The Impact of the COVID-19 Lockdown on Parents and their Adolescent Children in Relation to Science Learning

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Abstract
With the transition to distance-learning at the beginning of the COVID-19 outbreak, several countries required parents and their children to remain at home, under lockdown. Many parents found themselves taking on additional responsibilities regarding their children’s education. However, children do not always interpret their parents’ intentions as they intended. This study investigated this complex relationship, showing that parents’ emphases regarding science learning changed during the first COVID-19 lockdown and in parallel, the relations between these emphases and their adolescent children’s goal orientation and self-efficacy toward science learning also changed. In 2019, one year before the COVID-19 lockdown, the children’s mastery and performance orientations toward science, and their self-efficacy in science were significantly correlated with their parent’s attitudes toward science. In 2020, shortly after the end of the first COVID-19 lockdown, these relations remained significant, but in addition the parents’ emphasis on performance became a significant predictor of the children’s mastery and performance orientations, and of their self-efficacy in science. A small increase in the children’s performance orientation and self-efficacy in science was seen, and only a small decline in their mastery orientation toward science. These findings contrast with what the literature indicates is typical at this age, when there are no lockdown conditions.

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Introduction

During the COVID-19 pandemic, children in Israel and in many other countries (Daniela et al., 2021) were required to stay home and could not go to school, often also could not visit friends. As schools and friends became physically and emotionally more distant, the role of parents in their children’s formal education increased. Parenting attitudes have a significant impact on their children’s attitudes toward many things, including science learning (Breakwell & Beardsell, 1992; Kang & Yoo, 2015). Gottfried et al. (2016) and Rozek et al. (2015) stressed that not enough has been done to connect and leverage the existing bond between parents and children to strengthen the learning of science.

This study serendipitously emerged from a larger study on adolescence and the decline in students’ motivation to learn science, when the COVID-19 pandemic began. We realized, from our discussions with teachers, parents, and students, that the outbreak of COVID-19 changed the ways in which students were learning and perhaps also changed their attitudes towards learning (Bubb & Jones, 2020; Delès, 2021; Morse et al., 2022). The emergence of the COVID-19 pandemic had a detrimental impact on our original study design. However, we also recognized that this change provided an opportunity to analyze part of the data we had collected in an entirely different direction than we had originally intended. We hypothesized that the COVID-19 pandemic may have led to a shift in the relations between parents’ attitudes and motivational emphases (in our study, academically educated parents) and different aspects of their adolescent children’s motivation toward science learning. The research questions for this study were:

1. How did adolescent children’s motivation and self-efficacy toward science learning change during the first COVID-19 lockdown? How did their academically educated parents’ attitudes and motivational emphases toward science change during the lockdown?
2. What are the relations between the attitudes and motivational emphases toward science of academically educated parents and their adolescent children’s self-efficacy and motivation toward science learning? How did these relations change during the first lockdown of the COVID-19 pandemic?

Adolescents’ Declining Motivation to Learn Science

As known from previous studies, both the attitudes toward science – “the feelings, beliefs and values held about an object that may be the enterprise of science, school science, the impact of science on society or scientists themselves” (Osborne et al., 2003, p. 1053) – and the motivation to study science – “the process whereby [science-related] goal-directed activities are instigated and sustained” (Schunk et al., 2012, p. 5) – tend to decline during adolescence (Vedder-Weiss & Fortus, 2012; Osborne et al., 2003). This is evident in many countries (Archer et al., 2010) and in both genders. The decline sometimes starts with the transfer from elementary to middle school (Lee et al., 2016; María & José, 2020), but it can begin as early as the third year of elementary school (Toma et al., 2019; Tröbst et al., 2016). Breakwell and Beardsell (1992) showed that children tend to develop more negative feelings about science learning as they gain more experience with school science, even when controlling for the effect of peers and parents. This decline has many reasons,
including lack of curricular relevance (Basu & Barton, 2007), teachers and schools emphasizing performance on tests over the development of deep understanding and the sense of mastery (Vedder-Weiss & Fortus, 2013), and focusing more on bookwork rather than hands-on activities as students grow older, against students’ expectations and desires (Dorfman & Fortus, 2019).

The decrease in students’ motivation and attitudes toward science are especially concerning because there is a stronger correlation between the choice of a career in STEM and having positive science learning experiences in school than with science achievement in school (Bonnette et al., 2019; DeWitt et al., 2013). Another issue that may increase the disengagement of students from science is the socio-cultural stigma that marks “science people” as geeks, nerds, and “weirdos” (Archer et al., 2010; Kelly, 2019; Starr, 2018). Young people today are less focused on “what do you want to do” and more oriented toward “who do you want to be” (Barmby et al., 2008). When students feel that their peers appreciate their ability to understand science, their engagement in science classes, their self-efficacy, and their motivation to continue learning science is higher (Vedder-Weiss & Fortus, 2013). Students do not spend as many hours in school as we may think. Averaged over the entire year (not a pandemic year), including holidays and vacations, a student is at school about four hours a day (Archer, Dewitt, & Osborne, 2015b; Feder et al., 2009). This means that out-of-school influences may play a greater role in shaping students’ science identities than school science (Caspi et al., 2020; Taylor, 2019). Students can engage today with science in after-school activities, TV shows, magazines, YouTube videos, science fairs, science centers, and many other ways (Dierks et al., 2016).

Several studies showed that an interest in science, which can develop into a career choice, often begins to develop at a young age (e.g., Archer et al., 2010; DeWitt et al., 2013). A 2006 survey of people who were professionally involved with STEM (Tai et al., 2006) found that 28% of them knew that they wanted to work in STEM already when they were 11 years old (Tai et al., 2006). On the other hand, a study of several thousand students showed that many of them had, already by age 14, a clear idea that they did not aspire to a career in science (Bonnette et al., 2019; DeWitt et al., 2013). These findings show that many students have a sense of direction early in life (Scholes & Stahl, 2020). These findings emphasize the importance of early adolescence as years that shape students’ attitudes toward the sciences. As will be described in a different section, parents have significant influence on their children during these years.

Another important aspect that has a great influence on motivation and continuing engagement with science is science self-efficacy (Ames & Archer, 1988). Students’ science self-efficacy – “people’s judgments of their capabilities to organize and execute courses of action required to attain designated types of performances [in science]” (Bandura, 1986, p. 391) – has great influence on their enjoyment of science learning and on their aspirations to increase their knowledge in science (Ainley & Ainley, 2011). Science self-efficacy is strongly related to success in school science and is a strong predictor of choosing to major in science and seeking a career in science (Avargil et al., 2020; Authors). Children’s science self-efficacy is strongly influenced by their parents’ and teachers behavior, conduct, and the messages they relay (Eccles et al., 1993), such as creating situations that offer students opportunities to feel success/failure in science-related endeavors, providing supporting/undermining messages to students’ regarding their abilities in science, with girls tending to exhibit lower science self-efficacy than boys (Foeken, 2018). This emphasizes the importance of teaching science in a way that enhances students’ science self-efficacy (Archer et al., 2010).
Parents, Adolescents, and Science Learning

Parents’ involvement in their children’s science education is a major contributor to their children’s science capital (Archer, Dawson, et al., 2015a). The ways in which parents spend time with their children in diverse activities can affect the pathway of their children in the future in relation to science (Chakraverty & Tai, 2013), especially since children may develop an interest in science at an early age (Maltese & Tai, 2010). There is a positive association between a family’s attitude toward science learning and a child’s self-efficacy in science (Turner et al., 2004). This effect is seen across nations and cultures: children who grow up in a science-supportive home are more likely to develop an appreciation and an early interest in science (Chakraverty & Tai, 2013; Kang & Yoo, 2015). Studies have shown that parental worldviews influence their children (Gutman & Eccles, 2007; Šimunović & Babarović, 2021), shaping and changing their children’s experiences regarding science learning and in other areas as well (Fredricks et al., 2006).

Adolescence is a challenging period of time for parents and for the adolescents themselves, for example, involving school transitions and changing roles with peers and families (Gutman & Eccles, 2007). Despite these challenges, the interactions between parents and their adolescent children significantly influence how the adolescents develop and what they strive to become. While other significant individuals and environmental factors, such as siblings, peers, schools, teachers, and informal activities also influence adolescents’ development (Gottfried et al., 2016; Gutman & Eccles, 2007), it appears that the parents’ conduct is the most influential factor on their children’s self-efficacy, interest, and motivation (Gutman & Eccles, 2007). This holds despite the fact that adolescents do not always understand their parents as their parents intended (Gutman & Eccles, 2007; Smetana, 1988, 2000).

Parental and Family Attitudes

Students’ attitudes to sciences are strongly related to their parents’ attitudes. Students’ families can offer supportive experiences and foster the belief that doing science is a possibility (Gilmartin et al., 2006; Wang et al., 2020). Parental physical and emotional involvement can have important influence on academic development and career choice in science (DeWitt & Archer, 2015; Šimunović & Babarović, 2020). An accessible family member that works in science or a science-related profession can inspire and encourage interest in the same field (Franse et al., 2020; Gilmartin et al., 2006).

If students experience a disappointment in one or more of their science learning environments, the parents have an important and critical role to help keep the student engaged in science despite the disappointment (Aschbacher et al., 2010; Halim et al., 2018). Specifically, Hoferichter and Raufelder (2019) demonstrated that girls’ performance in math and biology was related to their parents’ support, clearly showing the impact of parental influence on their children’s STEM aspirations and studies.

Home-Schooling

The number of families all over the world choosing home-schooling for their children is rising, with many families preferring this form of education over formal education systems (Bachman, 2011; Blok, 2004; Murphy, 2014). Farris and Woodruff (2000) found that children who attended home-schooling tended to be more academically advanced than their
peers who participated in regular schools and were admitted in similar frequencies to the same degree programs at the same colleges as their traditionally educated peers; they also found that home-schooled students graduated from their colleges at a higher rate than traditionally educated students. Collom (2005) and Bachman (2011) indicated that parents with academic backgrounds tended to expect higher academic achievement of their home-schooled children than non-academic parents (Collom, 2005). It should be noted that the only statistical index that distinguished parents who chose home-schooling for their children from parents who sent their children to traditional schools was dissatisfaction with the formal education system. All other indexes, such as academic background, race, socio-economic status, etc., did not predict the choice of home-schooling (Collom, 2005; Murphy, 2014).

Only a few studies have investigated home-schooling in the sciences (Bachman, 2011; Weinhandl et al., 2021). Bachman (2011) found a difference between the educational approaches of parents with an academic background and those without: parents with an academic background taught their children science more theoretically and abstractly, while parents without an academic background taught science more experimentally. This difference may be related to home-schooled children’s motivation and self-efficacy toward science learning.

Guided Home-Schooling During the Lockdown

The term home-schooling was used to describe the learning environment in many countries during the COVID-19 lockdown (Bubb & Jones, 2020; Weinhandl et al., 2021). However, to say that what occurred in Israel was traditional home-schooling (Collom, 2005) is inaccurate. Perhaps it should be referred to as guided home-schooling. Instruction and guidance were provided by teachers but overseen and realized by the parents, who took the tasks and requirements of the teachers and supported their children in doing them at home. It is understandable why the term home-schooling was commonly used when talking about learning during the lockdown. Schooling was done at home, parental involvement was substantial, sometimes determining the pace of learning. Parents had a great deal of autonomy in directing their children’s learning. Parents were much more involved in their children’s learning than in traditional school settings. These are traditional cornerstones of home-schooling (Blok, 2004; Murphy, 2014).

From the studies published to date that deal with the COVID-19 pandemic and parental involvement in distance learning, it appears that parents had an impact their children’s learning (Daniela et al., 2021; Thomas & Rogers, 2020). Bubb and Jones (2020) indicated that in many cases the relationships in the teachers–parents–child triangle were strengthened. Some parents learned to recognize and cherish the work of teachers more than before (Bubb & Jones, 2020) and many parents were heavily involved in teaching their children science (Daniela et al., 2021).

Goal Orientation Theory

This study draws on one of the main motivation theories, achievement goal theory (Ames, 1992) which focuses on how and why students engage in academic activities. This theory has been widely used in prior studies on adolescents’ motivation to learn in general and in science in particular (e.g., Kaplan & Maehr, 2007; Vedder-Weiss, 2017), and served as the theoretical underpinning for a series of studies on the motivation to engage with science.
done by the authors (Vedder-Weiss & Fortus, 2011, 2013, 2018; Fortus & Daphna, 2020) whose findings provided the impetus for the larger investigation from which this study emerged. There have been several versions to this theory. The earliest ones distinguished between two types of goals (e.g., Ames, 1992) – mastery oriented goals and performance-oriented goals. Later versions distinguished between three types of goals – self-oriented goals, task-oriented goals, and others-oriented goals (e.g., Elliot et al., 2011; Elliot & Hulleman, 2017). In some situations it has been useful to distinguish between two valences – approach and avoidance – for each type of goal (Elliot & McGregor, 2001), leading to 2 x 1, 3 x 1, 2 x 2, and 3 x 2 models. Elliot and Hulleman (2017, p. 50) state that, “… by no means is a later model meant to make obsolete a former model; a researcher’s specific question of interest should dictate the goal model on which he or she focuses. Likewise, … using a subset of the goals from a particular model that match one’s research question is a sensible empirical strategy.” In this study we chose to focus on the 2 x 1 model for two reasons: (A) we felt comfortable ignoring the avoidance valence because we did not expect parents to encourage avoidance behavior in home-based learning, and (B) it has been used successfully in the past with adolescents (Ames & Archer, 1988).

Accordingly, we considered two goal orientations: mastery goals orientation and performance goals orientation. A mastery goal oriented student strives to develop competence, understanding and skills, to achieve a sense of mastery (Ames, 1992). Many desirable learning characteristics, such as seeing science as something of intrinsic value (DeBacker & Nelson, 2000), the desire to learn new things or to master a task (Meece & Holt, 1993), enthusiasm, interest, and involvement (Patrick & Yoon, 2010), persistence (Elliot et al., 1999), and transfer of problem-solving strategies (Bereby-Meyer & Kaplan, 2005), have a positive relation with mastery goals; it should therefore be fostered by parents, teachers, and schools. Past studies have identified a decline during adolescence in students’ mastery goal orientation in science and other domains (Anderman & Midgley, 1997; Vedder-Weiss & Fortus, 2011, 2012).

On the other hand, performance-oriented people are concerned with others’ perceptions of their competence and with their ability relative to others (Ames, 1992). The evidence regarding performance-oriented goals is inconclusive (Harackiewicz et al., 1998; Urdan, 1997). When performance-approach goals were coupled with mastery approach goals, they too led to desirable outcomes (Pintrich, 2000). Students are not either mastery or performance oriented. They can be variously oriented toward each goal simultaneously (Kaplan & Maehr, 2007).

Due to the changes in the ways in which science was taught and learned during the first COVID-19 lockdown, enhancing the role of parents in their children’s formal science education while distancing students from their schools and teachers, we hypothesized that the COVID-19 lockdown may have led to shifts in parents’ educational emphases and to students’ goal orientations and self-efficacy toward science. This study aimed to investigate this hypothesis.

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1 For example, a 2 x 1 model includes two goal orientations, mastery orientation and performance orientation, while a 3 x 2 model addresses six different goal orientations: self-approach orientation, self-avoidance orientation, task-approach orientation, task-avoidance orientation, others-approach orientation, and others-avoidance orientation.
Methods

Population

The sample consisted of 32 Israeli children, 15 girls with an average age of 11.1 (SDEV 0.6) years and 17 boys with an average age of 12.7 (SDEV 0.7) years, and one of their parents. The participants were recruited by a notice on the campuses of two universities and signed an informed consent form. As mentioned in the introduction, this study was a spin-off of a larger investigation that ran into obstacles caused by the COVID-19 pandemic. In the larger investigation, we studied children who were at the very start of adolescence and one of their parents. At least one of the parents was required to have a strong academic background, to control for an issue that was relevant to us in the original study. Thus, the child–parent dyads were selected according to the children’s age (early adolescents) and one of their parents’ education, which typically was an MSc or PhD, usually in science.

Most of the female students in the sample were elementary school children, which typically runs in Israel from 1st to 6th grade. Most of the male students in the sample were from junior high schools that run from 7th until 9th grade. Science is typically taught in Israeli elementary schools by teachers with a general education degree specializing in science but not a bachelor’s degree in science. In junior high schools, teachers usually have a bachelor’s degree in science.

Instruments

In March 2019, before the outbreak of COVID-19, parents answered a short questionnaire regarding their attitudes and motivational emphases toward science learning. In parallel, their adolescent children answered a survey about their goal orientations and self-efficacy toward science. The same questionnaire and survey were re-administered a year later, at the end of May 2020, shortly after the first COVID-19 lockdown in Israel ended.

Parents’ Questionnaire

The questionnaire completed by the parents was in Hebrew and was drawn from a study by Vedder-Weiss (2012), which in turn was adapted from a study by Midgley et al. (2000). For example, if an item from the study by Midgley et al. (2000) was “My parents would like me to do challenging class work, even if I make mistakes”, it was changed into “I would like my child to do challenging science work, even if s/he makes mistakes.” The questionnaire measured the following constructs: emphasis on mastery orientation in science (MAS) – 7 items, emphasis on performance orientation in science (PER) – 4 items, and general attitudes toward science and scientists (ATT) – 5 items. The questionnaire was composed of 5-level Likert-type statements, with the following levels: completely disagree, disagree, not sure, agree, and completely agree. See Table 1 for example items.

Children’s Survey

The survey completed by the children was in Hebrew and was based on existing scales drawn from a study by the Vedder-Weiss and Fortus (2011), which in turn, like the parents’ questionnaire, was drawn in part from a study by Midgley et al. (2000). The validity and
| Instrument          | Construct               | Item                                                                 |
|---------------------|-------------------------|----------------------------------------------------------------------|
| Children’s survey   | Mastery orientation     | It’s important to me to understand what we are learning in science   |
|                     | Performance orientation | It’s important to me to get higher grades than my classmates in science|
|                     | Science self-efficacy   | I can understand even the hardest subjects in science                |
| Parents’ questionnaire | Emphasis on mastery    | I would like my child to do challenging science work, even if s/he makes mistakes. |
|                     | Emphasis on performance | I want my child to show the teacher and the other students that s/he is very good at science |
|                     | Attitudes toward science and scientists | Scientists are interesting and important people |
reliability of the scales in this survey have been reaffirmed in numerous studies across different contexts (Vedder-Weiss & Fortus, 2011, 2012, 2013, Fortus & Vedder-Weiss, 2014; Fortus & Daphna, 2017; 2019). The survey measured the following constructs: mastery orientation in science, performance orientation in science, science self-efficacy, and several other constructs that were relevant to the original larger investigation but played no role in this particular study. The questionnaire was composed of 5-level Likert-type statements, with the following levels: completely disagree, disagree, not sure, agree, and completely agree. See Table 1 for example items.

**Analysis**

Exploratory factor analysis (EFA) with varimax rotation was done separately on the data collected by the parents’ questionnaire and by the students’ survey on the entire dataset of the larger investigation (hundreds of participants) of which this study was a spin-off. This analysis identified three factors in the parents’ questionnaire, coinciding with an emphasis on mastery, and emphasis on performance, and attitudes toward science and scientists, and three different factors in the students’ survey, coinciding with mastery orientation, performance orientation, and science self-efficacy. The loadings of the various items on each factor for the parents’ questionnaire is given in online supplement S1, while the same information for the children’s survey is given in online supplement S2. Cronbach alpha was calculated for each construct; all were above 0.6, reaffirming the scales’ internal consistencies – see Table 2.

Based upon the loadings of the various items on their factors, individual values for each construct were calculated for the parents and the students. All constructs were normally distributed, with absolute values of skewness and kurtosis smaller than one, allowing the use of parametric tests. Paired t-tests were used to compare pre-post COVID-19 results. The following models were tested using multiple linear regression to identify relations between parental constructs and the children’s constructs:

\[ \text{Mastery}_{\text{Children}} = \beta_1 \text{MAS} + \beta_2 \text{PER} + \beta_3 \text{ATT} + \beta_4 \]

\[ \text{Performance}_{\text{Children}} = \beta_5 \text{MAS} + \beta_6 \text{PER} + \beta_7 \text{ATT} + \beta_8 \]

\[ \text{Science Self Efficacy}_{\text{Children}} = \beta_9 \text{MAS} + \beta_{10} \text{PER} + \beta_{11} \text{ATT} + \beta_{12} \]

Here MAS is the parents’ emphasis on mastery, PER is the parents’ emphasis on performance, and ATT is the parents’ attitudes toward science and scientists.

| Table 2 | Structure and reliability of constructs |
|---------|----------------------------------------|
|         | Parents’ questionnaire                  | Children’s survey                        |
|         | Emphasis on mastery | Emphasis on performance | Attitudes toward science | Mastery orientation | Performance orientation | Self-efficacy |
| Number of items | 4 | 5 | 4 | 3 | 3 | 4 |
| Cronbach alpha | .61 | .69 | .64 | .71 | .70 | .88 |
Results

It is important to note that although the sample size is small, we can see a clear trend in the data. Paired t-tests indicated that the children’s mastery orientation in science, performance orientation in science, and their self-efficacy in science did not change significantly between 2019 and 2020 – see Table 2 for statistical details (RQ1). This contrasts with prior studies (e.g., Vedder-Weiss & Fortus, 2011) which identified, for this age group, significant decreases in children’s mastery orientation in science and in their self-efficacy in science over a period of 12 months with “normal” school-based instruction, prior to the outbreak of COVID-19.

Paired t-tests identified no significant change to the parents’ emphasis on mastery or to their attitudes toward science and scientists, but there was a small significant increase to their emphasis on performance – see Table 3 for statistical details.

In 2019, before the COVID-19 lockdown, when instruction was still being held face-to-face at schools, the children’s mastery orientation in science, their performance orientation in science, and their self-efficacy in science were significantly predicted by their parents’ attitudes toward science and scientists (ATT), but not with their parents’ emphasis on mastery (MAS) or on performance (PER) – see Table 4.

Table 3 Changes in means from 2019–2020 pre- to during COVID), t-test results

|                | Mean (SDev) 2019 | Mean (SDev) 2020 | t-value, degrees of freedom, and significance |
|----------------|-------------------|-------------------|-----------------------------------------------|
| Children       |                   |                   |                                               |
| Mastery        | 3.63 (0.91)       | 3.57 (1.12)       | t = -.37, df = 26, n.s.                       |
| Performance    | 3.70 (1.05)       | 3.72 (1.19)       | t = .09, df = 26, n.s.                        |
| Self-efficacy  | 3.88 (1.02)       | 3.93 (0.98)       | t = .85, df = 26, n.s.                        |
| Parents        |                   |                   |                                               |
| Mastery        | 9.78 (0.69)       | 9.68 (0.58)       | t = -.92, df = 27, n.s.                       |
| Performance    | 8.72 (2.31)       | 9.36 (2.27)       | t = 1.7, df = 27, *                          |
| Attitudes      | 10.63 (1.44)      | 10.69 (1.74)      | t = .23, df = 27, n.s.                       |

1* = p < .05; n.s. = non-significant

Table 4 Parents’ emphases predicting children’s motivation, linear regression results

|                  | Mastery | Performance | Attitudes |
|------------------|---------|-------------|-----------|
|                  | 2019    | 2020        | 2019      | 2020    |
| Children         |         |             |           |         |
| Mastery          | β₁ - n.s. | β₁ - n.s.  | β₂ - n.s. | β₂ = .49, ** | β₃ = .44, * | β₃ = .54, ** |
| Performance      | β₅ - n.s. | β₅ - n.s.  | β₆ - n.s. | β₆ = .44, * | β₇ = .50, ** | β₇ = .42, * |
| Self-efficacy    | β₉ - n.s. | β₉ - n.s.  | β₁₀ - n.s.| β₁₀ = .45, * | β₁₁ = .68, *** | β₁₁ = .45, * |
|                  |         |             |           |         |

2* = p < .05; n.s. = non-significant; df = 26
In 2020, immediately after the first COVID-19 lockdown, when instruction was done through distance learning at the children’s homes, both the parents’ attitudes toward science and scientists (ATT) and their emphasis on performance (PER) were significant predictors of their children’s mastery and performance orientation in science and of their self-efficacy in science; the parents’ emphasis on mastery was not a significant predictor of their children’s goal orientations and self-efficacy toward science – see Table 4.

Thus, during the short period of the first lockdown, while there were no significant changes to the parents’ emphases and attitude, we see a small realignment between the parents and the children, with the children becoming more attuned to their parent’s...
emphasis on performance than before the lockdown, with a shift from insignificant relations between the parents’ emphasis on performance and their children’s goal orientations and self-efficacy in science, to significant relations. Figures 1, 2, and 3 highlight these shifts and show how these relations changed during the first lockdown of the COVID-19 pandemic (RQ2).

Discussion

The findings of this study illuminate an interesting interaction between academically educated Israeli parents and their children in relation to learning science that developed during the COVID-19 pandemic.

Data for this study were collected in two waves, the first a year before the outbreak of the COVID-19 epidemic in Israel, the second a year later, shortly after the first lockdown ended. Until the first data collection wave, the children who participated in the study received their formal science instruction at school, in face-to-face instruction. In the months preceding the second data collection wave, the children received their formal instruction, in science and in all other subjects, at their homes, through distance learning. During the lockdown, many parents around the world reported that they served as their children’s teachers (Thomas & Rogers, 2020; Weinhandl et al., 2021), replacing the formal science teachers as the adults responsible for the children’s formal science education (Bubb & Jones, 2020; Daniela et al., 2021). This shift led to diverse and interesting outcomes. In this study we looked at the motivational changes and emphases regarding science that developed in the children and their parents and in the relations between the two. Comparing the two data collection waves made it possible to get a look at the impact of the change that parents and children felt during their stay at home in the context of online science learning.

The only change in the parents’ motivational emphases was a small increase in their emphasis on performance. A related finding was described by Bachman (2011) who showed that educated parents emphasize performance in STEM with their home-schooled children more than non-academic parents. In our study the parents all had strong academic backgrounds, with an MSc or higher, often in science. We hypothesize that this increase resulted from the parents realizing that they were now, while learning from home, the primary adults responsible for their children’s achievements in science (Bubb & Jones, 2020; Daniela et al., 2021).

In 2019, before the lockdown, only the parents’ attitudes toward science were related to their children’s goal orientation and self-efficacy toward science, while in 2020, after the lockdown, the parents’ emphasis on performance joined their attitudes toward science as a significant predictor of their children’s motivation and self-efficacy. Simpkins et al. (2012) showed that parents’ actions and intentions have a significant influence on their children’s self-efficacy in mathematics and in other fields. Parents and especially mothers, were more involved in their children’s learning at home during the pandemic (Daniela et al., 2021). We assume that increased parental involvement in their children’s learning occurred as well in the families that participated in our study, but we have no direct evidence verify this. In parallel with the parents becoming aware that they were now the main adults responsible for their children’s science achievement, the influence of the science teachers’ emphasis on performance decreased because the teachers were now more distant, making the children more attuned to their parents’ emphasis on performance.
In parallel, we did not see the drop in mastery orientation and self-efficacy in science that is typical for children of these ages (Vedder-Weiss & Fortus, 2011; Dorfman & Fortus, 2019), even though there was no increase in the parents’ emphasis on mastery. We believe this may be primarily due to the distancing of the school and the science teachers, which increased the relative influence of the parents’ emphases, even though these emphases may not have changed. In general, the parents viewed mastery as an important goal (9.8 out of 14.0) and strongly felt that everybody could and should, to some degree, engage in science (10.6 out of 12.0). This sent a strong message of positive social persuasion (Bandura, 1994) to their children, possibly preventing the decline in the children’s mastery orientation and self-efficacy toward science that is often seen at these ages (Vedder-Weiss & Fortus, 2011). This result is in line with findings from Chakraverty and Tai (2013) who showed that parents can create learning opportunities through role modeling, encouragement, exposure, familiarity, and connection. It is likely that much of this occurred at home during the lockdown with the academically oriented parents that participated in our study, and is similar to the influence of parents involved in an after-school activity (Simpkins et al., 2005), where high parental involvement had a positive effect on their children’s desire and motivation to study science. Guided homeschooling in our study allowed parents to be directly involved in their children’s learning of science, and this interaction seems to have a good influence in that it prevented the decline in motivation and self-efficacy toward science that is often seen in this age.

Conclusions, Implications, and Limitations

The results of this study shed new light on the complex ways in which parents with strong academic backgrounds and the education system influence their children’s motivation and self-efficacy toward science. The distance from school seems to have magnified the influence these parents had on their children’s motivation and self-efficacy toward science. Unfortunately, this study reinforces a conclusion identified elsewhere (Vedder-Weiss & Fortus, 2011, 2019; Yager & Penick, 1986), that schools may have a negative influence on children’s motivation and self-efficacy toward science, since when schools of the children in this study became more distant and their prominence in the children’s lives decreased, the negative trends that are typical of the motivation and self-efficacy toward science of children of this age disappeared, at least for now. This implies that, under certain conditions, academically strong parents can positively influence their children’s motivation to engage with science, counteracting potentially negative external influences, which under other circumstances may be more difficult to override. This study indicates that the decline in student motivation and self-efficacy for science, typically seen across countries and genders, can be avoided or at least moderated; this decline should not be seen as inevitable. Continued focused and timely involvement of parents, or at least of academically strong parents, in their children’s formal science learning may preserve the positive trend we identified. Further investigation should study various ways of involving parents in their children’s formal science learning to see which ways are effective in supporting students’ motivation to learn science. Readers should bear in mind that this study is based on a relatively small sample and that parents were not asked whether or how they helped their children learn science, and therefore any generalizations should be done with caution. Further studies on the relations between students and their parents, with or without strong academic backgrounds, regarding science learning, are needed to identify the conditions that can prevent this decline from occurring.
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Declarations

Conflict of Interests  The authors declare no competing interests.

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