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Do learners declining to seek help conform to rational principles?

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ABSTRACT
Why do learners fail to seek help, when doing so would be beneficial? Principles of rational decision suggest that seeking help is not an optimal action if its costs are greater than its expected benefits. Accordingly, learners should be sensitive to three parameters when making the decision to seek help: the benefits of doing so, but also the probability of obtaining these benefits, as well as the intrinsic costs of seeking help. We report three experiments that pitted the financial, temporal, and social costs of help-seeking against its expected benefits. Participants were more likely to seek help when help came at no financial cost, but showed little sensitivity to other parameters. These findings contribute to identify low-priority interventions to improve help-seeking behaviour. Learners may not need reassurance that help will come if they ask, and that they will not waste time by seeking help.

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KEYWORDS Help-seeking; learning; decision making; problem solving

Introduction

Learners who encounter difficulties can improve their performance by seeking help (Nelson Le-Gall, 1981, 1985), but they often fail to do so (Aleven, Stahl, Schworm, Fischer, & Wallace, 2003; Newman, 2000), even when they need help the most (Karabenick & Knapp, 1988b). In this article, we consider why a rational decision maker might exhibit such an apparently suboptimal behaviour, by investigating the conformity of help-seeking decisions to some rational principles involving the cost of seeking help, the probability of getting help conditional on seeking it, and the benefits of getting help.

We suggest that previous studies of help-seeking behaviour focused on the benefits of getting help more than on the probability of obtaining such benefits (Babin, Tricot, & Mariné, 2009; Huet, Escribe, Dupeyrat, &

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Sakdavong, 2011; Karabenick, 2003, 2004; Kitsantas & Chow, 2007; Luckin, 2013; Roll, Aleven, McLaren, & Koedinger, 2011; Roussel, Elliot, & Feltman, 2011; Ryan & Pintrich, 1997; Stahl & Bromme, 2009), and that they largely focused on a single category of costs, that is, threat to social image or self-image. Although this approach led to many important insights, we suggest that it should be organized, subsumed and extended within the framework of rational decision-making.

From the perspective of a rational agent, seeking help is not an optimal decision if the expected benefits of seeking help are not sufficient to offset the costs of help seeking: Either the costs are larger than the benefits, or the probability of obtaining the benefits is too small. To follow rational principles, an agent should decide to take an action x if and only if the expected utility of x is positive. The expected utility of x is the sum of the utility of all the positive and negative consequences of the decision, weighted by the probability of their occurrence:

$$\mathrm{EU}(x) = \sum p_i \times u_i,$$

where p_i and u_i are the probability and utility of consequence i, and 'utility' is broadly defined as the extent to which some state of the world conforms to the preferences of the agent.

In the context of help seeking, we make the simplifying assumption that the agent has a fixed cost c of seeking help, and a belief that she will obtain some benefits b with a probability p, leading to the following formulation of the expected utility of seeking help:

$$\mathrm{EU}(\text{help}) = p \times b - c.$$

Accordingly, we assume that an agent will decide to seek help if and only if:

$$p \times b > c.$$

Thus, the decision to seek help should be a function of three parameters: the cost of seeking help, the probability of getting help conditional on seeking it, and the benefits of getting help. Note that our intention was not to provide a full-fledged rational model of help-seeking behaviour. The simple inequality above is closer to an intuition pump, and a guideline for experimental design, than to a formal model.

This article begins with a brief presentation of the help-seeking model on which our work is based; then we review the literature on help-seeking through the prism of these rational decision principles. As a consequence, we identify the need for an integrative investigation of help-seeking, that would experimentally manipulate the costs of asking for help as well as the probability of getting help, alongside the benefits of the help. Finally, we report three studies in which we tested the relevance of such rational principles for predicting decisions to seek help in a learning environment for mathematics and statistics, and discuss the results.

Help-seeking in learning

Nelson Le-Gall (1981, 1985) proposed that help-seeking in learning was viewed as an alternative to facing difficulties. This conception should be considered as connected to success and emphasizes the costs of not seeking help and, mainly, treats help-seeking as part of a continuous process.

However, help-seeking behaviour is not always appropriate. Nelson Le-Gall (1981) distinguished two types of help-seeking behaviour: the executive and the instrumental. Executive help-seeking refers to the situations where the student purpose is to have someone else show her the solution or even solve the problem for her. The instrumental help-seeking is when the required help is limited to knowledge or information that will allow the student to solve the problem by herself. Students who are considered to have help-seeking skills are able to refuse help when they can manage the task alone and can obtain help when it is necessary.

According to Nelson Le-Gall (1981), the instrumental help-seeking, the one that can improve learning and achievement, can be characterized by a model that is composed of five cognitive and behavioural activities in which those who seek help should consider engaging: 1) awareness of the need of help; 2) decision to seek help; 3) identification of the potential helper; 4) use strategies to get the help; 5) reaction to help-seeking attempt. Even if this model was proposed in a traditional learning context, these five activities are also applicable to interactive learning environments (Aleven et al., 2003), although the process of seeking help in human-technological and in human-human interactions presents both similarities and distinctions (Puustinen & Karabenick, 2013) and, as pointed by Karabenick & Gonida (2018), there is still the need for research on how learners distinguish between help sources.

This work is focused on the second step of this model, the decision to seek help. Our main goal, rather than manipulating different types of help, is to understand the rational mechanisms involved in the help-seeking decision.

In the next section we present a literature review of help-seeking by taking up each one of the three parameters that we chose to investigate. We start by discussing papers that considered the benefits of help-seeking, then we discuss studies that somehow got to the probabilities of having the benefits of help-seeking and we finally discuss those that dealt with the costs.

Benefits, expectancies, and costs of help-seeking

We consider in turn the available evidence for the role of the benefits of help-seeking; then its *expected* benefits, or expectancies (i.e. benefits weighted by probability); and finally, its costs.

Benefits

According to the educational psychology literature, being capable of solving a problem and learning are the benefits of help-seeking. In turn, studies have repeatedly found that learners are more likely to seek help when they believe that doing so will allow them to solve the problem or to learn.

The study of Ryan and Pintrich (1997) focused on finding whether the perception of benefits mediates the relation between perceptions of competence and achievement goals, and help-seeking behaviour. The authors found that students who felt that there were benefits in seeking help were more likely to seek adaptive help and less likely to avoid seeking help.

In the same way, the study of Roussel et al. (2011) had the goal of demonstrating if attitudes toward help-seeking (including perceived benefits referring to peers as help source) would mediate the relationship between achievement and friendship goals and instrumental help-seeking. Perceived benefits were found to mediate the relations between mastery goals and instrumental help-seeking.

Huet et al. (2011) assessed learners' perceptions of the benefits of help-seeking with a seven-item questionnaire, just before the participants were introduced to a computer-based learning environment for statistics. The greater the perceived benefits of help-seeking, the more likely the participants were to seek help after being notified of an incorrect answer.

In many studies, though, the benefits of help-seeking are assumed to be self-evident. For example, interactive learning environments often focus on giving prompts and hints about when it is appropriate to seek help, rather than on emphasizing the benefits of doing so (e.g. Babin et al., 2009; Luckin, 2013; Roll et al., 2011; Stahl & Bromme, 2009). Other studies do vary the nature and extent of the benefits of providing help—contrasting, for example, the benefits of instrumental and executive help, for various learners in various circumstances (Aleven, Roll, McLaren, & Koedinger, 2016; Aleven et al., 2003; Babin et al., 2009; Bartholomé, Stahl, Pieschl, & Bromme, 2006). These studies, however, do not typically focus on whether learners are aware of these differential benefits and integrate them in their decision process.

Expectancies

As noted in a recent literature review (Chan, 2013), the notion of expectancies (here, the probability weighting of the benefits of help seeking) is implicit in the help-seeking literature. Very little research has directly or indirectly explored whether learners were sensitive to the uncertainty of obtaining benefits when making the decision to seek help. One exception, though, investigated the preferences of students for various ways of obtaining help (in person, by telephone, or through electronic means), with the goal of identifying which way was preferred or found as more effective (Kitsantas & Chow, 2007). One could suppose that the perception about the best way of seeking help includes the probability of getting the help when seeking it. The limitation of this approach is that the probability of obtaining effective help is not manipulated experimentally, which means that the probability of getting help can be confounded with the effectiveness of the help—that is, the p parameter can be confounded with the b parameter. As a result, there is a need for experimental manipulations that would clearly distinguish between these two parameters.

Costs

While it has been acknowledged over the years that help-seeking may imply costs (Chan, 2013; Karabenick, 2006; Kitsantas & Chow, 2007; Nelson Le-Gall, 1981, 1985), and that these costs may be large enough to forego help (Tricot & Boubée, 2013), recent research in the learning domain has mostly considered one specific type of costs: threat to social image or self-image. Seeking help may indeed be perceived as a threat to self-esteem, perceived competence, or autonomy (Huet, Dupeyrat, & Escribe, 2013); and researchers investigated such costs through self-reported measures of attitudes toward help-seeking. Overall, research has provided good evidence for the role of such attitudes. In like vein, learners who are worried that seeking help may damage their image or self-image, and who are more concerned about avoiding this damage, are less likely to seek help (Karabenick, 2003, 2004; Roussel et al., 2011; Ryan & Pintrich, 1997). This effect is not always observed though (Huet et al., 2011), especially in environments which diffuse the threat, such as asynchronous web courses as opposed to traditional classrooms (Kitsantas & Chow, 2007) and when the source of help, as told by the experimenter, is a computer instead of a person (Karabenick & Knapp, 1988a). In sum, threats to self- or social image have been robustly established as a potential cost of help-seeking, which may deter learners from seeking help. There are other potential costs, though, which may enter the rational decision to seek help or not. Seeking help may entail financial costs (e.g. the purchase of an educational app), or even simply temporal costs (e.g. when performing under time constraints). Investigations of conformity of help-seeking to rational principles should account for all these costs, and should be fuelled by experiments that utilize these different costs.

Implementation

Our literature review identified the need to conduct experiments that would parametrize the expected benefits and costs of help seeking, in order to test the predictions of rational principles; and to cover a broad variety of costs, namely, financial and temporal costs in addition to social costs. Our general hypothesis is that the decision to seek help is in accordance with the rational decision principles presented in the introduction of this paper.

The three experiments we report in this article followed this logic, by investigating in turn the effect of financial, temporal, and social costs in a learning environment for mathematics and statistics. In all studies, participants were rewarded to solve a series of exercises (i.e. they were financially compensated as a function of the number of exercises that they correctly solved). They could request help at any moment, to solve the exercise they were currently engaged with. In other words, the 'benefit' of the help was to receive information which could be monetized through solving the exercise. We acknowledge that help-seeking benefits (just as help-seeking costs) may also be temporal or social—but for the sake of tractability, we did not consider these variants in our experimental designs. We also acknowledge that the information participants received may be closer to hint than to help, in the sense that it made it easier to solve the problem at hand, rather than trained participants to solve similar problems in the future.

Both in the simple inequality we sketched in the introduction, and in our experimental design, the benefit of help seeking (i.e. receiving information) was treated as a discrete positive outcome which could be obtained with a stated probability p. That is, participants were told that if they asked help, they would receive useful information with a probability p, and no information at all with a probability $1-p$. This is a simplification of the general case where there is a full probability distribution over a continuous benefit parameter. We opted for this simplification because it was much easier to implement experimentally. We do not know which of the simplified or general case is the most psychologically realistic, and in this state of ignorance, we opted for the design that was the easiest to explain to participants.

In the first study, the financial cost of requesting help varied from one exercise to another, orthogonally with the probability of actually obtaining help (which means that there was a possibility to pay for help and not receive any). Although seeking help usually does not present a financial cost in traditional learning contexts, it could be a cost to be considered in other learning contexts when deciding whether or not to purchase an educational app, or to pay for private tutoring. The probabilistic parameter, that is, the probability of not receiving any help even after paying for it, was introduced to simulate situations in which people ask for help only to find it useless. Because 'useless' help is difficult to create and control experimentally (and would have to be tailored to each individual), we resorted to the solution of simulating useless help with 'no help at all'.

The second study followed a similar design, but participants paid in time rather than money: they worked under time constraints, and requesting help either stopped the clock or not. The manipulation of time cost was an attempt to test costs that are more consistent with typical learning environments, where there is a trade-off between the time that is spent on learning new materials, and the time that is spent getting additional help on materials which were already covered.

The third study turned to social costs, by having participants being watched (or not) by an instructor while they worked on exercises labelled as 'easy' or 'hard'. Social costs are often mentioned in the help-seeking literature and are generally measured by self-reports. We decide to experimentally manipulate this cost in light of the decision to seek help instead of looking for this cost through the prism of motivational factors of help-seeking.

Experiment 1

Participants

Participants were recruited from the Humanities campus of the *Université Toulouse Jean Jaurès*, to take part in a study of 'problem solving'. Of the 65 students that accepted to take part in the study, 14 had to be dropped because they did not reach the end of the study before the maximal (and generous) time allotted. Of the remaining 51 participants (mean age = 22), 39 were women and 12 had a scientific[1] major in high school. We collected information about the high school major as an attempt to control for previous knowledge.

Design

The experiment followed a 3×3 within-participant design, which manipulated the cost of asking for help, and the probability of receiving help. The combination of these two variables in a within-participant design means that each participant was given nine opportunities to seek help (that is, once for each of nine exercises). The probability of receiving help (conditional on asking) was either 1/3, 2/3, or 1. The cost of asking for help was either 0, 100, or 150 'points'. Participants got 200 points per correct response, and their point total (reward for correct responses minus cost of help seeking) could be redeemed for a voucher of 10, 15, or 20€ (the higher their point total, the more valuable the voucher).

[1]In France, where the studies were conducted, students who finish high school can hold an economics and social major, a literary major, a scientific major or a non-general chain major certificate.

Material

Participants were presented with nine high school level mathematics exercises chosen from multiple French lists available on the Internet. Variations on the level of difficulty of the exercises were controlled in the model during the analysis, where the exercises were considered as random effects. All the proposed exercises can be found in the Appendix, but two examples are shown below:

a. Calculate the greatest common divisor of 69309 and 11322.
b. Calculate the following expressions and give the result as an integer number:

$$E = \left(2-4\sqrt{2}\right)\left(2+4\sqrt{2}\right)$$
$$F = \frac{64\sqrt{54}}{12\sqrt{96}}$$

For each of these exercises, participants could receive help. This help took the form of a partial solution of the current exercise. For the two examples above, the help was:

a. We calculate the greatest common divisor of 69309 and 11322 using the Euclidean Algorithm:

$$69309 = 11322 \times 6 + 1377$$
$$11322 = 1377 \times 8 + 396$$
$$1377 = 396 \times 4 + 153$$
$$306 = 153 \times 2 + 0$$

b. $E = (2-4\sqrt{2})(2+4\sqrt{2}) \quad | \quad E = 2^2-(4\sqrt{2})^2$

$$F = \frac{64\sqrt{54}}{12\sqrt{96}} \quad | \quad F = \frac{64 \times \sqrt{9} \times \sqrt{6}}{12 \times \sqrt{16} \times \sqrt{6}}$$

Figure 1 (left) shows an exercise together with the help button that opens the help window, and Figure 1 (right) shows the same exercise with the help window opened.

Procedure

Participants sat alone at a computer in a dedicated office, and used a piece of software developed for the experiment. After giving informed consent,[2] they went through a tutorial explaining the experiment, in particular the

[2]Participants gave informed consent by checking a box in the software agreeing to participate of the study before the beginning of the task and after they were informed that participation was voluntary, they could abandon the study whenever they wanted and collected data was confidential and going to be treated anonymously.

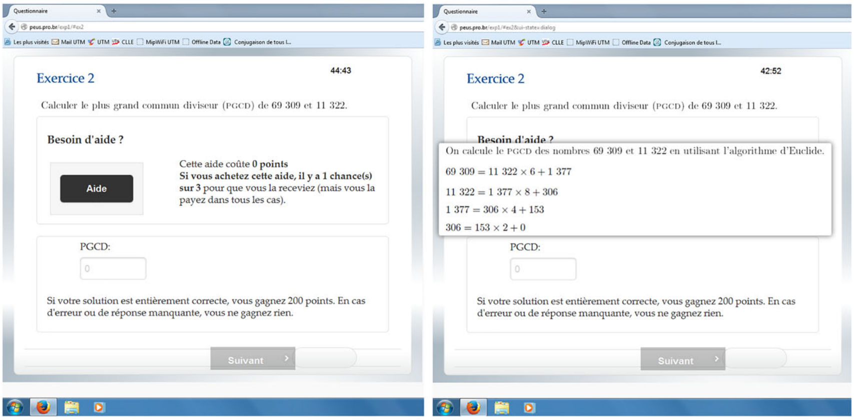

Figure 1. Screenshot of an exercise and the experimental elements—Experiment 1.

point system and the use of the help button. Concerning the point system, they were presented with a table containing the voucher values to be received according to the amount of point total (which was the sum of 200 points for correct answer minus the points of the costly help they sought). Participants only knew which answers were correct or not at the end of all exercises. In other words, they knew the total of points they had to achieve to get the more valuable voucher, but during the experiment they could not know if they were achieving this number. They were informed that for each exercise, they could clearly see the cost of asking for help, and the probability of getting help.

The software was actually rigged to always providing help when asked, whatever the nominal probability of getting help. We made this choice in order to control for the individual trajectory of different participants. For example, if a participant had had the bad luck of not getting help twice in a row, this participant might be less likely to ask for help for the rest of the experiment, compared to a participant who had had the good luck of getting help twice in a row. By always providing help to all participants who asked, we eliminated this source of variance.[3]

The order of the nine mathematical exercises was randomized for each participant, as well as the order of the nine cost-probability combinations to control for the effects of problem ordering. Participants had 45 minutes[4] to complete the nine exercises, and a timer was displayed on the screen.

[3]One could ask whether would most participants quickly figure this out and change their help-seeking behaviour accordingly. First, they only could figure this out if they were always seeking help. Second, the model we use to analyse the results is able to show if participants started to look for more help as they were realizing the exercises.

[4]Actually, initially 30 min were allotted. After realizing that some participants could not finish the task in time, we increased the time to 45 min and dropped those participants who had not completed all the exercises.

Also displayed on the screen was a calculator for numerical calculations. Participants were also provided with paper and pen, should they want to use them during the exercises. The experimenter was physically present in the room, but in a position where she could not see what the participant was doing. Mostly subjects participated one by one, but some participated in pairs. Whenever it was the case, the office was furnished with one computer for each participant positioned at an angle of at least 60 degrees to each other.

Results

Main results are shown in Figure 2, which displays the likelihood of seeking help in the nine treatments. The boxes show the 95% confidence interval of the mean of the dependent variables, that is, the decision to seek help.

Figure 2 suggests that (1) the stated probability of getting help does not seem to impact decisions and (2) the cost of asking for help does appear to impact decisions, but in a qualitative rather than quantitative manner: the

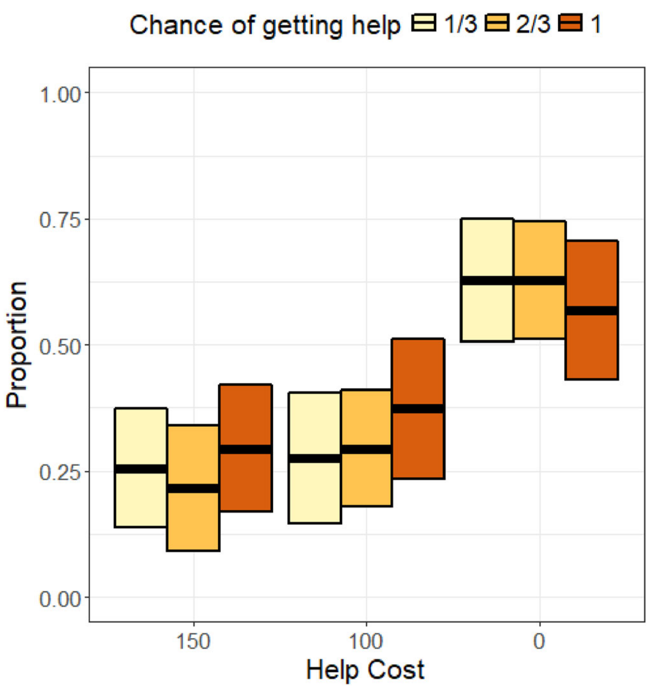

Figure 2. Proportion of help sought as a function of the cost of asking for help and the probability of getting help when asking. Boxes show the 95% confidence interval for the mean, based on within-participant standard error. The stated probability of getting help has little impact on the decision to seek help, but free help is much more likely to be sought than costly help.

important point is whether help is free or not, more than the amount it costs. Free help is asked for 61% of the time, while costly help is only asked for 28% of the time.

In order to confirm these results, we conducted a generalized mixed model (Bates, Mächler, Bolker, & Walker, 2015) in which the (binomial) decision to seek help was the dependent variable; the cost of asking for help, the probability of getting help, and their interaction were fixed effects; other fixed effects were gender, major in high school (scientific or not), and the number of problems already taken; and participant and exercise were entered as random factors.

A greater cost of asking for help significantly reduced the likelihood of seeking help ($b = -2.7$, $SE = 0.77$, $z = -3.54$, $p < 0.001$, $CI_{95\%}[-4.23, -1.22]$). The stated probability of receiving help when seeking it did not impact the decision to seek help ($b = -0.19$, $SE = 0.70$, $z = -0.27$, $p = 0.786$, $CI_{95\%}[-1.57, 1.19]$).

No statistically significant result was found for the control variables (gender, major in high school and the number of problems already taken).

Additional results

Even though the outcomes were not the core of this study, it might be interesting to consider that only 36% of the problems were correctly solved. Besides, comparing participants who had a scientific major to those who had other majors the first group correctly solved 60% of the problems while the second correctly solved only 28%. Concerning the help-seeking decision, participants with scientific major sought help in 31% of the exercises and participants with other majors sought help in 42% of the exercises. In average, participants spent 3.13 min for exercise ($SD = 2.13$) and 28 min to do all the 9 exercises ($SD = 8.16$), which showed the 45-min time limit was sufficient for the task. Forty-three participants received a 10€ voucher, eight participants received a 15€ voucher and none of the participants received a 20€ voucher.

Discussion

Our goal in this experiment was to verify if the decision to seek help followed rational principles. In order to respond affirmatively, the participants should be sensitive to three parameters: the benefits of help-seeking, the probability of receiving help when seeking it and the costs of this action. While the participants were sensitive to cost variations, they did not react to different stated probabilities of getting help. According to the results decisions obey one of the parameters we tested. It is worth considering that the probabilities we stated may differ from the probabilities that the participants subjectively experienced.

Experiment 2

Participants

As in the first experiment, participants were recruited from the Humanities campus of the *Université Toulouse Jean Jaurès*, to take part in a study of 'problem solving'. Of the 51 volunteers that agreed to participated of the study, one had to be dropped for not having reached the end of the study before the maximal time allotted. Of the 50 participants considered (mean age = 23), 43 were women and 18 said they have a scientific major in high school.

Design

The experiment followed a 2×3 within-participant design, which manipulated the time cost of asking for help, and the probability of receiving help. The combination of these two variables in a within-participant design means that each participant was given six opportunities to seek help (that is, once for each of six exercises). The probability of receiving help (conditional on asking) was either 1/3, 2/3, or 1.

When the help was 'costly', a help window appeared and masked the exercise for 60 s, while the timer continued to run. The window could not be closed until 60 seconds had passed. When the help was 'free', the timer stopped as soon as the help window appeared, and remained stopped until the participant closed the window, or until 60 s had passed. It is possible that sophisticated participants may decide that spending 60 s looking at the help might in fact save them time by letting them solve the problem quicker; but in any case, since 'free' help actually stopped the clock (and thus gave additional time), a rational participant should always prefer free help to costly help.

Participants got a variable amount of points per correct response, depending on the total time spent to complete the six exercises (the function was presented to participants in the instructions and can be seen in Figure 3). Their point total (reward for correct responses depending on the total time spent already considering the cost of 60 s for some help sought) was redeemed for a voucher of 10, 15, or 20€ (the higher their point total, the more valuable the voucher).

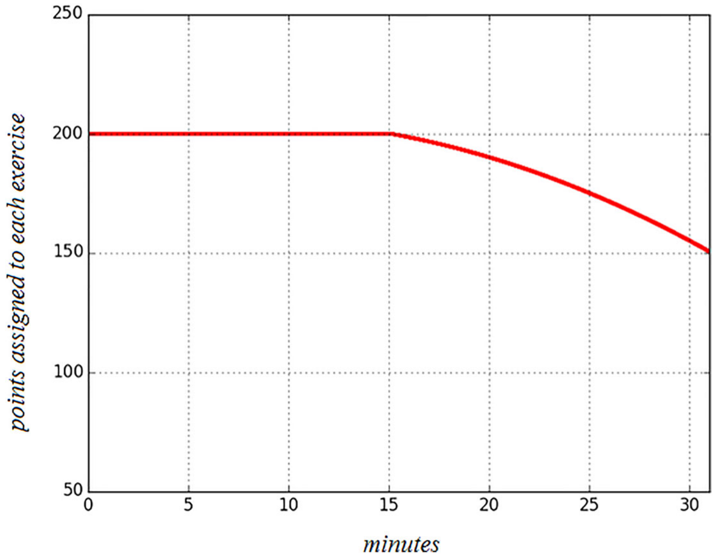

Figure 3. Points per question in function of minutes spent to complete the entire task.

Material

Participants were presented with six high school level mathematics exercises chosen from the list of nine exercises of the first experiment. We excluded the exercise that proved the most difficult in Experiment 1, the exercise that proved the easiest, and one exercise of intermediate difficulty, as an attempt to keep the same difficulty level from the previous experiment. For each of these exercises participants could receive help that took the form of the partial solution of the current exercise, as in Experiment 1. The exercise screen and the help window are displayed in Figure 4.

Procedure

The procedure of this experiment was equivalent to that of the first one. Participants sat alone at a computer in a dedicated office, and used a piece of software adapted for the experiment. After giving informed consent, they went through a tutorial explaining the experiment, in particular the point system and the use of the help button. They were told that during each exercise, they could clearly see what was the probability of getting help and whether, when asking for help, the timer would stop for 60 s ('free' help) or continue to run while the help window could not be closed for 60 s.

As in Experiment 1 and for the same reason, the software was actually rigged to always providing help when asked, whatever the nominal probability of getting help. The order of the six mathematical exercises was

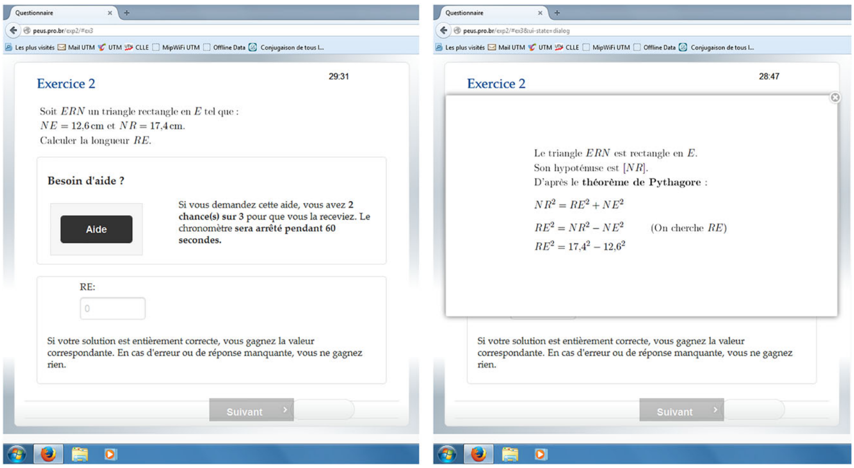

Figure 4. Screenshot of an exercise and the experimental elements—Experiment 2.

randomized for each participant, as well as the order of the six cost-probability combinations. Participants had 30 min[5] to complete the six exercises, and a timer was displayed on the screen. Also displayed on the screen was a calculator for numerical calculations. Participants were also provided with paper and pen, should they want to use them during the exercises. The experimenter was physically present in the room, but in a position where she could not see what the participant was doing. Mostly subjects participated one by one, but some participated in pairs. Whenever it was the case, the office was furnished with one computer for each participant positioned at an angle of at least 60° to each other.

Results

Results are shown in Figure 5, with the same conventions as in Figure 2. Figure 5 suggests that (1) the stated probability of getting help does not seem to impact decisions and (2) the time cost of asking for help does not appear to impact decisions either. Free help is asked for 65% of the time, while costly help is asked for 59% of the time.

In order to confirm these results, we conducted a generalized mixed model (Bates et al., 2015) in which the (binomial) decision to seek help was the dependent variable; the time cost of asking for help, the probability of getting help, and their interaction were fixed effects; other fixed effects were gender, major in high school (scientific or not), and the number of problems already taken; and participant and exercise were entered as random factors.

[5]Time was reduced proportionally to the amount of questions dropped to keep the average of time per question from previous experiment.

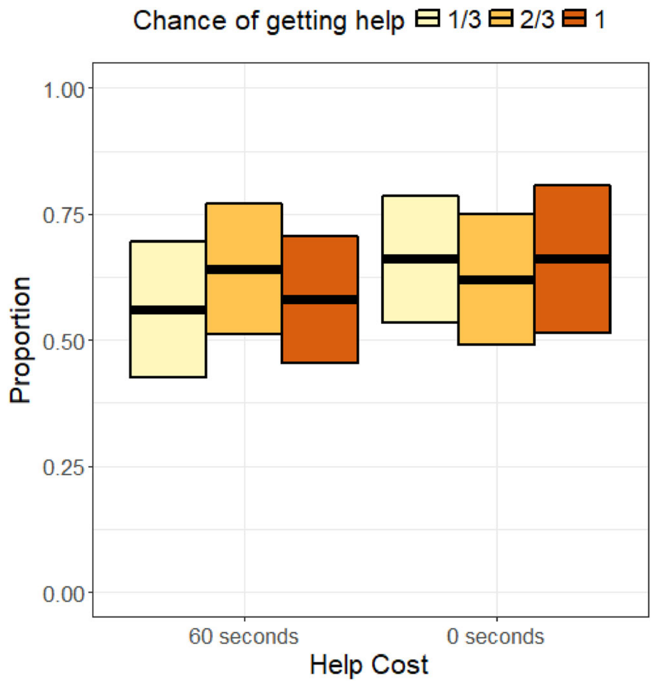

Figure 5. Proportion of help sought as a function of the time cost of asking for help and the probability of getting help when asking. Boxes show the 95% confidence interval for the mean, based on within-participant standard error. The stated probability of getting help has no impact on the decision to seek help, and so the free time help has no impact on the likelihood to seek help compared to the loss of 60 s.

The loss of 60 seconds when asking for help did not reduce the likelihood of seeking help compared to situations where no time was lost ($b = -0.30$, $SE = 0.81, z = -0.37, p = 0.712, CI_{95\%}[-1.91, 1.3]$). In the same way, the probability of receiving help when seeking did not impact the decision to seek help ($b = 1.03$, $SE = 0.85, z = 1.21, p = 0.224, CI_{95\%}[-.63, 2.7]$). With regards to the control variables, there was found an effect of the major degree in the decision to seek help, in the sense that those who had a scientific major, sought less help than the others ($b = -1.92$, $SE = 0.48, z = -3.94$, $p < 0.001$).

No significant statistical result was found for the other control variables, i.e. gender and the number of problems already taken.

Additional results

Even though the outcomes were not the core of this study, it might be interesting to consider that 52% of the problems were correctly solved. Comparing participants who had a scientific major to those who had other majors the first group correctly solved 74% of the problems while the second correctly solved only 40%. Concerning the help-seeking decision, participants with scientific major sought help in 43% of the exercises and participants with other majors sought help in 73% of the exercises. In average, participants spent 3.39 min for exercise ($SD = 2.33$) and 20 min to do all the 6 exercises ($SD = 5.69$), which showed the 30-min time limit was sufficient for the task. Four participants received a 10€ voucher, 45 participants received a 15€ voucher and 1 participant received a 20€ voucher.

Discussion

The aim of this experiment was to test if the temporal cost is intrinsic to the decision to seek help. Besides, we also wanted to re-test the effect of the probability parameter. Again the participants were not sensitive to variations in the stated probability of getting help. Furthermore, the results showed that temporal cost did not influence help-seeking, even if in the end it impacted on the compensation value to be received.

Studies comparing temporal and financial costs have provided evidence that people may not mentally account for time in the same way as they account for money (Soman, 2001). When the benefit is uncertain, people prefer to take more risks when paying with time rather than money, supposedly because time value is ambiguous, and hence people can adjust its value *a posteriori* according to the realized outcome (Okada & Hoch, 2004). Such findings may go a long way to explain our results. However, these studies considered decisions for hypothetical situations, and different results were found in a recent study that considered consequential choices like ours (Ashby & Rakow, 2018). This study did not find much difference when comparing the propensity to take risks over decisions involving time delays or monetary outcomes. Ashby and Rakow (2018) assume that possibly experiencing delays made the average participant treat time like money, according to previous results which showed that time accounting is facilitated when converting time investment into an equivalent monetary amount (Soman, 2001).

Measuring temporal costs must have been difficult for our participants: the value attributed for each correct answer was not fixed and varied according to the total time spent to solve all the six exercises. So, before starting the exercises, participants had to understand the figure that showed this variation of points per question and the table that showed the correspondence between the total points won and the value of the compensation, to, while doing the exercises, determine if it would be advantageous to pay one minute to try to have the benefit of the help. It probably meant a lot of mental effort and was perhaps easier to ignore. We note that the likelihood of seeking help in Experiment 2, in all conditions, is comparable to the likelihood of seeking *free help* in Experiment 1, which suggests that temporal costs did not enter participants' decisions: they appeared to treat any help as free help, whether or not they had to consume time to get it. Moreover, considering that our design allowed participants to adopt a strategy of seeking 'free' help just to stop the clock (working out the answer during the 60 seconds pause and providing the answer after no time has passed), but participants did not seek more help in the 'free' help condition compared to the costly one, it is possible that participants had difficulties understanding the incentive structure of the experiment.

Experiment 3

In this last experiment, we investigated social costs by having participants work either alone or under the eyes of an expert (introduced as a graduate student in statistics). Given the lack of effect of stated probabilities of getting help in the first and second experiments, we abandoned this manipulation in the last study. The manipulation was replaced with a random labelling of the exercises as either 'easy' or 'hard'. We hypothesized that the presence of an expert would make it socially costly to seek help for 'easy' exercises, more than for 'hard' exercises.

Participants

Participants were recruited among the psychology students that had followed the second year statistical course on the campus of the *Université Toulouse Jean Jaurès*, to take part in a study of 'statistical learning'. Our sample was composed of 105 students (mean age = 23), 90 were women and 35 had a scientific major in high school.

Design

The experiment followed a 2 × 2 mixed design, which manipulated the presence of an instructor (between-participant), and the perceived difficulty of the exercise (within participant). Each participant worked on eight exercises, half of which were (randomly) labelled as easy, the other half being labelled as hard.[6] Participants got 1 point per correct response, and their point total (reward for correct responses) could be redeemed for a voucher of 10, 15, or 20€ (the higher their point total, the more valuable the voucher).

[6]The goal was to test if 'knowing' that a task is easy or hard affects the help-seeking decision. It would be hard to measure the real difficulty level of the exercises. Moreover, those which are easy for some participants can be hard for others. Thinking about social cost, the important point was the impact of the difficulty label.

Material

Participants were presented with eight multiple choice questions extracted from the statistic class given to second year psychology students at their university (a content that they should all know). Each multiple choice question came with four responses (only one being correct). All exercises can be found in the Appendix, but one example is shown below:

Before using a *t* test for two independent groups, it is necessary to verify that:

- the binary qualitative variable has a Gaussian distribution.
- the variance of the population is known.
- the number of elements is larger than 30 in each group.
- the variance of the samples are homogeneous.

As in the other studies, for each question participants could receive help. Instead of giving the help in the form of a partial solution of the current exercise as we did in the former studies, we offered the elimination of one of the wrong options. In other words, by pressing the help button, the participants could increase their probability of choosing the correct answer. For example:

a. The following answer *is not* the right one:

   - the variance of the population is known.

Figure 6 (left) shows the screen displaying a question, the options and the help button. Figure 6 (right) part shows the same question with the help window opened. Near the help button, the participants could see whether the exercise was purportedly 'easy' or 'hard'.

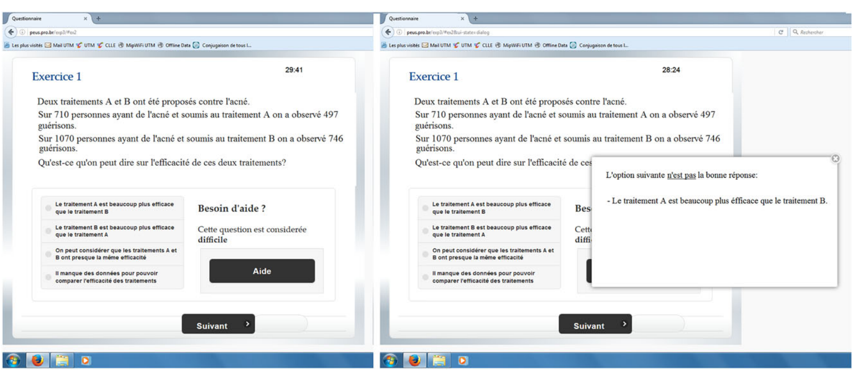

Figure 6. Screenshot of an exercise and the experimental elements—Experiment 3.

Procedure

The task and the instructions were exactly the same for both groups. The only difference was that in one of the groups the participants had to complete the task being watched by an 'expert' (expert condition) that we introduced as a graduate student in statistics, and the other group did the task alone (alone condition). In order to avoid any bias linked to some idiosyncrasy in the demeanour of the expert, we recruited five different experts for the experiment.

Participants took an individual appointment and were distributed to one of the two groups according to their availability and the availability of the experts. That is, when no expert was available, the participant was directly assigned to the alone condition. All experts confirmed that they had never met any of the participants they were in session with.

In the alone condition, participants sat alone at a computer where the software was displayed and were told to read the instructions and the tutorial after giving informed consent. The tutorial explained the experiment, in particular the help button, and that the questions were classified as hard or easy. Concerning the point system, they were presented with a table containing the voucher values to be received according to the amount of correct answers. Participants only knew which answers were correct or not at the end of all exercises. In other words, they knew the total of problems they had to answer correctly to get the more valuable voucher, but during the experiment they could not know if they were achieving this number.

In the expert condition, participants were introduced to the expert who was already seated beside the chair they would use. The experimenter stated: 'This is X, he/she is a graduate student in statistics and he/she will look at what you will be doing. He/she cannot help you or answer any question, he/she will just look.' After this presentation the instructions and the procedure were the same as in the alone condition.

The order of the eight questions were randomized for each participant, as well as the sequence of the difficulty classification to control for the effects of problem ordering. Participants had 30 minutes to answer the eight questions and a chronometer was displayed on the screen. They were provided with paper and pen, if so it should be necessary during the task. In both conditions the experimenter stayed in the room, in a position where she could not watch the participant or the expert.

Finally, we conducted two manipulation checks. First, we asked each participant to what extent they had noticed a difference in the difficulty of easy and hard exercises (7-point scale). Second, we asked participants in the expert condition whether the expert was an undergraduate psychology student, an undergraduate statistics student, a graduate student in psychology, or a graduate student in statistics. After the experiment, participants were told that the ’expert‘was not really an expert and that the ‘easy’ and ‘hard’ labels of the exercises were randomly assigned.

Results

Only eight subjects failed to remember that the expert was a graduate student in statistics. Analyses were conducted with and without these eight subjects. Because these two analyses delivered the same results, we report the analyses that used the whole sample. On average, participants neither agreed nor disagreed that purportedly ‘hard’ exercises were more difficult than purportedly ‘easy’ exercises ($M = 3.6$, SD $= 1.5$).

Main results are shown in Figure 7. The figure shows the proportion of help sought in the 2 conditions of the experiment (alone or expert) and

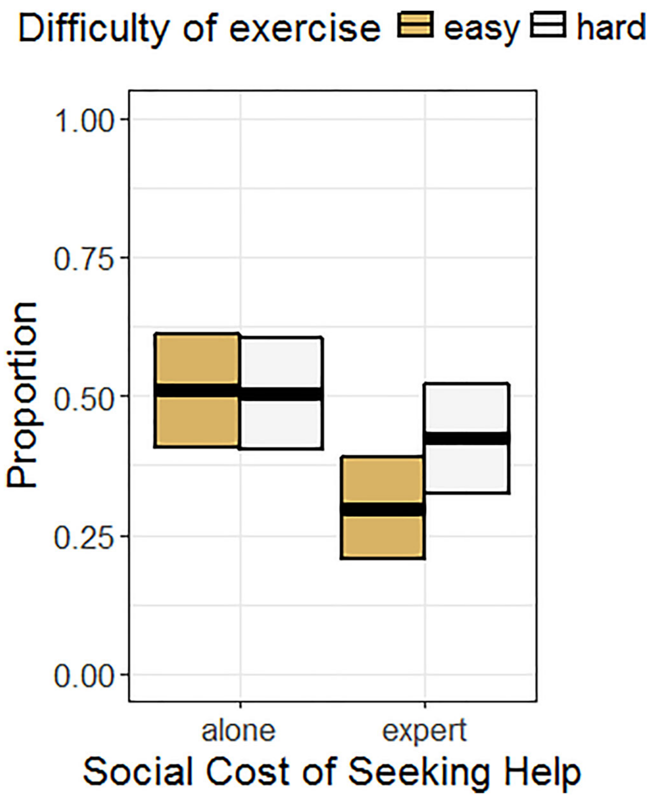

Figure 7. Proportion of help sought as a function of the social cost of asking for help and the difficulty of exercise. Boxes show the 95% confidence interval for the mean. The difficulty of exercise has impact only on the decision to seek help in the expert condition, and the social cost seems to impact on the likelihood to seek help.

their interaction with the difficulty classification of the exercise (easy or hard).

Figure 7 suggests that (1) the difficulty of the exercise seems to impact decisions only for participants of the expert condition, and (2) the social cost of asking for help appears to impact decisions particularly when the participants are facing an easy question. In terms of social cost, free help is asked for 51% of the time, while costly help is asked for 36% of the time.

In order to confirm these results, we conducted a generalized mixed model (Bates et al., 2015) in which the (binomial) decision to seek help was the dependent variable; the social cost of asking for help, the difficulty of the exercise, and their interaction were fixed effects; other fixed effects were gender, major in high school (scientific or not), and the number of problems already taken; and participant and exercise were entered as random effect.

The presence of an expert decreased the likelihood of seeking help ($b = -1.35$, $SE = 0.46, z = -2.93, p = 0.003, CI_{95\%}[-2.26, -.45]$). This main effect was qualified by a marginal interaction with the difficulty of the exercise: participants were especially unlikely to seek help for easy exercises when they were watched by an expert ($b = 0.63$, $SE = 0.36, z = 1.74, p = 0.08, CI_{95\%}[-.08, 1.35]$). In addition, participants decided to seek more help as they advanced in the task ($b = 0.15$, $SE = 0.04, z = 3.59$, $p < 0.001$).

No significant statistical result was found for the other control variables, i.e. gender and major in high school.

Additional results

Even though the outcomes were not the core of this study, it might be interesting to consider that 40% of the problems were correctly solved. Besides, comparing participants who had a scientific major to those who had other majors the first group correctly solved 43% of the problems while the second correctly solved 38%. Concerning the help-seeking decision, participants with scientific major sought help in 37% of the exercises and participants with other majors sought help in 46% of the exercises. In average, participants took 10.87 min to do all the 8 exercises (SD = 3.41), which showed the 30-minetime limit was sufficient for the task. Thirty-seven participants received a 10€ voucher, 66 participants received a 15€ voucher and 2 participants received a 20€ voucher.

Discussion

The aim of this experiment was to investigate the social cost of seeking help in an experimental manipulation. The importance of the social cost in this context is robustly documented in previous studies and was confirmed in ours: participants were less likely to seek help when they were observed by an expert and mainly as the exercise was labelled 'easy'.

We acknowledge that this result may partly reflect experimental demands: if the experimenter labelled some exercises as 'easy', then seeking help for these exercises may signal that you do not trust the experimenter. We tried to neutralize this demand effect by having two different persons play the role of the experimenter (who sat in a different part of the room, her back to the participants) and the expert (who watched participants' behaviour). However, it is possible that some subjects imagined that the expert, not the experimenter, labelled the exercises as 'hard' and 'easy'.

General discussion

Why do learners fail to seek help, when doing so would be beneficial? Considering rational principles a general answer to this question can be provided: seeking help is not an optimal action if its costs are greater than its expected benefits. Accordingly, learners should be sensitive to three parameters when making the decision to seek help: the benefits of doing so, but also the probability of obtaining these benefits, as well as the intrinsic costs of seeking help.

While previous research provided important insight about the impact of these three parameters, we identified the need for experiments that focused on the cognitive mechanisms involved on the decision to seek help and that would integrate the parameters in a single design, using experimental manipulations rather than self-reports; clearly distinguish between the benefits of seeking help and the probability of obtaining these benefits to test a rational model; and explore other costs (like financial and temporal costs) in addition to social costs.

We reported three such experiments that used financial costs, temporal costs, and social costs, respectively. Before discussing the main results of them, it is important to mention the fact that our sample, in all three experiments, is composed by a majority of women. We should note that, despite this fact, gender has not been found to be a variable that impact help-seeking (Makitalo-Siegl & Fischer, 2013; Ryan, Patrick, & Shim, 2005).

One of our goals in this article was to explore costs other than social, and their interaction with the probability of seeking help. Our first and second experiments showed that (a) participants reacted qualitatively to financial costs: they were less likely to ask help when they had to pay for it, but they were not sensitive to the amount they had to pay; (b) participants were not sensitive to temporal costs, even though these costs ultimately impacted their financial compensation: whichever temporal cost they had to pay, they asked help as if it was free; (c) participants never showed any sensitivity to expectancies: they sought help to the same extent whichever the stated probability of receiving help, even if they had to pay for it anyway.

These results do not strongly support the conformity of help-seeking decision with rational principles. We should be careful before concluding that help-seekers are irrational though. First, our investigation may have failed to account for participants subjective estimations of costs and benefits. Second, our design choices may have failed to capture some important dimensions of the help-seeking situation. We can only conclude that conditional on our experimental implementation, and on the assumption that participants' subjective estimations of costs and benefits broadly respected the monotonicity of their objective values, participants did not behave as per the predictions of rational principles. On the one hand, people are more likely to seek help when help comes at not financial cost, which is a prediction of rational principles. On the other hand, people show little sensitivity to rational principles when considering other parameters we tested. In particular, they do not treat wasted time as a cost, even when working under time constraints; and they do not react to the uncertainty of getting help conditional on asking, even when asking is financially costly. We should remember that it might be interesting to find other ways to manipulate the time cost, especially if these manipulations facilitate the mental conversion between time and money (Ashby & Rakow, 2018; Okada & Hoch, 2004; Soman, 2001).

We confirmed the importance of social costs in the final experiment: participants were less likely to seek help when being watched by an expert, and especially when the exercises were randomly labelled as 'easy'. This result hearkens back to a phenomenon we described in the introduction: the learners who need help the most are the least likely to seek help. Our results point at one mechanism for this phenomenon: we can suppose that the learners who need help the most are the most likely to need help for 'easy' problems—however, when an expert (such as a teacher) is present, asking help for easy problems has a higher social cost than asking help for hard problems. Accordingly, the learners who need help the most are also the ones that face the highest social cost when seeking help. Fortunately, our results are in line with previous findings on suggesting that this undesirable effect can be suppressed in anonymous learning environments (Karabenick & Knapp, 1988a; Kitsantas & Chow, 2007). Our findings do suggest that labelling educational material as easy and hard can be problematic, as it gives cues to students about whether they are expected to seek help or not. Given that difficulty is a function of the student, it would be more cautious to treat all educational material as though it had the potential to be difficult.

Our findings help to identify low-priority interventions to improve help-seeking behaviour, more than they validate a model of this behaviour. In other words, our findings suggest that there is little leverage to be gained by reassuring learners that help will come if they ask (because this uncertainty does not seem to concern them); and they suggest that there is similarly little leverage to be gained by reassuring learners that they will not waste time by seeking help (because this potential waste of time does not seem to concern them). We observed that the literature on help-seeking strongly focused on social costs, and left other costs and expectancies relatively unexplored. In view of our findings, this focus seems legitimate, for practical if not theoretical reasons. Finally, this work opens up a perspective of research in the help-seeking domain towards the cognitive mechanisms involved in the decision to seek help.

Future studies should consider the cost of not getting the right answer, for instance if participants lose an amount of money each time they got an incorrect answer would it change their decision to seek help? In parallel, the use of surveys should be helpful in understanding their decision making process. Finally, increasing the difference between the financial incentive they get according to their performance might be an interesting approach to rule out the possibility they may have not deemed it worth their time and effort to seek help because the benefits discrepancies were not high enough.

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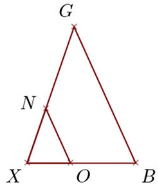
Appendix

List of the exercises and helps

First experiment

Exercises

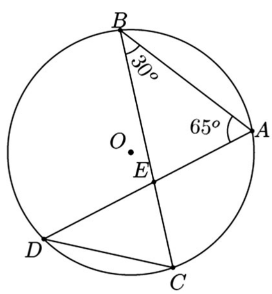
1. In the figure below, the segments (BG) and (ON) are parallel. Given XB = 4 cm, XG = 5.3 cm, ON = 2.2 cm and OB = 2.4 cm, calculate BG and XN.



2. Calculate the greatest common divisor of 69309 and 11322.
3. In a box, there is 1 green ball (G), 3 red balls (R) and 1 yellow ball (Y) indistinguishable when touching. 2 balls are drawn one by one without replacement. Which is the probability that the second ball is green?
4. Calculate the following expressions and give the result as an integer number:

$$E = \left(2-4\sqrt{2}\right)\left(2+4\sqrt{2}\right)$$
$$F = \frac{64\sqrt{54}}{12\sqrt{96}}$$

5. Calculate the length of RE in a ERN right-angled triangle in E given that side NE = 12.6 cm and NR = 17.4 cm.
6. A farmer owns two enclosures. The first contains 28 chickens and 21 geese. The second contains 20 chickens and 3 geese. How many geese we must add to the second enclosure so that the probability of choosing a chicken in this enclosure have the same value as that obtained in the first enclosure?
7. In a classroom of 31 students, the average age is 15.5 years. Taking into account the mathematics teacher age the average increases to 15.86. Determine the teacher's age.
8. Given $f : x \to 4x^2 + 2x - 1$ which is the image of –3 to the function f?
9. Determine the measure of each one of the angles of EDC triangle.



Helps

1. According to Thales' theorem:

$$\frac{XB}{XO}=\frac{XG}{XN}=\frac{BG}{ON}$$

Additionally, $XO = XB - OB = 1.6\text{cm}$

$$\frac{4}{1.6}=\frac{5.3}{XN}=\frac{BG}{2.2}$$

2. We calculate the greatest common divisor of 69309 and 11322 using the Euclidean Algorithm:

$$69309 = 11322 \times 6 + 1377$$

$$11322 = 1377 \times 8 + 396$$

$$1377 = 396 \times 4 + 153$$

$$306 = 153 \times 2 + 0$$

3. It is noted (?,G) the event: the second drawn ball is green.

4. $$p(?,g)=p(g,g)+p(r,g)+p(y,g)=\frac{1}{5}\times\frac{0}{4}+\frac{3}{5}\times\frac{1}{4}+\frac{1}{5}\times\frac{1}{4}$$

$$E=(2-4\sqrt{2})(2+4\sqrt{2}) \quad | \quad E=2^2-(4\sqrt{2})^2$$

$$F=\frac{64\sqrt{54}}{12\sqrt{96}} \quad | \quad F=\frac{64\times\sqrt{9}\times\sqrt{6}}{12\times\sqrt{16}\times\sqrt{6}}$$

5. The triangle ERN is right-angled in E. Its hypotenuse is [NR]. According to the Pythagorean theorem:

$$NR^2 = RE^2 + NE^2$$

$$RE^2 = NR^2 + NE^2$$

$$RE^2 = 17.4^2 + 12.6^2$$

6. The first enclosure has 49 poultry. The probability of choosing a chicken is:

$$\frac{28}{49}=\frac{4}{7}$$

Note x the number of geese we add to the second enclosure. So, the probability of choosing a chicken in the second enclosure become:

$$\frac{20}{20+3+x}$$

So that the probability of choosing a chicken have the same value in both enclosures, the number s must verify the following equality:

$$\frac{20}{20+3+x}=\frac{4}{7}$$

7. Note x the teacher's age and $\sum$ the sum of students ages. The average of students ages being 15.5 years, we have the relation:

$$\frac{\sum}{31}=15.5 \rightarrow \sum = 15.5\times 31 = 480.5$$

Adding the teacher's age to the calculation of this average we have:

$$\bar{x} = 15.86 \rightarrow \frac{\sum +x}{32} = 15.86$$

8. $f(-3) = 4 \times (-3)^2 + 2 \times (-3) - 1$
9. The angles $\widehat{CBA}$ and $\widehat{ADC}$ are inscribed angles intercepting the arc $\widehat{AC}$. Two inscribed angles to a circle intercepting the same arc are equals.

$$\widehat{ADC} = \widehat{CBA}$$

The angles $\widehat{BCD}$ and $\widehat{BAD}$ are inscribed angles intercepting the arc $\widehat{BD}$. Two inscribed angles to a circle intercepting the same arc are equals.

$$\widehat{BCD} = \widehat{BAD}$$

The sum of the measure of the angles in a triangle is equal to 180°. The angles are supplementary, so we have:

$$\widehat{DEC} =$$

Second Experiment

In the second experiment we used the exercises and helps 1, 2, 5, 6, 7 and 8 listed above.

Third Experiment

Exercises

1. The variable sex (2 levels: man and women) and the variable marital state (2 levels: married and single) were studied in a sample. After the analysis of the results, a statistician declares that "in the studied sample the frequency of the level man conditionally to the level single is equal to 25%." It means that:
   - On the sample, 25% is composed of men and 25% is composed of single.
   - Among the males of the sample 25% is single.
   - Among the singles of the sample, 25% is male.
   - 25% of the sample is composed of single men.
2. Two acne treatments A and B were proposed. From 710 patients with acne and submitted to A treatment, we observe 497 cured. From 1070 patients with acne and submitted to B treatment, we observe 746 cured. What can we say about the effectiveness of these two treatments?
   - Treatment A is much more effective than treatment B.
   - Treatment B much more effective than treatment A.
   - We can consider that both A and B treatments have almost the same effectiveness.
   - More data would be needed so we could compare the treatments effectiveness.
3. To determine if there was a link between breastfeeding from birth and blood pressure in childhood, a study consisted on measuring the systolic arterial pressure of children known to have been breast-fed or not at 7 years old. The mean systolic arterial pressure measured at age 7 was 98.5 mmHg (standard deviation, 9.0) from 5478 children that had been breast-fed from birth and 99.9 mmHg (standard deviation, 9.6) from 1125 children that had not been breast-fed from birth. The systolic arterial pressure is a variable of normal distribution.
   To this study it is necessary to use a test:
   - of comparison of 2 means on 2 matched samples.
   - of comparison of 1 mean on 1 samples to a theoretical average.

- of comparison of 2 means on 2 independent samples.
- of association of 2 continuous quantitative variables

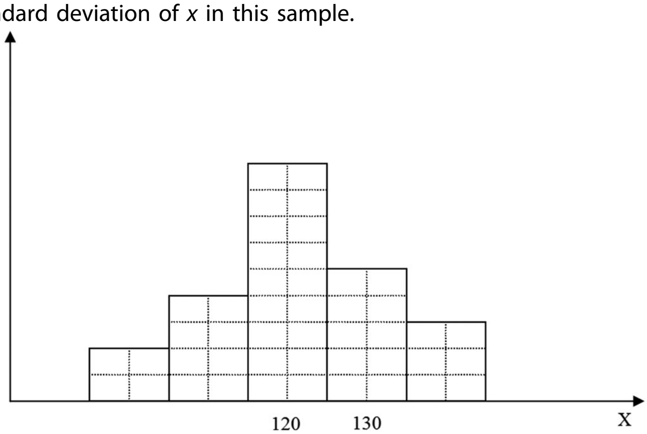
4. The reintroduction of bears in a mountainous region brought to these animals the accusation of strangling sheep. In this way for the 21 first weeks of year 1 previous to the bears comeback, the number of sheep strangled is given by *X*; while for the 21 weeks correspondent of year 2 following the bears comeback the number of sheep strangled is given by *Y*:

semaine	X	Y	semaine	X	Y	semaine	X	Y
1	2	3	8	0	4	15	1	10
2	3	3	9	3	6	16	1	10
3	2	4	10	4	7	17	3	11
4	4	6	11	0	6	18	2	10
5	0	4	12	3	6	19	5	11
6	3	6	13	1	8	20	2	11
7	5	5	14	3	7	21	4	12

During year 1, for half of weeks, the number of strangled sheep was at least equal to 3. Identify the index that allowed the conclusion that in year 2 this number was increasing.

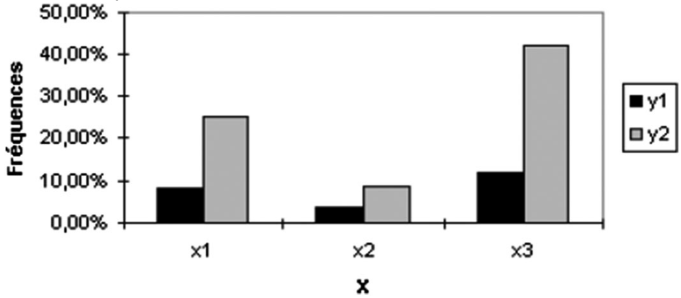
- median
- average
- standard deviation
- mode

5. The graph shows the histogram of the staff of variable IQ (denoted by *x*) on a sample of people. The values of *x* are grouped into classes of same amplitude 10. The class denoted by center 120 has 63 as staff. Estimate the average and the standard deviation of *x* in this sample.



- average = 121.30; standard deviation = 11.15
- average = 161.07; standard deviation = 14
- average = 63.51; standard deviation = 120
- average = 120; standard deviation = 124.39

6. Before using the Student T test for two independent groups, it is necessary to verify that:
   - the binary qualitative variable has a Gaussian distribution.
   - the variance of the population is known.
   - the number of elements is larger than 30 in each group.
   - the variance of the samples are homogeneous.
7. A variable X (3 modalities: x_1, x_2, x_3) and a variable Y (2 modalities: y_1, y_2) were studied on a sample.



   The figure above shows:
   - the dissociated distribution of x and y.
   - the joint distribution of x and y.
   - the distribution of x conditionally to y.
   - the distribution of y conditionally to x.
8. Which of the following statements is the correct one?
   - To use a non parametric test it is necessary to know the distribution of the studied variables.
   - The parametric tests always require the distribution of the studied variables to be normal.
   - The parametric tests rest on the ranking of observed values.
   - The non parametric tests are relatively insensitive to outliers.

Helps

1. The following answer *is not* the right one:
   - On the sample, 25% is composed of men and 25% is composed of single.
2. The following answer *is not* the right one:
   - Treatment A is much more effective than treatment B.
3. The following answer *is not* the right one:
   - of association of 2 continuous quantitative variables
4. The following answer *is not* the right one:
   - standard deviation
5. The following answer *is not* the right one:
   - Average = 161,07; standard deviation = 14
6. The following answer *is not* the right one:
   - the variance of the population is known.
7. The following answer *is not* the right one:
   - the dissociated distribution of x and y.
8. The following answer *is not* the right one:
   - The parametric tests always require the distribution of the studied variables to be normal.