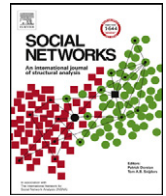




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Calling social capital: An analysis of the determinants of success on the TV quiz show “Who Wants to Be a Millionaire?”

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ABSTRACT

This paper analyzes the determinants of successful participation of candidates on the well known television quiz show “Who Wants to Be a Millionaire?”. Our study includes a survey of 660 contestants who participated in the German version of the show between 1999 and 2007. We are particularly interested in two hypotheses. The first hypothesis refers to the assumed advantage of social capital. Contestants on the show have the option of calling a friend (the phone-a-friend lifeline) whom they select from their personal networks. The person chosen to be the phone-a-friend lifeline should be especially helpful if the contestant has a large network of able contacts from which to choose. Second, according to human capital theory the participants’ education should increase the chances of success and should lead on average to higher payoffs. Since contestants on the show can answer questions correctly mainly on the basis of their knowledge and since other characteristics of the candidates are irrelevant, estimates of the human capital effect are not affected by other possible causes suggested by signaling theory. Thus, our analysis is an assessment of the effects of social capital and human capital on the show.

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1. Introduction

TV quiz shows can offer interesting opportunities to study social behavior. The shows “Jeopardy” and “Deal or no Deal” have been used to analyze players’ risk aversion (Bombardini and Trebbi, 2005; Metrick, 1995; Post et al., 2008,) and Oberholzer-Gee and Waldfogel (2003) analyze “Friend or Foe?” to study individuals’ cooperativeness. Of course, human behavior in these shows takes place within very specific and artificial environments. However, they also reduce the complexities of social reality and offer a “natural experiment” that allows to scrutinize certain behaviors in a straightforward manner. In this paper, we use this advantage and analyze data collected from the show “Who Wants to Be a Millionaire?” in order to demonstrate the monetary benefits of social capital and human capital.

“Who Wants to Be a Millionaire?” (WWM hereafter) is a very popular TV show and has been broadcasted in more than 100 countries. Contestants on WWM have to answer 15 multiple-choice questions of increasing difficulty in order to win one million dollars (or about the equivalent in a country’s currency, e.g. in Germany one million Euro). Each correct answer is rewarded by a monetary prize that increases as questions become more difficult. If a contestant does not know the correct answer he can use three different

lifelines. One of the lifelines is to call a friend or acquaintance who can be asked for help. The contestant has to provide the moderator with three names before the show and the candidate is allowed to call one of them. Thus, in order to be successful in the show a contestant has to make an intelligent selection of the phone-a-friend lifeline. Since the three lifelines are selected from contestants’ personal networks, the characteristics of the network should be linked to a contestant’s ability to come up with a helpful lifeline. Hence, an analysis of the relation between the contestants’ network structure and the phone-a-friend lifelines can be used to demonstrate the beneficial effects of social capital.

The success in WWM depends also on human capital and offers an interesting twist regarding the estimation of human capital effects. The advantages of schooling are often demonstrated in the literature by comparing individuals with varying levels of education with respect to their labor market income. However, as Spence (1973) and Stiglitz (1975) have pointed out, such estimations do not allow separating the productivity enhancing effect (or causal effect) of education from selection effects. According to the sorting hypothesis, more able individuals (that is, individuals with higher IQs, more motivation and/or better self-discipline) are more likely to go on to higher education. Accordingly, employers infer the productivity of an applicant from the achieved educational degree. Therefore, the higher income of the well educated employees may come not only from the educational training but also from the unobserved characteristics of employees. Interestingly, signaling effects are irrelevant for success in WWM and the show can therefore be

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used to observe the benefits of educational training net of signaling effects.

Before we go into more detail on the hypotheses and the data, we will first consider the show's rules and the contestants' selection process in the next section. This will be followed by Section 3 in which we specify the hypotheses about the determinants for successful participation on the show. In Section 4 we describe our data and how we measured social capital and human capital. Section 5 then presents the descriptive as well as multivariate statistical results. Finally, in the last section, the major findings are summarized and discussed.

2. The rules of the show

In order to be selected as a contestant, candidates have to apply for the show and to survive a preliminary screening.¹ Candidates must answer seven questions on different fields of knowledge and an additional guessing question over the phone. The guessing question could be, for instance, "How many steps are there going up the Eiffel Tower?". Around 100 applicants are screened for every show and the top 10 are picked to go on. If more than 10 candidates answer all the questions correctly the guessing question is decisive. The contestants are, however, not screened for their television-friendly appearance. Contrary to many other quiz games the selection is based solely on the knowledge test. The 10 pre-selected participants then have to answer another preliminary question by putting four answers into the correct order ("fastest finger first"). The candidate who provides the correct order in the shortest time is finally selected for the "hot seat" and is asked 15 multiple-choice questions. Four possible answers are provided for each question and the contestant has to choose the right one. On their way to the million, the contestants can make use of three different lifelines. One gives contestants the option of asking the audience (ask-the-audience lifeline). Another option eliminates two of the four answer categories (the Fifty-fifty lifeline), and with the third, the candidate can call someone for help (phone-a-friend lifeline).

From when the German show started in the fall of 1999 until the beginning of our survey in May 2007, 1350 contestants were in the "hot seat" of the show. Six of them answered all questions correctly. Thus, if all participants had an equal chance of answering all questions correctly, the chance of winning a million would be 6/1350 or a probability of 0.004.² Therefore, the odds of winning the million are quite low, but still substantial if compared with the probabilities of winning big prizes in standard lotteries. Also, the contestants do much better than compared with random choice. If the answers to each question were selected randomly, the probability of winning the million would be 0.25¹⁵ only, or about 1 out of 1 billion times. Of course, the probability of winning the million is not the same for every participant, but depends on the performance of the candidates.

3. The returns of human capital and social capital

Human capital theory assumes that education (and work experience) increases productivity and therefore increases an individual's wage in the labor market (Mincer, 1958, 1974; Becker, 1964).

¹ Our description refers to the rules and contestant's selection process of the German version. Both may be different in other countries.

² Taking the selection probability of the fastest finger question into consideration, the probability of winning the million decreases to 0.0004. If we consider the number of potential candidates in the pre-screening then the probability of winning the million decreases to 6/54000 (or 0.0001) because as until May 2007 about 540 shows were broadcasted and for every show about 100 candidates were pre-screened.

Since WWM is based on factual knowledge questions and since such knowledge can be accumulated through education, individuals with higher education should be able to answer more questions correctly. Human capital theory has been tested predominantly in labor market studies. However, estimating the wage bonus for education is typically affected by the difficulty of separating the effect of schooling from other unobserved characteristics such as ability, physical attractiveness, and health. Also other constraints such as market segmentation and discrimination influence recruitment and thus might bias the estimated effect of education. Signaling theory (Spence, 1973; Stiglitz, 1975; Weiss, 1995) in particular maintains that individuals with greater ability such as intelligence and motivation invest more in their education. Hence, the estimated wage bonus might not solely be due to schooling, but also due to these unobserved individual characteristics. Since employers know about the self selection of the more productive individuals into the group of better educated individuals, they interpret educational degrees as signals of higher productivity and prefer hiring and promoting individuals with higher levels of education.

WWM presents an opportunity to estimate the productivity effects of education net of other characteristics that might be signaled by educational degrees. On the game show, individuals "earn" the prize solely by providing the correct answer to a knowledge question. The correct answer may or may not be known by contestants, however, it can usually not be deduced using motivation, intelligence, impression management or other similar skills. Let us demonstrate this with an example: on the German show which was broadcasted on September 30, 2005, the moderator posed the following one million Euro question to the candidate: Which of the following Nobel-prize winners did not have a high school diploma? (A) Albert Schweitzer, (B) Max Planck, (C) Wilhelm Röntgen, or (D) Robert Koch.³ Since all named persons were Germans, knowing the correct answer is particularly difficult for non-Germans. But even for a German candidate, profound knowledge of the biography of Röntgen would be required to be able to choose the correct answer. Anyway, the right answer can certainly not be found with the help of logic, intelligence, endurance or motivation. Thus, the unobserved characteristics usually assumed by signaling theory cannot explain successful participation in the game show. Instead, success depends on the knowledge candidates have acquired either by schooling or by auto-didactically. Also, informal education acquired by reading books, journals or newspapers should increase productivity in the show. To sum up, we formulate two hypotheses focusing on multiple indicators of human capital:

H₁. Contestants with higher formal schooling should perform better than candidates with less schooling.

H₂. Contestants with high levels of knowledge acquired outside formal schooling should perform better than individuals with lower levels of knowledge.

Success on the show depends not only on education but also on the selection of the telephone lifelines. First, phoning somebody should be particularly promising if a candidate has a large pool of social contacts from which he can choose. Contestants with larger networks can pre-select a more knowledgeable sample of three telephone lifelines. Thus, a large network should be more helpful than a small network. The finding that network size has benefits for individuals (e.g. for their health or job satisfaction) has been confirmed by several studies (Flap and Völker, 2001; Haines et al., 1996; Haines and Hurlbert, 1992). For instance, Wellman and Wortley

³ The correct answer is Wilhelm Röntgen; Röntgen dropped out of school in Utrecht (Netherlands) without a high school diploma. Admission to any German university was thereafter impossible. However, the Swiss Federal Institute of Technology (ETH) in Zurich offered an exceptional admission test that Röntgen passed.

(1990) found that support (e.g. emotional aid, small services) is usually allocated by many different network members. Also, the proportion of supportive ties in a network can grow with its size (Wellman and Gulia, 1999).

Second, the network of the contestants should not only be large, but should also consist of educated contacts. We expect that telephone lifelines with higher levels of education and more prestigious occupations will be more likely to provide contestants with helpful information. This aspect of a network refers to a resource-based approach which is often associated with the concept of social capital (e.g. Bourdieu, 1986; Burt, 1992, 2000; Flap, 2004; Lin, 2001; Portes, 1998; Van der Gaag and Snijders, 2005). Contestants in WWM should be more successful if they have access to more knowledge. Hence, we expect that contestants who have a large network of educated contacts have an advantage over contestants with small and less educated networks.

Third, networks should be heterogeneous with respect to the areas of competence or knowledge. A heterogeneous network should offer more diverse resources to a candidate and should therefore be more helpful than a homogeneous type of network. Heterogeneity exists, for example, when the network is composed of persons who have different educational degrees, belong to different age groups, and/or diverse occupations. Research exists especially with regard to this last aspect. According to several authors (Lin et al., 2001; Lin and Dumin, 1986; Van der Gaag et al., 2008) occupational diversity is an appropriate indicator for social capital. Further aspects of heterogeneity (e.g. age, education) were also found to have a positive impact on getting social support (Erickson, 2003). In WWM, heterogeneity should help candidates to receive relevant information. Thus, if a candidate has little or no knowledge in a specific field, a person who does have some knowledge in this area should be picked as a lifeline. Therefore, the success in WWM should be increased if a contestant's network consists of contacts with different areas of expertise as opposed to homogeneous networks with redundant knowledge. According to Granovetter (1973, 1983) such knowledge can most likely be obtained from weak ties, since strong ties are relationships that often exist between like-minded persons with similar interests and therefore similar knowledge (Granovetter, 1973, p. 1362). According to this concept, weak ties are relations that should secure non-redundant information for the contestant. However, within the framework of WWM it seems also to be very important that the candidate has detailed information about the competence of the telephone lifelines in order to select the right person. This consideration would postulate that networks which consist of many strong ties with different expertise are most advantageous.

Burt (1992, 2000) has called the usefulness of the distinction between weak and strong ties into question. He hypothesizes that contacts which provide access to different types of information are often contacts that bridge "structural holes" between networks. Hence, it is not important whether a relation is weak or strong, but rather whether the contact is linked to another network (Burt, 1992, p. 28). Unfortunately, our information about the candidates' network is purely egocentric and thus does not allow to measure bridging contacts.

To sum up, we postulate the following hypotheses:

H₃. Candidates with a large network of personal contacts should be able to select a better sample of telephone lifelines and choosing a better telephone lifeline leads to higher monetary success on the show.

H₄. Since candidates must be quite well informed about the expertise of the telephone lifeline, we expect that the number of strong ties matter more than the number of weak ties.

H₅. The more heterogeneous a network is with respect to the education, occupations and competences of its members, the better the chances are of contestants selecting successful telephone lifelines.

Putting it more formally we assume that success or earning (y) in WWM is a function of formal (e_1) and informal education (e_2) as well as of the candidates' social capital (sc). Following the standard econometric formulation of human capital theory (Mincer, 1974) the model can be written as

$$\ln(y) = b_0 + b_1e_1 + b_2e_2 + b_3sc + \sum_{j=1}^k b_jc_j + \varepsilon \quad (1)$$

where c_j denotes further control variables such as candidates' age or gender. Social capital (sc) in Eq. (1) contributes only to earnings if the telephone lifeline supplies the correct answer. Thus, the variable sc is a dichotomous variable which takes the value of 1 if the telephone lifeline is correct and the value of zero otherwise. The probability that the telephone lifeline is correct depends on candidates' network size (n), the education or knowledge resources (r) of the network contacts and the heterogeneity (h) of his contacts. We suppose that increasing network size, resources and heterogeneity yield diminishing returns. Hence putting hypotheses H₃–H₅ into statistical terms results in the following logistic regression model:

$$P(sc = 1) = \frac{e^z}{1 + e^z} = \frac{1}{1 + e^{-z}} \quad \text{with } z = \beta_0 + \beta_1n + \beta_2r + \beta_3h, \\ \text{for } n > 0 \quad (2)$$

Estimating the monetary benefits of network embeddedness is usually fraught with difficulties. Empirical studies investigating the advantages of finding a job with the help of social networks often find contradictory evidence (Granovetter, 1995, p. 147; Mouw, 2003; Franzen and Hangartner, 2006). One reason for this is that job search and job placement depend on many influences that are difficult to incorporate with survey data. An analysis of WWM provides the option of demonstrating the advantage of network contacts in a quite straightforward manner since the network's characteristics influence the selection of a telephone lifeline which, in turn, determines the contestants' chances of winning.

4. Data and measurement

We surveyed all German contestants who made it to the "hot seat" between 1999 and May 2007. Until then, about 1350 individuals participated in the show. We managed to gather 1024 valid addresses. These 1024 participants received a written questionnaire, an accompanying letter from the production team and an introductory letter from the authors. The questionnaire was answered and returned by 660 participants, which constitutes a response rate of 64.5%.⁴

Table 1 shows some socio-demographic information about the contestants. We measured human capital as is standard in the literature (Becker, 1964; Mincer, 1974) by asking candidates for the highest level of schooling obtained. In Germany, individuals can reach four different educational levels. Students can leave school after 9 (obligatory) or 10 years with basic school qualifications. A high school diploma can be achieved after 13 years of schooling. After that, individuals can go on to study at universities of applied sciences (technical or social work schools) or universities.

⁴ We know the number of millionaires and zero Euro "winners" from official sources. Four out of the six millionaires have responded to our questionnaire, but only two out of 18 contestants who have won zero Euro answered. Hence, our sample could be biased towards the more successful participants.

Table 1
Contestants' socio-demographic characteristics, human capital and social capital indicators.^a

Variable/index	Min.	Max.	\bar{x}	sd	n
Average prize in Euro	0	1 million	47,793	109,433	539
Sex (female = 1)	0	1	0.46	0.50	656
Age at time of participation	17	80	44.47	11.04	653
Children (no = 0/yes = 1)	0	1	0.54	0.50	655
Employed (no = 0/yes = 1)	0	1	0.75	0.43	657
Education in years	9	17	14.03	2.64	653
Subjects with high school diploma as highest education (high school diploma = 1)	0	1	0.27	0.44	653
Subjects with applied college degrees (applied college = 1)	0	1	0.16	0.37	653
Subjects with university degrees (university = 1)	0	1	0.34	0.47	653
Books read in 2007	0	80	9.72	9.94	652
Books in household	5	9900	689	1,093	655
Readers of daily newspapers (yes = 1)	0	1	0.76	0.43	659
Readers of weekly journals (yes = 1)	0	1	0.57	0.50	654
Areas of competence (18 fields were specified)	0	15	6.76	2.61	660
Number of potential telephone lifelines	2	10	3.84	1.73	658
Number of close friends (without kin contacts)	0	30	9.20	6.01	641
Number of other friends (weak ties)	4	150	46.10	35.93	612
Number of siblings	0	9	1.54	1.28	659
Number of close relationships to relatives	0	25	8.69	5.39	628
Ask-the Audience lifeline used	0	1	0.95	0.21	649
Fifty-fifty-lifeline used	0	1	0.91	0.29	642
Phone-a-friend lifeline used	0	1	0.87	0.34	562
Helpful telephone lifelines (helpful = 1)	0	1	0.46	0.50	562
Question level at which telephone lifeline was used	4	15	10.18	1.81	549
Closeness of relation to telephone lifeline ^b	1	5	2.96	1.22	561

^a The average prize was calculated on the basis of a restricted sample taking only those contestants into account who participated after the currency change from German Mark to Euro.

^b The strength or closeness of a relationship was measured by adapting a suggestion of Marsden and Campbell (1984). Candidates were asked how close they feel to the selected telephone lifeline. The item has five answer categories ranging from "very close" to "not close at all" and is supposed to measure the emotional intensity of a relationship.

Degrees from applied universities are reached after 4 years, degrees from universities generally after 5 years.⁵ Universities of applied sciences offer labor market oriented special training while universities offer general academic education in natural or social sciences, or arts and humanities. In our sample 23% of the contestants had completed nine years of schooling, 27% reported that their highest qualification is a high school diploma, 16% had attended universities of applied sciences and 34% had visited universities. Comparing these sample proportions with the official statistics reveal that our sample consists, as expected, of educated individuals. 16% of the population of Germany (German Micro Census of 2003) have a university degree as compared with the 34% in our sample.

In addition to the standard measure of human capital, we also included a number of "soft" indicators of informal education. We asked respondents about the number of books they had read from the beginning of 2007 until the survey time (May 2007), and how many books they own. We also asked whether they were regular readers of daily newspapers and weekly and monthly journals. Finally, we asked them about areas in which they are knowledgeable. For this purpose the questionnaire listed 18 different competence areas such as physics, literature, pop music, classical music and so on. This list is identical to the list the production team uses for the show.

The surveyed contestants were a group of quite avid readers (see Table 1). They read on average 9.7 books during the first five months of 2007 and own on average about 690 books.⁶ 76% reported to be regular readers of newspapers and 57% read journals on a regular

⁵ The university system in Germany is in the process of being changed to the B.A./M.A. system. The B.A. can be achieved in 3 years, the M.A. in additional 2 years of study. However, the contestants surveyed in the present study had studied before the change was introduced and therefore hold degrees comparable to a master degree.

⁶ The median and mode of "books in household" is $\bar{x}=350$ and $M=300$. As a comparison, the German data of the PISA study 2003 reports a median category of 26–100 books.

basis. The average number of self reported competence areas was 6.8.

Next we describe the measurement of social capital. We used a variety of different indicators to measure the size of social networks. The questionnaire contained questions on the amount of close friends a contestant had; it also asked whom he/she would count as being acquaintances or not so close friends. Moreover we asked about the number of siblings and also for the estimated total number of relatives with whom a contestant has contact. Furthermore, the questionnaire collected information (on age, gender, education, occupation) about the three preselected telephone lifelines using a name interpreter. The contestants were also asked to name other potential lifelines if they would have had the option to select more, using a name generator.

Overall, the surveyed contestants have comparatively large networks. They provided on average 3.8 additional potential telephone lifelines, which in combination with the three pre-selected results in an average of 6.8 telephone lifelines. Another indicator of network size is the answers provided regarding the total number of strong and weak ties. Our respondents reported to have on average of 9.2 close friends and 46 weak ties. The average number of relatives a respondent is in contact with is 8.7. Thus, the name generator for the potential telephone lifelines indicated a much smaller network than the simple questions about the size. The averages concerning the latter measure indicate that the contestants of WWM are well embedded. Furthermore, we examined the heterogeneity of the network by gathering information via the name interpreter about gender, age, level of education, occupation and areas of competence of the preselected telephone lifelines and those who were additionally named.

5. The determinants of success

First, we will present some relevant descriptive results, followed by testing our hypotheses using OLS-regression and logistic regression models. Almost all candidates used all three lifelines during the

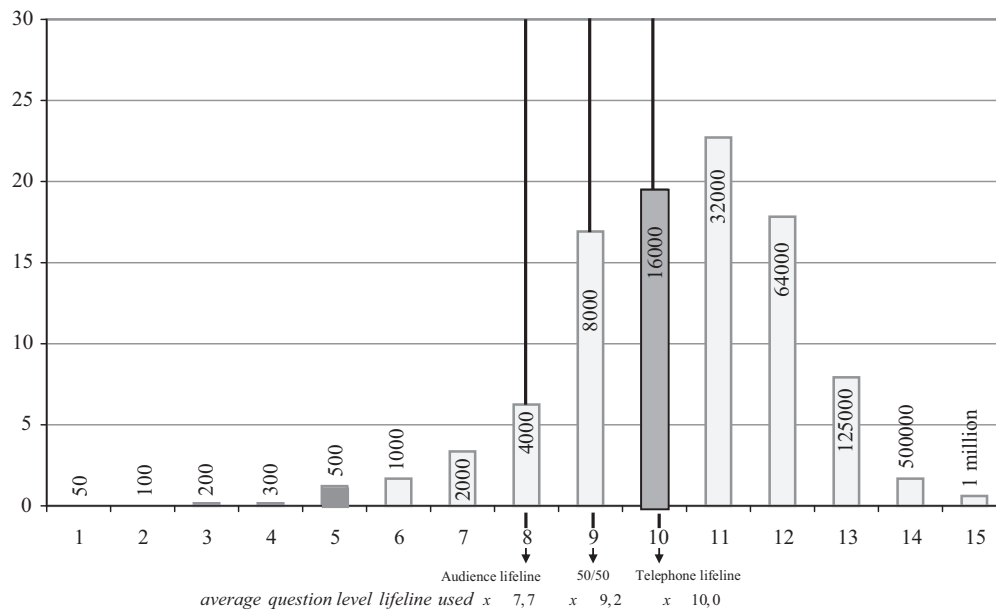


Fig. 1. Last question correctly answered.

quiz. 95% asked the audience for support, 91% used the Fifty–fifty lifeline, and 87% called the telephone lifeline for help. Fig. 1 displays the frequency distribution of the last correctly answered question. Additionally, the figure shows the order in which the three lifelines (vertical arrows) were applied. Usually the audience was asked first at around the 8th question, followed by the Fifty–fifty lifeline which was used on average for question number 9. The telephone lifeline was used last, usually for the 10th question.

The modal question correctly answered is the 32,000 Euro question (22.7%), while only few contestants reached questions number 14 or 15. The gray bars indicate the “security level”, that is, the sum to which participants went back when they answered higher question levels wrongly. Answering question number 10 for instance guarantees a payoff of 16,000 Euro. Hence, answering question 11 poses no risk since a wrong answer still results in a payoff of 16,000. However, a wrong answer at the 12th or higher question also results in an actual payoff of 16,000, which means that the last question answered correctly and the actual payoff can differ. Overall, 184 contestants left the show with real amounts of 16,000 Euro (28.2%). 107 reached 32,000 Euro (16.4%), and 102 candidates dropped back to the 500 Euro level (15.6%).

Success on WWM depends not only on the candidates themselves, but also on how they use the three lifelines. Not every lifeline is equally helpful for a candidate or leads automatically to the next question. It is therefore interesting to investigate how useful the lifelines proved to be. The results of this analysis are presented in Table 2. For every show the production team records how the audience performed when a candidate asked for its help on a question. Thus, for analyzing how well the audience performs we were able to use this process generated data. From the 1337 times the audience was asked, the majority vote erred only 147 times. Thus, the majority of the audience provided the correct answer 91% of the time. Unfortunately, the production team did not collect any information about the success of the other two lifelines and we therefore had to use our survey data for an equivalent calculation.

Overall, the Fifty–fifty lifeline decreased the error rate of the candidates substantially. Only 15.7% of all candidates still chose the wrong answer after using it. Finally, the telephone lifeline produced the highest error rate. 46% of the friends or acquaintances who were called by the candidates either did not know the correct answer or provided an incorrect answer. Of course,

Table 2
Error probabilities of lifelines according to question levels.^a

Question number:	Audience lifeline	Fifty–fifty lifeline	Telephone lifeline
1–5	0% (N=77) [0%, N=152]	0% (N=12)	0% (N=3)
6–10	1% (N=367) [7.7%, N=946]	6.1% (N=309)	28.6% (N=206)
11–15	38.7% (N=75) [31%, N=239]	45.3% (N=106)	69.4% (N=173)
1–15	6.2% (N=519) [11%, N=1337]	15.7% (N=427)	46% (N=562)

^a Statistics for the audience lifeline as provided by the production team are reported in brackets [] (N=1337). All other data were calculated from the responses to the written questionnaire. Due to item non–response concerning the question at which level exactly a specific lifeline was used, the number of valid cases differs from the total number of respondents.

comparing the overall error rates is not a fair comparison of the lifelines since these were used at different question levels. A fair comparison must therefore consider the level of difficulty. We asked for the question level at which the lifelines were used in our survey and the production team provided this information for the audience lifeline. We can therefore divide the fifteen questions into three groups, into easy questions (questions 1–5), more difficult questions (questions 6–10) and most difficult questions (questions 11–15). However, even comparing error rates within a certain level of difficulty reveals that the audience lifeline is the best one at every level, followed by the Fifty–fifty lifeline and then the phone–a–friend lifeline.⁷ The finding that the audience lifeline is the best lifeline is evidence for the “Wisdom of Crowds” phenomenon described by Surowiecki (2005) or respectively the averaging principle (e.g. Larrick and Soll, 2006): Averaging the estimates of many independent individuals is usually closer to the true value than the

⁷ This information is helpful for deciding which sequence of lifeline use is best in order to maximize the payoff: to gain a high prize, a candidate obviously has to avoid dropping out of the show. This risk is minimized when the candidates use their best lifeline first, followed by the second best and finally by the least effective. Interestingly, this is exactly the sequence that most candidates followed (see Figure 1).

Table 3
Determinants of success (OLS-regression).

	Model 1	Model 2	Model 3	Model 4
Age	0.017 (3.31)**	0.014 (2.63)**	0.008 (1.74)*	0.009 (1.90)*
Female (0/1)	−0.00 (−0.02)	0.01 (0.09)	−0.04 (−0.46)	−0.02 (−0.24)
Employed (0/1)	0.01 (0.10)	0.03 (0.27)	−0.01 (−0.07)	−0.03 (−0.28)
Children (0/1)	−0.39 (−3.33)**	−0.38 (−3.30)**	−0.23 (−2.41)*	−0.24 (−2.48)*
Number of siblings	0.11 (2.57)*	0.11 (2.62)**	0.09 (2.77)**	0.09 (2.71)**
High school diploma (0/1)	0.32 (1.35) [†]	0.22 (1.45)	0.25 (2.00) [†]	0.24 (1.95) [†]
University of applied science (0/1)	0.21 (1.29)	0.13 (0.79)	0.05 (0.36)	0.06 (0.41)
University degree (0/1)	0.53 (3.80)***	0.34 (2.34) [†]	0.24 (1.98) [†]	0.25 (2.07) [†]
Number of books (log)		0.12 (2.38) [†]	0.12 (2.61)**	0.10 (2.47) [†]
Number of competence areas		0.04 (2.10) [†]	0.05 (2.73)**	0.05 (2.75)**
Audience lifeline used (0/1)			0.84 (4.66)***	0.83 (4.62)***
Fifty–fifty lifeline used (0/1)			1.07 (4.50)***	1.07 (4.54)***
Telephone lifeline used (0/1)			1.23 (8.04)***	1.12 (7.07)***
Telephone lifeline provided correct answer (0/1)				0.24 (2.58) [†]
Constant	8.99 (34.85)***	8.15 (23.94)***	5.72 (16.83)***	5.73 (16.94)***
F-test	4.52***	4.97***	27.07***	25.80***
Corr. R ²	0.043	0.059	0.359	0.365
N	633	628	607	606

Note: OLS-Regression, we show unstandardized coefficients with *t*-values in brackets.

The model was tested for multicollinearity and heteroscedasticity. The VIF-Values vary between 1.03 and 1.90 and thus multicollinearity is not present. The White-Test for heteroscedasticity is not significant ($\text{Chi}^2 = 87.76$, $p = 0.89$). The distribution of the residuals is therefore homogeneous.

[†] $p < 0.1$.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

estimate of a single individual. Our finding suggests that the principle also applies to choosing the correct option from a number of given categories.

For the analysis of the determinants of success on WWM we used the last correct answer as the dependent variable, since this variable measures the contestants' productivity best. We transformed this variable into the associated monetary gains (see Fig. 1) and took the natural logarithm of it. However, our results remain stable if we take the actual amounts won by candidates as the dependent variable. The results of our analyses are displayed in Table 3. Model 1 of Table 3 takes some socio-demographic variables (age, gender, employment status), variables measuring family structure (children and siblings), and the human capital indicators into consideration. Model 2 integrates the "soft" indicators of human capital. Model 3 adds the use of each lifeline, and finally model 4 takes the effect of the telephone lifeline into account if he/she provided the correct answer.

Let us first turn to the socio-demographic variables. Neither age, gender, nor the employment status of the candidates is related significantly to their success. In the first equation age matters, but the significance level drops below the critical level in later models. However, whether contestants have children as well as the number of siblings have a significant influence. We hypothesized no clear effect with both variables. However, the estimates suggest that the net effect of having children decreases the success on the show and that having siblings has a positive effect on the development of the contestants' human capital.

Model 1 (and the other models) confirms the hypothesized effect of education (H_1). Individuals with a high school diploma received on average 38% ($(\exp 0.32) - 1) \times 100$) higher payoffs than individuals with a lower educational level, and a university degree increases payoffs by almost 70%. Both effects decrease in magnitude in later models when more variables are added. However, the effect of having a university degree remains significant and shows that education increases payoffs by 29% (model 4) on average as compared with candidates who did not complete high school. Interestingly, having a degree from a university of applied sciences seems to have no advantage over lower levels of education. This may be due to the fact that universities of applied sciences provide special training in very specific fields. Hence, this result suggests

that general education is more helpful on the show than special training.

Model 2 is enriched by the inclusion of soft indicators of human capital. From all the indicators gathered and described in the measurement section, the number of books owned by contestants and the number of self reported competence areas matter most (H_2). Participants who own 1% more books (we took the natural logarithm of the number of books in the household) receive a higher payoff of 0.1%. Also payoffs increase by 5% with every additional field of competence. Newspaper or journal reading, however, is not significantly related to performance (variables not shown in model 2).

In model 3 the level effects of using the lifelines are included into the regression. The use of a lifeline affects the payoff in two separate ways. First, using a lifeline indicates that a candidate reached a certain level in the quiz and did not drop out before he had the chance to use the lifeline. Second, using a lifeline may have helped them to answer the question correctly. These combined effects are displayed in model 3. Thus, using the audience lifeline (which most often was the first lifeline) increases payoffs by 130%. The Fifty–fifty lifeline leads to a higher payoff of about 190% on average, and the telephone lifeline to an increase of about 240%. Finally, model 4 separates the level effect from the effect of receiving a correct answer from the telephone lifeline. The level effect drops to 200% when we take into consideration whether the telephone lifeline knew the correct answer or not. If the correct answer was obtained from the telephone lifeline, the subjects' payoffs increased further by 27% as compared with the payoff of candidates who received a wrong answer. Thus, this effect denotes how much a correct answer contributes to the overall payoff of a candidate. It shows how useful a good telephone lifeline is on the show. However, not all telephone lifelines were successful; only about half of them could help the contestants. Therefore the effect says nothing yet about the value of having a good network. To answer that question, we have to analyze the relation between a candidates' network and the probability of choosing a telephone lifeline who can provide the correct answer.⁸

⁸ Since networks could also increase a candidate's knowledge (e.g. by exchanging trivia), we also included different network indicators (e.g. number of close friends) into model 4. However, none of the network variables were statistically significant.

Table 4

Socio-demographic information pertaining to the telephone lifelines.

Variable	Min.	Max.	\bar{x}	sd	N
Sex (female = 1)	0	1	0.23	0.42	559
Age of telephone lifeline	18	83	47.34	13.32	559
Education of telephone lifeline in years	9	17	15.16	2.53	535
Telephone lifelines with high school diploma	0	1	0.19	0.39	535
Telephone lifelines with university of applied science degree	0	1	0.11	0.31	535
Telephone lifelines with university degree	0	1	0.59	0.49	535

Table 5

Determinants of the selection of a successful telephone lifeline (logistic regression).

	Model 1	Model 2	Model 3
Level of use	−0.29 (31.88)***	−0.28 (27.99)***	−0.29 (24.64)***
Age		−0.006 (0.87)	−0.005 (0.41)
Gender (female = 1)		−0.26 (1.35)	−0.19 (0.64)
Education (years)		0.01 (0.05)	−0.02 (0.29)
Number of potential lifelines			−0.07 (1.75)
Number of other friends			0.00 (0.08)
Number of strong ties (friends)			0.04 (4.82)*
Number of strong ties (relatives)			−0.04 (3.52)
Closeness of relation to phone lifeline			−0.01 (0.01)
Intercept	2.85 (28.41)***	2.98 (14.21)***	3.61 (14.99)***
Cox/Snell	0.062	0.065	0.081
Nagelkerke	0.083	0.087	0.109
N	548	514	453

Note: Displayed are the logistic regression coefficients with the Wald-statistic in brackets.

All models were tested for multicollinearity (by a method suggested by Menard, 1995, p. 66).

* $p < 0.05$.*** $p < 0.001$.

According to our hypotheses the success probability of a telephone lifeline depends on the one hand on the knowledge of the lifeline, and on the other hand on the ability of the candidate to pick a person from his network who matches the quiz questions. To look at this, we first display some descriptive information about the chosen telephone lifelines in Table 4. Obviously, the telephone lifelines chosen were predominantly older males with a college or university degree.

To analyze the success chances of the telephone lifeline we applied a logistic regression. The dependent variable indicates whether the telephone lifeline knew the correct answer (coded as 1) or not (coded as 0). The results of these analyses are displayed in Table 5. 261 telephone lifelines gave the correct answer, while 301 telephone lifelines were not able to help the contestant. First, model 1 in Table 5 shows the influence of the question level: naturally, a higher question level should reduce the chances of the telephone lifeline being helpful due to the difficulty of the question. This assumption is confirmed since the logit coefficient indicates that the chances of a correct answer decreases with higher question levels. In model 2 we have added socio-demographic variables of the telephone lifeline. Age and gender are not related to the probability of providing the correct answer. Also, none of the human capital indicators such as the educational level of the telephone lifeline is significantly related to the probability of giving a correct answer (not all shown in Table 5). At first glance this finding is counter-intuitive since one would expect more educated telephone lifelines to be more likely to provide correct answers. However, the result indicates that education may not be the only crucial factor but rather whether a telephone lifeline's knowledge is relevant for answering a question.

In model 3 of Table 5 we test the network hypotheses with a series of the candidates' network characteristics collected in the questionnaire. Concerning network size we hypothesize that large networks should be beneficial for a good choice of a telephone lifeline (H_3). We did not obtain any statistically significant result using the number of named potential lifelines in the name generator. However, the more strong ties a candidate reported to have, the

higher the chance that the chosen telephone lifeline did provide the correct answer (H_4). The effect of the number of strong ties on the probability of providing the correct answer was calculated by plugging the estimated logit coefficient (0.044) into the logit equation ($(p(y=1) = e^x / (1 + e^x))$) while setting all other metric variables to their averages and all dichotomous variables to their reference category (0). As can be seen from the graphical presentation in Fig. 2 the effect of network size on the probability that the telephone lifeline provided the correct answer is quite substantial. The probability of the lifeline providing the correct answer increases from about 0.38 if he was chosen from a very small network to 0.68 if he was chosen from a large network of 30 contacts.⁹

The number of weak ties (other friends) or the closeness of the relationship between the candidate and the telephone lifeline is not statistically related to the probability of providing the correct answer. Thus, the weak tie argument is not confirmed in this analysis. On the contrary, our results seem to suggest that close contacts are on average more helpful as telephone lifelines. One of the reasons for this might be that a candidate has to know a potential telephone lifeline relatively well in order to be able to judge whether he/she can help. We also hypothesized that heterogeneous networks are more helpful than homogeneous networks (H_5). To test this hypothesis we constructed various measurements of network heterogeneity such as the heterogeneity with respect to education, occupational prestige, age, sex or the competence areas among the three telephone lifelines. We also tested whether it makes a difference if a candidate and the chosen telephone lifeline are different with respect to these variables or, whether the average of the three pre-selected lifelines differs from the candidate. However, none of these measurements is significantly related

⁹ In addition to the variables displayed in Table 5 we also tested whether the socio-demographic information or the educational degree of the contestants had any influence on their choice of a successful telephone lifeline. However, none of this was significantly related to the probability of the phone lifeline providing the correct answer.

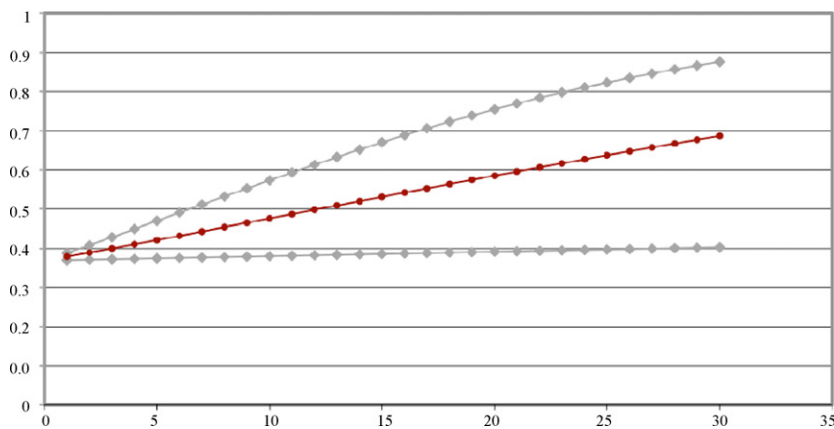


Fig. 2. The probability of receiving the correct answer from the telephone lifeline conditional on the number of contestants' strong ties. *Note:* Gray lines denote the boundaries of the 95% confidence interval.

to a successful lifeline choice (results not shown). Thus, our arguments about the usefulness of heterogeneous networks were not confirmed.

6. Summary and discussion

This study investigates the question which candidates are successful on the TV show “Who Wants to Be a Millionaire?”. We focused on two theoretical approaches, on human capital and social capital theory. The results clearly demonstrate a human capital effect. On average a university degree increases a contestant's payoff on WWM by almost 30% as compared with a basic school degree. Furthermore, a few informal measurements of human capital, such as the number of books owned by contestants, or the number of their areas of competence are also linked to success on the show. Since unobserved personality characteristics have presumably little or no impact on contestants' performance on the quiz show the findings strongly support human capital theory. This does not imply that signaling has no effect within other environments, (e.g. on the labor market), but it does demonstrate that formal and informal education increase productivity at least within the environment of the quiz show in question. Our study may underestimate the benefits of human capital because contestants on the show are a selected group of relatively highly educated individuals; we therefore cannot say how individuals who are less educated would have performed. The proportion of individuals with a university degree on the show is about twice as high as in the German population. However, there is no straightforward method to correct this selection bias in the study as we lack information about applicants who did not survive the screening process.

Our second finding concerns the effect of social capital. Labor market studies investigating the monetary benefits of finding jobs through network contacts usually deliver inconclusive results. This is partly due to the fact that the measuring of the advantage of social capital in surveys is confronted with a number of problems. However, measuring the benefit of social capital in WWM is fairly straightforward. Some candidates (about half) have helpful personal contacts who provide them with the correct answer. The correct answer from a phone-a-friend lifeline increases the monetary reward on average by 27%.

Moreover, choosing a helpful telephone lifeline is not only determined randomly but is also linked to certain network characteristics. Our finding suggests that the size of the contestants' networks matters. The larger the number of strong ties a candidate has, the better the chances that he/she will choose a helpful telephone lifeline who can provide the correct answer. The fact that strong ties matter does not necessarily imply that the closeness

of the relation is essential. Contestants' closeness to the telephone lifeline is not significantly associated with the probability of him/her obtaining a correct answer. Thus, either we have a bad measure of closeness, or having many strong ties in the network is helpful because these close friends provide information to the contestant about whom to choose as a telephone lifeline.

Of course, “Who Wants to Be a Millionaire?” does present a unique social environment. The sizes of the estimated coefficients depend on the rules of the game. Hence, if the rules were to change (e.g. the show would allow two telephone lifelines), the combined effects of the two lifelines would be different from our evaluation of how useful a single lifeline is. Furthermore, the questions are presented in a certain format. If the number of answers provided were to be increased, for instance, to eight, guessing would be less successful than in the present version of the show. Hence increasing the number of answer categories should also increase the effect of human capital. Thus, the size of our coefficients certainly cannot be generalized to other types of social environments, or even to other types of game shows. However, the advantage of the chosen design is that it allows submitting some hypotheses derived from human capital and social capital theory to a test that differs from the usual areas of application. The results of this study demonstrate that human capital and social capital are also valid for examining this specific social environment and therefore provide additional evidence for the validity of both theories.

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