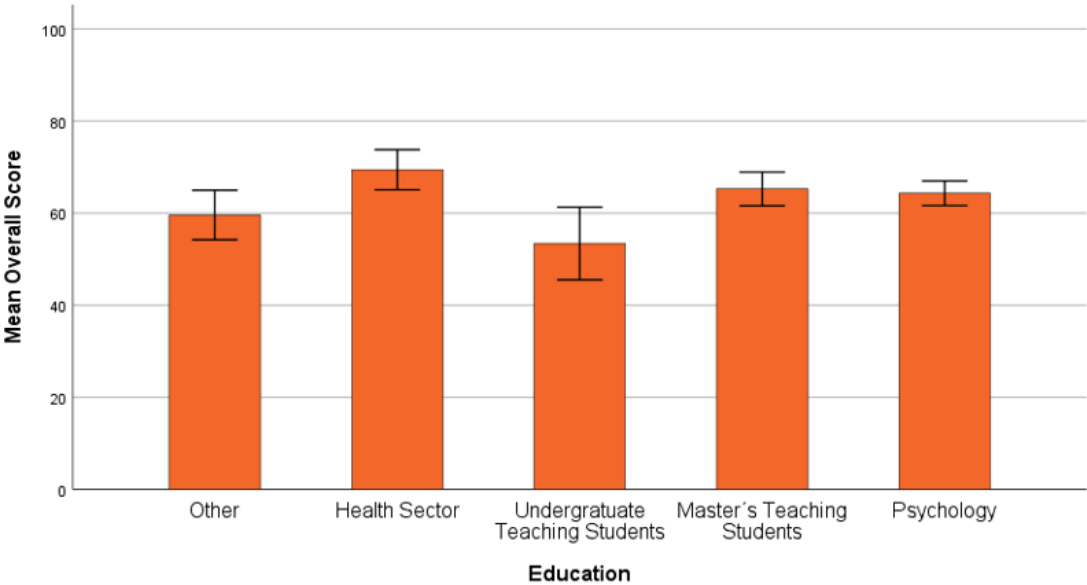
Mean scores for Overall Knowledge are presented in Figure 2. As already mentioned, the aim was to look at whether Psychology students show the most misconceptions regarding behavior analysis, that is if they had the lowest mean score. The results show, however, that overall, it were not the Psychology students who scored the lowest for Overall Knowledge, or in any of the subcategories. Psychology students scored just above average for all groups in Overall Knowledge, which indicates that Psychology students showed less misconceptions

than average for all education groups. Undergraduate Student Teachers students had the lowest mean scores in Overall Knowledge, meaning that those students showed the most misconceptions overall. The student group that got the highest mean score in Overall Knowledge was the Health sector, signifying that they showed the least misconceptions overall. Interestingly, there is a significant difference between the Undergraduate Student Teachers, who scored the lowest overall, and the Master’s Student’s Teachers, who received the second highest overall scores. Overall, the Psychology students showed slightly more misconceptions than the Master’s Student Teachers.

The category that scored significantly highest in Overall Knowledge, across all students, is Applications. Knowledge scored the second highest overall mean score. The category which scored the second lowest overall mean score was Theory, which had mean overall scores just under Knowledge. Beliefs scored significantly lowest out of the four categories.

Figure 2

Mean Score for Overall Knowledge for all Education Groups

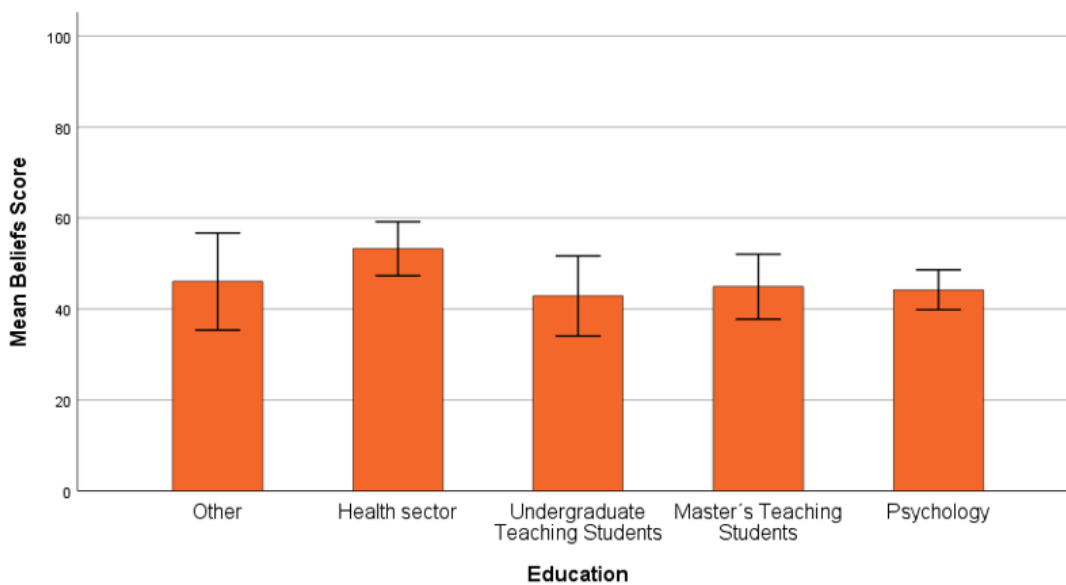


Note. Overall proportion of correct responses for each education group is presented. 95% confidence interval for the means.

On the Beliefs Scale, presented in Figure 3, the Undergraduate Student Teachers had the lowest mean overall score, while the Health sector had the highest mean overall score. Psychology students showed similar results as the Master’s Student Teachers, and both groups had higher mean score than the group labeled Other, which consists of students in Biotechnology, Fishery science, Police science and other educations.

Figure 3

Mean Beliefs Score for all Education Groups

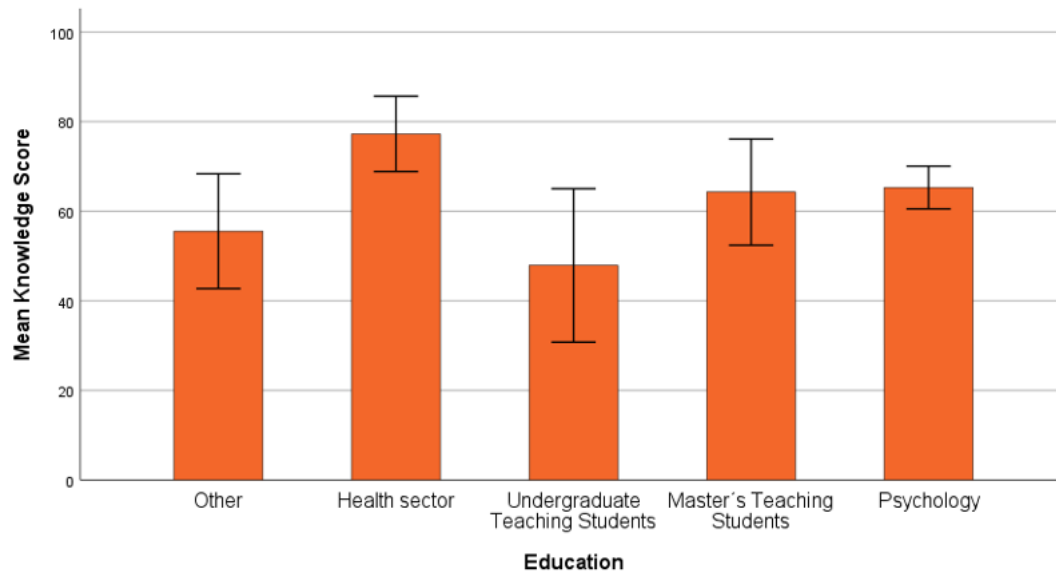


Note. Mean proportion of correct responses for Beliefs for each education group. 95% confidence interval for the means.

On the Knowledge Scale, presented in Figure 4, the Undergraduate Student Teachers had the lowest mean overall score, while the Health sector had the highest mean score. Psychology students had the second highest mean overall score, and their score was just above the Master’s Student Teachers.

Figure 4

Mean Knowledge Score for all Education Groups

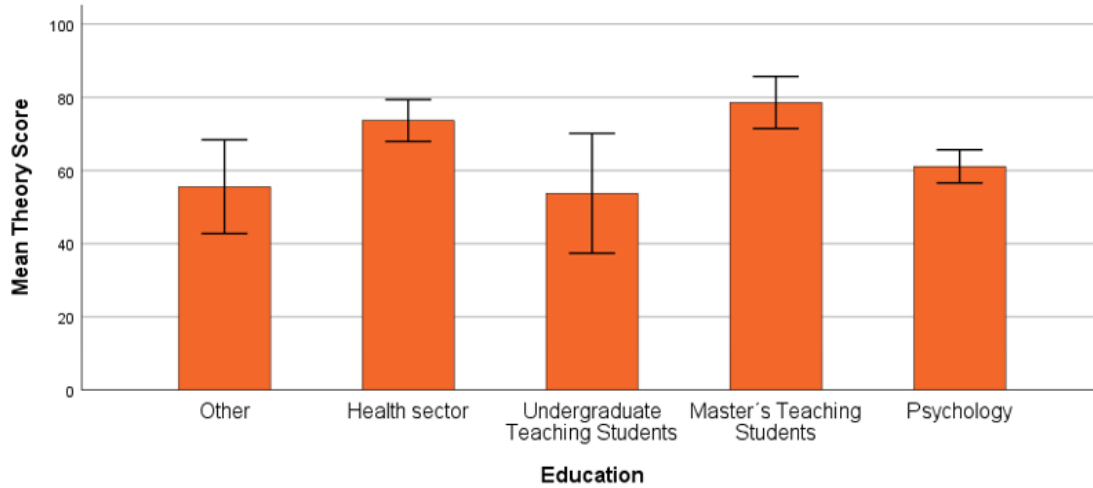


Note. Mean proportion of correct responses for Knowledge for each education group. 95% confidence interval for the means.

On the Theory Scale, presented in Figure 5, the group who had the lowest mean overall score was the Undergraduate Student Teachers, they scored a little less than Other. The Master's Student Teachers had the highest mean overall score. They scored relatively higher than the group who scored the second highest, which was the Health sector. The Psychology students had the third highest score out of the five groups.

Figure 5

Mean Theory Score for all Education Groups

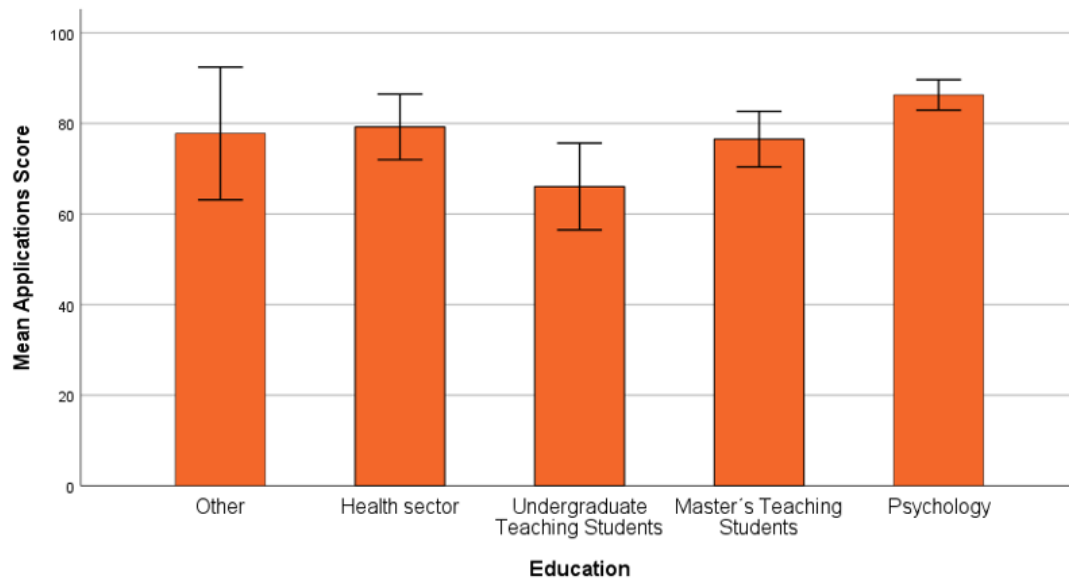


Note. Mean proportion of correct responses for Theory for each education group. 95% confidence interval for the means.

On the Application Scale, presented in Figure 6, Undergraduate Student Teachers received , once again, the lowest mean overall score, whereas the Psychology students had the highest mean overall score. They scored higher than the next group, which was the Health sector. On the Application Scale, the Master's Student Teachers and Other showed similar mean scores.

Figure 6

Mean Application Score for all Education Groups



Note. Mean proportion of correct responses for Application for each education group. 95% confidence interval for the means.

Figure 7 represents categorized survey questions by scale answered by Psychology students. The questions that were answered incorrectly by most students were questions 3, 16 and 17. Questions 3 and 17 belong to the Beliefs category and question 16 belongs to the Theory category. Questions 2 and 13 were answered incorrectly by most Psychology students as well. The questions that were answered correctly by at least 90% of the students are questions 8, 10, 11 and 14. Question 14 belongs to the Theory category and questions 8, 10 and 11 belong to Application. In fact, Psychology students scored relatively high on all questions regarding Application, and as mentioned above, Psychology students had the highest overall score in the Application category.

Figure 7

Questions Answered Correctly by Psychology Students

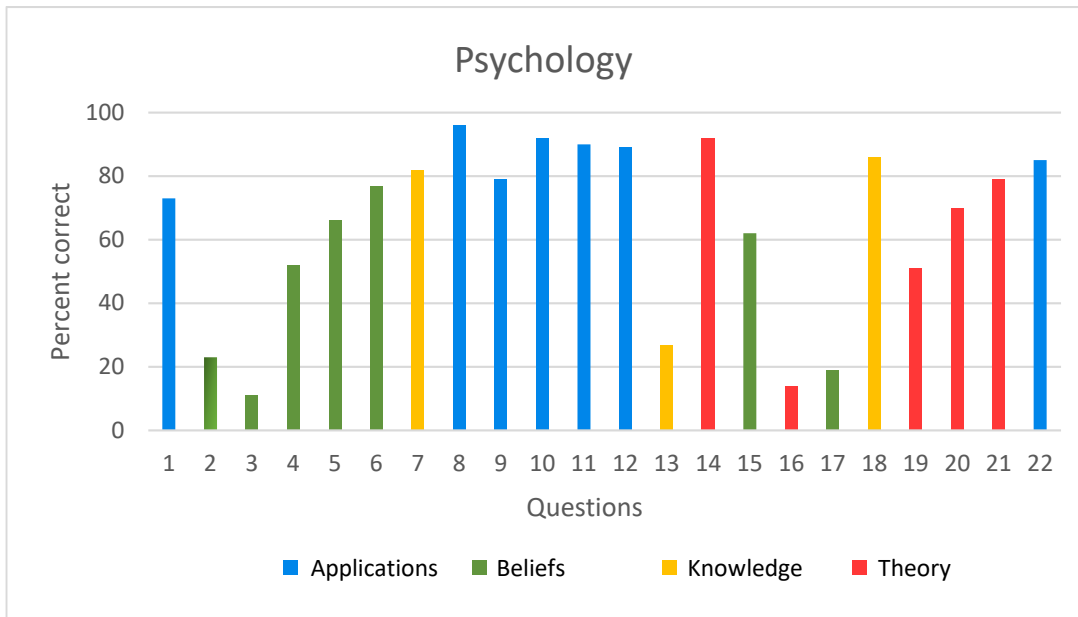
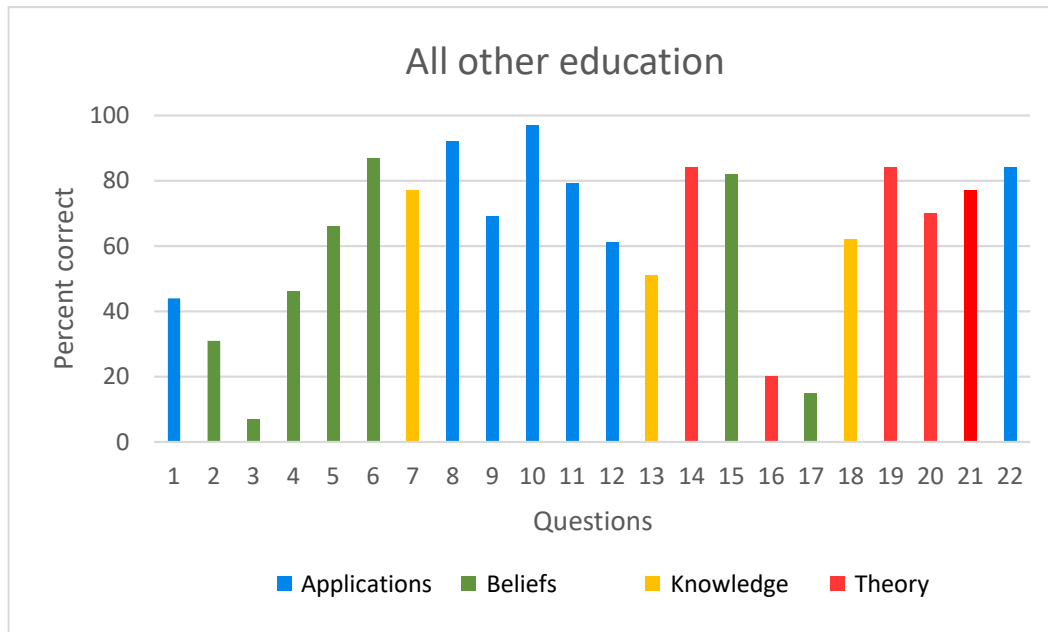


Figure 8 represents categorized survey questions by scale answered by all other student groups. Those groups are the Health sector, Undergraduate Student Teachers, Master's Student Teachers and Other. The questions answered incorrectly by most students are questions 3, 16 and 17, which were the same questions that most Psychology students answered incorrectly as well. Questions 3 and 17 belong to the Beliefs category and question 16 belongs to Theory. The questions that other students answered correctly most often were questions 6, 8 and 10. Questions 8 and 10 belong to the Application category and question 6 belongs to the Beliefs category. Questions 8 and 10 were answered right by most Psychology students as well.

Figure 8

Questions Answered Correctly by Students in all Other Education



When looking at which questions Psychology students scored significantly lower than the other students, they are the following questions: 2, 6, 13, 15 and 19. Questions 2, 6 and 15 belong to the Beliefs category, question 13 belongs to Knowledge and question 19 belongs to Theory. The questions that Psychology students did better on than the other students were questions 12 and 18. The questionnaire is presented in Table 3. No questions in the survey were skipped.

Table 3*Questionnaire With Remarks for Questions That Psychology Students did Better and Worse on Than Other Students*

Nr.	Questions	T/F
1.	According to behavior analysis, negative reinforcement is another form of punishment	F
2.	Behavior analysts believe that any behavior can be conditioned*	F
3.	Behavior analysts believe that theories that attempt to explain psychological constructs are useful to psychology	F
4.	Behavior analysts believe that genes play an important role in shaping behavior	T
5.	Behavior analysts use rigorous statistical analyses in examining data from their studies	F
6.	Behavior analysts recognize the uniqueness of individuals*	T
7.	Behavior analysts have shown that principles of learning apply more to animals than to humans	F
8.	Behavior analysts support the use of physical punishment in controlling human behavior	F
9.	Behavior analysts have demonstrated that shaping has minimal impact in teaching new behavior	F
10.	In general, behavior analysts believe that positive reinforcement is more effective than punishment	T
11.	Behavior analysts focus on behavior that is observable and measurable	T
12.	Behavior analysts discuss secondary reinforcers; one example of this is money**	T
13.	Behavior analysis is a popular viewpoint in Iceland*	F
14.	Behavior analysis denies private events	F
15.	Behavior analysts compare humans with machines when explaining behavior*	F
16.	Behavior analysts treat humans as infinitely changeable organisms	F
17.	Behavior analysts argue that almost every behavior is elicited by preceding stimuli	F
18.	Very few effective modern treatment methods have been based on behavior analysis**	F
19.	Behavior analysis has no place for thinking and feeling, as thinking and feeling cannot be observed by anyone other than the behaving organism*	F
20.	Behavior analysis cannot explain creative achievements, such as art	F
21.	Behavior analysis can explain phenomena that are usually described as cognitive, such as problem solving and remembering	F
22.	Behavior analysts can explain how we learn and use language	T

Note. T=true and F=false.

*Questions were Psychology students scored significantly lower than other students.

**Questions were Psychology students scored significantly higher than other students.

Discussion

The aim of this study was to replicate Arntzen et al.'s (2010) study on misconceptions among university students. The results from this study showed that Psychology students did not exhibit the most misconceptions, neither in the Overall Knowledge nor any of the subcategories. Overall, the Psychology students scored just above average compared to all groups, which indicates that they showed slightly less misconceptions than the average for all other groups. The Psychology students showed the least misconceptions of all the student groups in the category Application, which contains questions that are practical and have to do with the application of behavior analysis. In Arntzen et al.'s (2010) study, the Psychology students showed the least misconceptions in Application as well. This suggests that Psychology students have in general an above average understanding of how to practically use behavior analysis. This study did not support the findings of Arntzen et al.'s (2010) study that Psychology students showed the most misconceptions about behavior analysis, and furthermore the naïve group in our study, which is labelled Others, did not show the most misconceptions either. This study was conducted on students in Iceland and included different educational groups than Arntzen et al.'s (2010) study had. Furthermore, it did not include a group of teachers, as both Arntzen et al.'s (2010) and Lamal's (1995) studies had included.

The results of the current study furthermore suggest that all students held some misconceptions about behavior analysis. The Health sector, which included Nursing students, Occupational therapy students and Master's students in Health science, showed the least misconceptions in Overall Knowledge. The Health sector also showed the least misconceptions in both Beliefs and Knowledge. The group who showed the most misconceptions in both Overall Knowledge and in each subcategory is Undergraduate Student Teachers. The subcategories were Beliefs, Knowledge, Application and Theory.

There was in fact an interesting difference between the Undergraduate and Master's Student Teachers. While the Undergraduate students showed the most misconceptions, the Graduate students showed the second least misconceptions. Some reasons for this difference could be that the Master's Student Teachers have taken more courses and spent more years studying at the university. The Undergraduate Student Teachers could be students in their first year of university, and therefore taken fewer courses. Grey et al. (2005) describe that there are some limitations for using applied behavior analysis in school settings, and those limitations which include availability of skilled practitioners staffing requirements, supervision that is specialized, intensity of the behavior treatment and acceptance of it as an educational

intervention (Grey et al., 2005). These factors, especially the staffing requirements, could support the notion that teachers should get some training in behavior analysis and how to implement it. Grey et al. (2005) describe that their results suggest that after a training programme, teachers can successfully conduct a functional assessment and use it to design an effective behavior support plan. If teachers are able to conduct a behavior assessment and implement it instead of consultant behavior analyst it is promising for the future of education (Grey et al., 2005).

When comparing current findings with Arntzen et al.'s (2010) findings for other student groups, not the same groups showed the most misconceptions in these two studies. As mentioned above, our group of Psychology students and naïve participants (the group Other) do not have the most misconceptions, but it is in fact the Undergraduate Student Teachers. The group that has the least misconceptions according to current study is the Health sector, while in Arntzen et al.'s (2010) study it was the Master's students in Behavior analysis, which the current study did not include. The Health sector can be compared to Arntzen et al.'s (2010) group of Social Education students, the prior knowledge about behavior analysis can be expected to be similar. Not quite naïve and not advanced either. Both the Health sector in the current study and Social Education students in Arntzen et al.'s (2010) study did better than Psychology students. In the current study the Health sector showed the least amount of misconceptions, while Arntzen et al.'s (2010) Social Education students scored just average, but as their study included both teachers at the university and Master's students it is not comparable.

Results from the present study are in line with previous studies (such as Arntzen et al., 2010 and DeBell and Harless, 1992) which suggest that there are widespread misconceptions regarding behavior analysis. The misconceptions are both regarding the field of behavior analysis and how behavior analysts conduct their studies (Wyatt, 2001). Common misconceptions are for example that behavior analysts ignore feelings, thoughts, and cognition (Wyatt, 2001). Another common misconception is that behavior analysts ignore genetic influence in the role of behavior (Wyatt, 2001; Myers and Thyer, 1994). This was a common misconception in the current study (although not the question that most students answered incorrectly), and as well as in Arntzen et al.'s (2010) and Lamal's (1995). Findings from this current study do not support Arntzen et al.'s (2010) results in which the Psychology students showed the most misconceptions, along with the naïve students (which were bioengineering students). Our student group that should be the naïvest was Other, which

consisted of Biotechnology and Fishery Science students, Police students and other education, which were students who didn't belong to any of the nine original groups. Psychology students in the present study showed less misconceptions than Other and both groups showed less misconceptions than Undergraduate Student Teachers, which had the most misconceptions on Overall Knowledge, as well as in all subcategories.

Questions that students in the current study answered most often incorrectly were questions 3, 16 and 17. Those questions are "Behavior analysts believe that theories that attempt to explain psychological constructs are useful to psychology", "Behavior analysts treat humans as infinitely changeable organism" and "Behavior analysts argue that almost every behavior is elicited by preceding stimuli". In Arntzen et al. (2010), the questions that were answered incorrectly most often were questions 2, 16 and 22. In the present study question 22 was replaced. As mentioned above, many students answered question 16 incorrectly in the current study as well. The second question, that most students answered incorrectly (along with questions 16 and 22) in Arntzen et al. (2010) is "Behavior analysts treat humans as infinitely changeable organism". Students frequently answered that question incorrectly in the current study, it was the question with the fourth lowest mean overall score. Interestingly, most students in the Lamal's (1995) study also answered this question incorrectly, along with questions 4 and 13.

At the current point of this study, the resistance of students to change their misconceptions has not been inspected. It was included in both Arntzen et al.'s (2010) and Lamal's (1995) study. They included a second survey that was conducted after the students had taken a course in behavior analysis, and their results showed that it is hard to change the currently held views of students about behavior analysis. This is in line with former studies, such as Taylor and Kowalski's (2004) in which they state that it is hard to change the views of students who enter a psychology course with a misconception that is strongly held. According to the authors there must be a strong intervention, so the students recognise that the view they hold is, in fact, wrong.

There are some limitations on this study's questionnaires regarding misconceptions of which one must be aware. Brown (1984) describes that simple true/false questions must be viewed with caution since the behavior of humans and animals is so complex, so in many cases the statement is in fact "mostly false" instead of only "false". Since the field of psychology is so complex, such simple statements are hard to compose (Brown, 1984). In the current study, a question that could have been a matter of discussion, that Arntzen et al.

(2010) used in their questionnaire was removed and replaced in the current study. That question was “Behavior analysis includes descriptions that in other parts of psychology have been called the self, or sense of the self.” The self could have been too complex and a matter of discussion. The wording used in studies of misconceptions in behavior analysis has been changed, for example Lamal changed the wording DeBell and Harless (1992) had previously used in their paper. Lamal (1905) changed all wording that referred to Skinner to “behavior analysis” or “behavior analysts”. DeBell and Harless (1992) had previously found that students showed many misconceptions regarding statements that referred to Skinner and his work. Furthermore, Ruble (1986) describes that many statements and true/false questions in a questionnaire can be too ambiguous and might be up for interpretation by the students and the correct answer depends on how the statement was interpreted (Ruble, 1986). The author describes that it could be due to the fact that the test items being taken from different sources, which are often textbooks. In order to construct a misconception test that truly measures misconceptions that students hold, it is important to pay great attention to the construction of test items (Ruble, 1986).

It is important to be both aware of how persistent misconceptions about behavior analysis can be and the limitations in the studies about misconceptions since the field of behavior analysis has the potential to grow in the future. In addition, as Arntzen et al. (2010) describe, it is important to change misconceptions about the field since misconceptions can interfere with the goal of psychology as well as behavior analysis. That is, to predict, describe and control, or influence, behavior. Harmful or ineffective treatments, along with other negative outcomes for the client, might be the result of inaccurate descriptions of causes (Arntzen et al., 2010).

Conclusion

Misconceptions about behavior analysis and behavior analysts are widespread, among the general population as well as among university students. Misconceptions that are common and persistent are both about the field of behavior analysis but also about how behavior analysts conduct their practice. Previous studies have suggested that Psychology students show everything from some misconceptions about behavior analysis to a great deal of misconceptions. The current study replicated Arntzen et al.'s (2010) study that looked at misconceptions among university students. The results of the current study did not support Arntzen et al.'s (2010) findings that Psychology students showed the largest number of misconceptions. They showed just under an average number of misconceptions out of all education groups in the study. The results of the current study suggested that all education groups showed misconceptions about behavior analysis. The group that showed the largest amount of misconceptions was Undergraduate Student Teachers and the group that showed the least number of misconceptions was the Health sector. There was an interesting difference between Undergraduate and Graduate Student Teachers students, the Graduate students showed much fewer misconceptions. That is an interesting finding considering the promising future of teachers using techniques from behavior analysis in the classroom. It is important to be aware of misconceptions in order to replace them with the right knowledge. Additionally, misconceptions about behavior analysis can be harmful for the field. They result in educators being more reluctant to use the strategies of behavior analysis. Treatments based on behavior analysis are effective and can have a lot of impact on the lives of people who receive the treatments. Furthermore, behavior analysis has the potential to grow in the future, both as a treatment for people with autism and behavioral challenges and even people who have no diagnosis. Future research that aims to study misconceptions must be aware of methodological flaws in the construction of the test items of a questionnaire, in order to be able to measure the true misconceptions.

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Appendix

Table A1

Questionnaire in Icelandic

Nr.	Spurning	T/F
1.	Samkvæmt atferlisgreiningu er neikvæð styrking ein tegund refsingar	Ó
2.	Atferlisfræðingar telja að hægt sé að skilyrða hvaða hegðun sem er	Ó
3.	Atferlisfræðingar telja að kenningar sem reyna að útskýra sálfræðileg fyrirbæri séu gagnlegar fyrir sálfræði	Ó
4.	Atferlisfræðingar telja að erfðir skipti miklu máli þegar hegðun er mótuð	S
5.	Atferlisfræðingar nota eingöngu nákvæma tölfræðilega greiningu þegar niðurstöður úr rannsóknum á sviði atferlisgreiningar eru skoðaðar	Ó
6.	Atferlisfræðingar viðurkenna að hver einstaklingur er einstakur	S
7.	Atferlisfræðingar hafa sýnt að lögmál hegðunar eiga meira við um dýr heldur en manneskjur	Ó
8.	Atferlisfræðingar styðja notkun líkamlegrar refsingar við að stjórna mannlegri hegðun	Ó
9.	Atferlisfræðingar hafa sýnt að mótun hegðunar skiptir litlu máli þegar ný hegðun er kennd	Ó
10.	Almennt séð telja atferlisfræðingar að jákvæð styrking sé áhrifaríkari en refsing	S
11.	Atferlisfræðingar einbeita sér að hegðun sem hægt er að sjá og mæla	S
12.	Atferlisfræðingar fjalla um skilyrta styrkja; eitt dæmi um þetta eru peningar	S
13.	Atferlisgreining er vinsæl nálgun á Íslandi	Ó
14.	Atferlisgreining hafnar tilvasta einkaátburða	Ó
15.	Atferlisfræðingar bera saman manneskjur við vélar þegar hegðun er útskýrð	Ó
16.	Atferlisfræðingar líta svo á að manneskjur séu lífverur sem alltaf sé hægt að breyta	Ó
17.	Atferlisfræðingar telja að næstum öll hegðun sé kölluð fram af áreiti sem kemur á undan henni	Ó
18.	Mjög fáar meðferðarleiðir sem notaðar eru í dag byggja á atferlisgreiningu	Ó
19.	Hugsun og tilfinningar eiga ekki heima í atferlisgreiningu þar sem engin önnur en manneskjan sjálf getur skoðað þetta tvennt	Ó
20.	Atferlisgreining getur ekki útskýrt getu á skapandi sviðum eins og listum	Ó
21.	Atferlisgreining getur útskýrt fyrirbæri sem venjulega er lýst sem hugarferlum, svo sem þrautalaun og minni	Ó
22.	Atferlisfræðingar geta útskýrt hvernig við lærum og notum tungumál	S

Note. S=true and Ó=false. The questionnaire was translated to Icelandic from Arntzen et al. (2010) questionnaire, except item 22, which was replaced.

Table A2

Questionnaire in English

No.	Questions	T/F
1.	According to behavior analysis, negative reinforcement is another form of punishment	F
2.	Behavior analysts believe that any behavior can be conditioned	F
3.	Behavior analysts believe that theories that attempt to explain psychological constructs are useful to psychology	F
4.	Behavior analysts believe that genes play an important role in shaping behavior	T
5.	Behavior analysts use rigorous statistical analyses in examining data from their studies	F
6.	Behavior analysts recognize the uniqueness of individuals	T
7.	Behavior analysts have shown that principles of learning apply more to animals than to humans	F
8.	Behavior analysts support the use of physical punishment in controlling human behavior	F
9.	Behavior analysts have demonstrated that shaping has minimal impact in teaching new behavior	F
10.	In general, behavior analysts believe that positive reinforcement is more effective than punishment	T
11.	Behavior analysts focus on behavior that is observable and measurable	T
12.	Behavior analysts discuss secondary reinforcers; one example of this is money	T
13.	Behavior analysis is a popular viewpoint in Iceland	F
14.	Behavior analysis denies private events	F
15.	Behavior analysts compare humans with machines when explaining behavior	F
16.	Behavior analysts treat humans as infinitely changeable organisms	F
17.	Behavior analysts argue that almost every behavior is elicited by preceding stimuli	F
18.	Very few effective modern treatment methods have been based on behavior analysis	F
19.	Behavior analysis has no place for thinking and feeling, as thinking and feeling cannot be observed by anyone other than the behaving organism	F
20.	Behavior analysis cannot explain creative achievements, such as art	F
21.	Behavior analysis can explain phenomena that are usually described as cognitive, such as problem solving and remembering	F
22.	Behavior analysts can explain how we learn and use language	T

Note. T=true and F=false. The Icelandic version can be viewed in Table A1.